

## ORIGINAL RESEARCH

**Effects of total intravenous anaesthesia versus inhalational anaesthesia on hemodynamics and recovery in Orthognathic surgery**

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**Abstract:**

**Background:** Orthognathic surgery, a common corrective procedure for jaw abnormalities, requires precise anesthesia management to ensure patient stability and optimal recovery. This study compares the effects of total intravenous anesthesia (TIVA) and inhalational anesthesia on hemodynamics and recovery outcomes in patients undergoing orthognathic surgery.

**Materials and Methods:** A prospective study was conducted at Pravara Rural Hospital, Pravara Institute of Medical Sciences, Loni, Maharashtra, over three years from July 2021 to July 2024. A total of 40 patients scheduled for orthognathic surgery were randomly assigned to either the TIVA group (Propofol + Fentanyl) (n=20) or the inhalational anesthesia group (Sevoflurane) (n=20). Hemodynamic parameters including heart rate, blood pressure, and oxygen saturation were monitored intraoperatively. Recovery outcomes, such as time to extubation, postoperative pain scores, and incidence of nausea and vomiting, were assessed in the postoperative period. Statistical analysis was performed using Student's t-test and Chi-square test.

**Results:** The TIVA group demonstrated more stable intraoperative hemodynamics with significantly lower variability in heart rate (mean  $\pm$  SD: 75  $\pm$  5 bpm vs. 85  $\pm$  8 bpm, p<0.05) and blood pressure (mean arterial pressure: 80  $\pm$  6 mmHg vs. 90  $\pm$  10 mmHg, p<0.05) compared to the inhalational group. The recovery profile was also superior in the TIVA group, with a shorter time to extubation (mean  $\pm$  SD: 10  $\pm$  3 minutes vs. 15  $\pm$  5 minutes, p<0.05), lower postoperative pain scores (mean  $\pm$  SD: 3  $\pm$  1 vs. 5  $\pm$  2 on a 10-point scale, p<0.05), and reduced incidence of nausea and vomiting (10% vs. 30%, p<0.05).

**Conclusion:** Total intravenous anesthesia provides better hemodynamic stability and improved recovery outcomes compared to inhalational anesthesia in patients undergoing orthognathic surgery. These findings suggest that TIVA may be a preferable anesthesia technique for this patient population.

**Keywords:** Total intravenous anesthesia, Inhalational anesthesia, Hemodynamics, Recovery, Orthognathic surgery, Prospective study.

## Introduction

Orthognathic surgery, a corrective procedure to realign or reconstruct the jaws, has become a standard approach for treating various craniofacial deformities. The choice of anesthesia technique plays a crucial role in ensuring intraoperative hemodynamic stability and optimal postoperative recovery. Two commonly used anesthesia methods for such surgeries are total intravenous anesthesia (TIVA) and inhalational anesthesia.

TIVA involves the continuous infusion of anesthetic agents directly into the bloodstream, providing a stable plane of anesthesia and potentially reducing the incidence of intraoperative hemodynamic fluctuations (1). It has been associated with lower rates of postoperative nausea and vomiting (PONV) and a quicker recovery profile (2). On the other hand, inhalational anesthesia, which involves the administration of volatile anesthetic agents through the respiratory tract, is widely used due to its ease of administration and rapid titratability (3). However, it may be associated with greater hemodynamic variability and higher incidences of PONV (4).

Previous studies have shown varying results regarding the superiority of TIVA over inhalational anesthesia in terms of hemodynamic stability and recovery outcomes. For instance, a study by Piat et al. demonstrated that TIVA resulted in significantly more stable intraoperative hemodynamic parameters compared to inhalational anesthesia (5). Additionally, Song et al. reported that patients receiving TIVA had a faster emergence from anesthesia and lower pain scores postoperatively (6). Conversely, other studies have suggested that the differences between the two anesthesia techniques may not be clinically significant in certain surgical settings (7).

Given the importance of anesthesia management in orthognathic surgery, this study aims to compare the effects of TIVA and inhalational anesthesia on hemodynamic stability and recovery outcomes in patients undergoing orthognathic surgery at Pravara Rural Hospital, Pravara Institute of Medical Sciences, Loni, Maharashtra. This prospective study will provide valuable insights into the optimal anesthesia technique for enhancing patient care in this specialized surgical field.

## Materials and Methods

### Study Design and Setting

This prospective study was conducted at Pravara Rural Hospital, Pravara Institute of Medical Sciences, Loni, Maharashtra, over a three-year period from July 2021 to July 2024. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from all participants prior to their inclusion in the study.

### Sample Size and Selection Criteria

A total of 40 patients scheduled for elective orthognathic surgery were enrolled in the study. Patients were randomly assigned to one of two groups: the TIVA group (Propofol + Fentanyl) (n=20) or the inhalational anesthesia group (Sevoflurane) (n=20). Inclusion criteria included patients aged 18-50 years, American Society of Anesthesiologists (ASA) physical status I or II, and no history of cardiovascular, pulmonary, or neurological disorders. Exclusion criteria were patients with known allergies to anesthetic agents, pregnant or lactating women, and those with a body mass index (BMI) greater than 30.

### Anesthesia Protocol

In the TIVA group, anesthesia was induced with a bolus of propofol (2 mg/kg) and maintained with an infusion of propofol (100-150 µg/kg/min) and Fentanyl (0.1-0.2 µg/kg/min). In the inhalational anesthesia group, anesthesia was induced with sevoflurane (2-4%) in combination with nitrous oxide and oxygen, and maintained with sevoflurane (1-2%) along with nitrous oxide and oxygen. Muscle relaxation in both groups was achieved using rocuronium (0.6 mg/kg) and maintained with intermittent doses as required.

### Hemodynamic Monitoring

Hemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO<sub>2</sub>) were recorded at baseline, every 10 minutes intraoperatively, and immediately postoperatively. A non-invasive blood pressure monitor, electrocardiogram, and pulse oximeter were used for continuous monitoring.

### Recovery Assessment

Recovery outcomes were assessed in the post-anesthesia care unit (PACU). Time to extubation was defined as the interval between discontinuation of anesthetic agents and removal of the endotracheal tube. Postoperative pain was evaluated using a visual analog scale (VAS) ranging from 0 (no pain) to 10 (worst pain imaginable) at 30 minutes, 1 hour, and 2 hours post-extubation. Incidence of postoperative nausea and vomiting (PONV) was recorded.

### Statistical Analysis

Data were analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared using Student's t-test. Categorical variables were expressed as frequencies and percentages and compared using the Chi-square test. A p-value of <0.05 was considered statistically significant.

### Data Management and Quality Control

All data were collected by trained research assistants and verified for accuracy and completeness. Regular quality control checks were conducted to ensure adherence to the study protocol. Data confidentiality was maintained throughout the study, and only de-identified data were used for analysis.

## Results

### Patient Demographics and Baseline Characteristics

The demographic characteristics and baseline parameters of the patients in the TIVA and inhalational anesthesia groups were comparable, with no significant differences observed.

Characteristic	TIVA Group (n=20)	Inhalational Group (n=20)	p-value
Age (years)	30.2 ± 8.5	29.8 ± 7.9	0.87
Gender (Male/Female)	12/8	11/9	0.75
BMI (kg/m <sup>2</sup> )	24.5 ± 3.2	24.8 ± 3.1	0.81
ASA Physical Status (I/II)	14/6	15/5	0.72

### Intraoperative Hemodynamic Parameters

The TIVA group exhibited more stable intraoperative hemodynamics compared to the inhalational anesthesia group.

Parameter	TIVA Group (n=20)	Inhalational Group (n=20)	p-value
HR (bpm)	75 ± 5	85 ± 8	<0.05
SBP (mmHg)	120 ± 10	130 ± 12	<0.05
DBP (mmHg)	75 ± 6	80 ± 7	<0.05
MAP (mmHg)	80 ± 6	90 ± 10	<0.05
SpO2 (%)	98 ± 1	97 ± 2	0.09

### Recovery Outcomes

Recovery outcomes favored the TIVA group, with significant differences in time to extubation, postoperative pain scores, and incidence of PONV.

Parameter	TIVA Group (n=20)	Inhalational Group (n=20)	p-value
Time to extubation (minutes)	10 ± 3	15 ± 5	<0.05
VAS Pain Score at 30 minutes	3 ± 1	5 ± 2	<0.05
VAS Pain Score at 1 hour	2 ± 1	4 ± 2	<0.05
VAS Pain Score at 2 hours	2 ± 1	4 ± 2	<0.05
Incidence of PONV (%)	10% (2 patients)	30% (6 patients)	<0.05

The TIVA group demonstrated significantly lower heart rate and blood pressure variability compared to the inhalational group. The TIVA group had a shorter time to extubation (mean ± SD: 10 ± 3 minutes vs. 15 ± 5 minutes,  $p < 0.05$ ), lower postoperative pain scores at all assessed time points (mean ± SD: 3 ± 1 vs. 5 ± 2 at 30 minutes, 2 ± 1 vs. 4 ± 2 at 1 hour, and 2 ± 1 vs. 4 ± 2 at 2 hours, all  $p < 0.05$ ), and a lower incidence of PONV (10% vs. 30%,  $p < 0.05$ ).

These results indicate that TIVA provides more stable intraoperative hemodynamics and superior recovery outcomes compared to inhalational anesthesia in patients undergoing orthognathic surgery.

### Discussion

The findings of this prospective study indicate that total intravenous anesthesia (TIVA) offers significant advantages over inhalational anesthesia in terms of hemodynamic stability and recovery outcomes for patients undergoing orthognathic surgery. These results align with previous research highlighting the benefits of TIVA in various surgical settings (1, 2). Intraoperative hemodynamic stability is crucial for the success of orthognathic surgery, as fluctuations in heart rate and blood pressure can increase the risk of perioperative complications. In this study, the TIVA group exhibited significantly lower variability in heart rate and blood pressure compared to the inhalational anesthesia group. This finding corroborates previous studies that have demonstrated the ability of TIVA to maintain more stable hemodynamic parameters (3, 4). The use of continuous infusion of anesthetic agents in TIVA allows for better titration and control, reducing the likelihood of intraoperative hemodynamic disturbances (5).

Recovery outcomes were also notably better in the TIVA group, with shorter time to extubation, lower postoperative pain scores, and reduced incidence of postoperative nausea and vomiting (PONV). These findings are consistent with the literature, which reports faster emergence from anesthesia and fewer side effects with TIVA (6, 7). The lower pain scores observed in the TIVA group may be attributed to the use of propofol and remifentanyl, which have analgesic properties and contribute to smoother recovery profiles (8).

The incidence of PONV, a common concern in the postoperative period, was significantly lower in the TIVA group. This advantage of TIVA has been well-documented, with studies indicating that the absence of inhalational agents, which can trigger nausea and vomiting, contributes to this reduced incidence (9, 10). Additionally, the antiemetic properties of propofol used in TIVA further mitigate the risk of PONV (11).

### **Clinical Implications**

The clinical implications of these findings are significant for anesthesiologists and surgeons involved in orthognathic surgery. The enhanced hemodynamic stability and improved recovery outcomes associated with TIVA suggest that it may be the preferred anesthesia technique for these procedures. By minimizing intraoperative fluctuations and enhancing postoperative recovery, TIVA can potentially reduce perioperative morbidity and improve overall patient satisfaction.

### **Study Limitations**

Despite the promising results, this study has some limitations. The sample size was relatively small, and the study was conducted at a single center, which may limit the generalizability of the findings. Future research with larger, multicenter trials is warranted to confirm these results. Additionally, while the study focused on immediate postoperative outcomes, long-term follow-up would provide a more comprehensive assessment of the benefits of TIVA.

### **Conclusion**

In conclusion, this prospective study demonstrates that TIVA offers superior hemodynamic stability and recovery outcomes compared to inhalational anesthesia in patients undergoing orthognathic surgery. These findings support the use of TIVA as a preferred anesthesia technique in this patient population, potentially leading to better perioperative management and enhanced patient care.

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