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Comparative study of remifentanil versus fentanyl for intra-operative analgesia during general anaesthesia. A retrospective comparative study at Bmims Pawapuri.

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Abstract

Background

Remifentanil and fentanyl are frequently used opioids for intra-operative analgesia, with differing pharmacokinetic profiles that may influence recovery and haemodynamic stability.

Methodology

A retrospective comparative study was conducted at BMIMS Pawapuri from August to October 2025 involving 70 adult patients undergoing general anaesthesia. Patients were grouped into remifentanil (n=35) and fentanyl (n=35). Mean age was comparable between groups (remifentanil: 42.3 ± 11.2 years; fentanyl: 44.1 ± 10.6 years), with male predominance (58.6%). Outcomes included extubation time, PACU stay, haemodynamic stability, hypotension, and PONV.

Results

Extubation time was significantly shorter in the remifentanil group (8.4 ± 1.8 min) compared to fentanyl (12.8 ± 3.0 min; $p<0.001$). PACU stay was reduced (62.6 ± 18.3 vs 84.4 ± 18.0 min; $p<0.001$). MAP stability was higher with remifentanil (77.1 ± 10.2% vs 71.3 ± 11.1%; $p=0.024$). Hypotension (25.7% vs 20.0%, $p=0.78$) and PONV (22.9% vs 8.6%, $p=0.19$) showed no significant difference.

Conclusion

Remifentanil provided faster recovery and improved haemodynamic control with similar safety outcomes.

Recommendation

Remifentanil may be considered the opioid of choice for intra-operative analgesia in procedures requiring rapid emergence and stable haemodynamics. Appropriate postoperative pain control strategies should be ensured due to its ultra-short acting profile.

***Keywords**: Remifentanil, Fentanyl, General Anaesthesia, Post Anaesthesia Care Unit, Haemodynamic Stability, Extubation.*
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Background of the Study

Opioids are routinely used during general anaesthesia to suppress the pain response to surgical stimulation and to maintain stable vital signs. Among these, fentanyl has been one of the most commonly used agents due to its strong analgesic effect and familiarity in clinical practice. However, when fentanyl is given repeatedly during longer operations, it may remain in the body for a longer duration. This can lead to delayed awakening, prolonged sedation after surgery, and increased time spent in the recovery unit. These effects may affect patient comfort, recovery flow, and operating room efficiency [1,2,3].

Remifentanil is a newer short-acting opioid that was introduced to overcome some of these limitations. It is rapidly broken down by enzymes present in blood and tissues, which allows it to take effect quickly and wear off soon after the infusion is stopped. This property makes remifentanil suitable for situations where precise control of analgesia and faster recovery after surgery are desired. Because the drug does not accumulate in the body, it allows for more predictable extubation and early postoperative assessment. However, its short duration also means that additional analgesia is needed before the end

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of surgery to prevent pain once the infusion is discontinued [4,5].

The decision to use fentanyl or remifentanil depends on the clinical situation, patient profile, expected duration of surgery, and postoperative goals. Remifentanil is often preferred in surgeries where rapid recovery and early movement or assessment are needed, while fentanyl may be used when longer-lasting analgesia is beneficial. With current focus on shorter hospital stays and smoother recovery pathways, the selection of an opioid that supports early awakening and maintains stable vital signs has become more important [6,7,8]

Although both drugs are widely used in anaesthesia practice, comparative evidence from Indian hospital settings remains limited. Practice patterns, patient response, and resource availability can differ across centres. Therefore, evaluating these drugs in the clinical environment of BMIMS Pawapuri is necessary to guide local anaesthesia practice. This study compares remifentanil and fentanyl in terms of intra-operative haemodynamic stability and postoperative recovery parameters, with the aim of assisting clinicians in choosing the most suitable opioid for routine surgical anaesthesia [9,10].

Methodology

Study design and setting

This was a retrospective comparative study conducted in the Department of Anaesthesiology at Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda district, Bihar, India. BMIMS is a tertiary care teaching hospital providing comprehensive healthcare services including general surgery, orthopaedics, obstetrics and gynaecology, emergency care, intensive care services, and various medical specialties. The hospital has a bed capacity of approximately 800 patients and serves as a major referral centre for surrounding rural and semi-urban regions of Bihar.

The study was carried out over a three-month period from August 2025 to October 2025.

Study participants

Medical records of adult patients aged 18–65 years who underwent elective surgical procedures under general anaesthesia during the study period were reviewed. Patients who received either remifentanil or fentanyl as the primary intra-operative opioid analgesic were included in the study.

Patients with incomplete medical records, those who received combined opioid therapy, emergency surgeries, major cardiac or neurosurgical procedures, and patients with severe systemic illnesses (ASA grade IV and above) were excluded.

A total of 70 patients who met the eligibility criteria were enrolled, with 35 patients in the remifentanil group and 35 in the fentanyl group. Consecutive sampling technique was used to select participants.

Bias control

To minimize selection bias, strict inclusion and exclusion criteria were applied uniformly to all patient records. Baseline characteristics such as age, gender, and type of surgery were comparable between the two groups. Information bias was reduced by extracting data using a standardized data collection form and cross-checking records for accuracy. Outcome measures were predefined before data collection.

Sample size determination

The sample size was calculated based on previous studies comparing extubation time between opioid groups using the formula:

$$n = (Z^2 \times \sigma^2) / d^2$$

where n is the sample size, Z is the standard normal deviate at 95% confidence level (1.96), σ is the standard deviation obtained from earlier studies, and d is the allowable error.

The calculated minimum sample size was 35 patients per group, giving a total of 70 participants.

Data collection

Data were extracted from patient anaesthesia charts and hospital records. Collected variables included demographic details (age and gender), type and duration of surgery, intra-operative opioid used, extubation time, duration of stay in the post-anaesthesia care unit (PACU), haemodynamic parameters including mean arterial pressure, incidence of hypotension, postoperative nausea and vomiting (PONV), and need for rescue analgesia.

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Statistical analysis

Statistical analysis was performed using SPSS software version 22. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test. Categorical variables were presented as frequencies and percentages and analysed using the Chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Bhagwan Mahavir Institute of Medical Sciences, Pawapuri (Approval No: BMIMS/IEC/2025/041, dated 05 August 2025). As the study was retrospective in nature, informed consent was waived, and patient confidentiality was strictly maintained throughout the research process. Significance was set at $p<0.05$.

Results

Out of 98 patient records assessed, 18 were excluded due to incomplete data and 10 due to combined opioid use. Finally, 70 patients were included in the analysis.

A total of 70 patients were included in the study, with 35 patients receiving remifentanil and 35 receiving fentanyl as the primary intra-operative opioid. Baseline demographic characteristics, such as age, gender distribution, and surgical duration, were comparable between the two groups, indicating both groups were clinically similar prior to intervention.

Mean age was 43.2 ± 10.9 years. Males constituted 58.6% and females 41.4%. Average surgical duration was comparable between groups (remifentanil: 92 ± 21 minutes; fentanyl: 95 ± 24 minutes).

Intra-operative and Recovery Findings

Patients in the remifentanil group demonstrated faster emergence from anaesthesia, with a mean extubation time of 8.4 ± 1.8 minutes, compared to 12.8 ± 3.0 minutes in the fentanyl group. Similarly, the duration of stay in the post-anaesthesia care unit (PACU) was shorter in the remifentanil group (62.6 ± 18.3 minutes) in comparison to the fentanyl group (84.4 ± 18.0 minutes). These findings indicate that remifentanil allowed for quicker postoperative recovery and turnover.

In terms of haemodynamic control, the percentage of time in which mean arterial pressure remained within ±20% of baseline was higher among patients who received remifentanil (77.1 ± 10.2%) compared to those who received fentanyl (71.3 ± 11.1%). Incidence of intra-operative hypotension and postoperative nausea/vomiting (PONV) showed no significant difference between the two groups, indicating that overall safety profiles were similar.

Table 1. Comparison of Key Peri-operative Outcomes

Parameter	Remifentanil (n = 35)	Fentanyl (n = 35)	p-value
Extubation time (minutes)	8.4 ± 1.8	12.8 ± 3.0	<0.001
PACU stay (minutes)	62.6 ± 18.3	84.4 ± 18.0	<0.001
MAP stability (%)	77.1 ± 10.2	71.3 ± 11.1	0.024
Hypotension (%)	25.7%	20.0%	0.78
PONV (%)	22.9%	8.6%	0.19
Rescue analgesia required (%)	28.0%	42.0%	0.21

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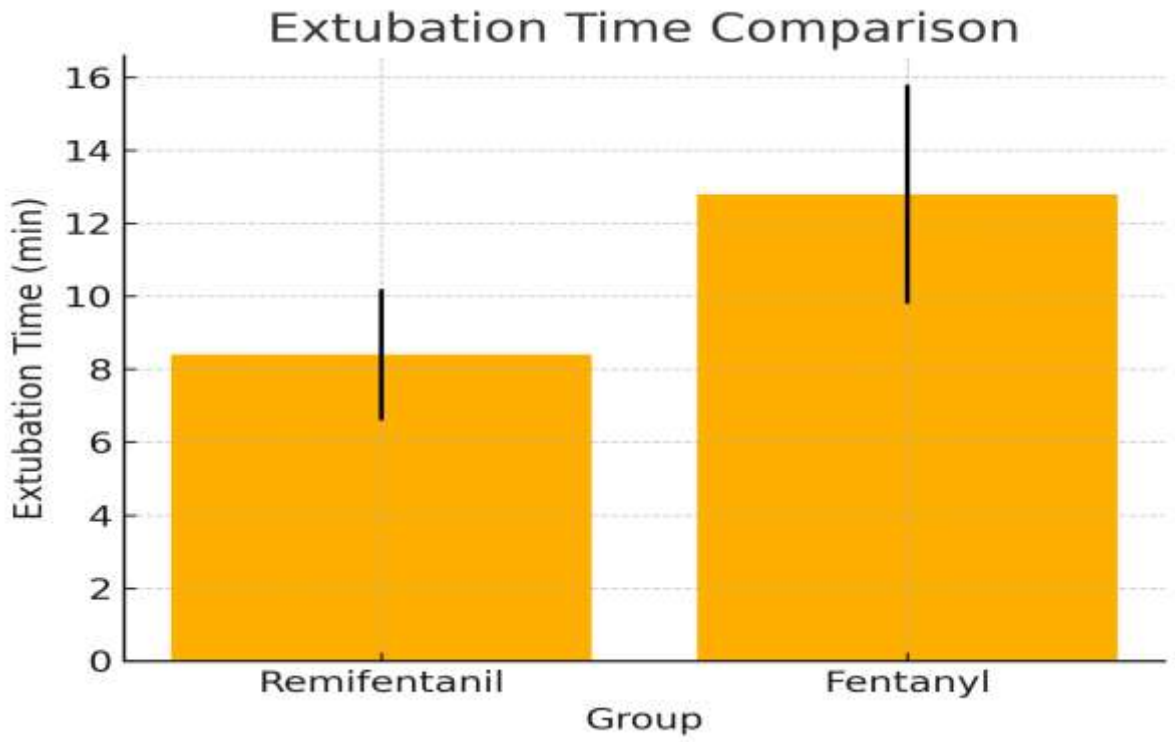

Figure 1. Extubation Time Comparison Between Groups

Discussion

The present retrospective comparative study evaluated the intra-operative analgesic efficacy and recovery characteristics of remifentanil and fentanyl in patients undergoing general anaesthesia. The key findings demonstrated that remifentanil was associated with significantly shorter extubation time and reduced post-anaesthesia care unit (PACU) stay compared to fentanyl. Additionally, patients receiving remifentanil exhibited better haemodynamic stability during surgery, while the incidence of hypotension and postoperative nausea and vomiting (PONV) did not differ significantly between the two groups [11,12].

In this study, the mean extubation time was markedly lower in the remifentanil group (8.4 ± 1.8 minutes) compared to the fentanyl group (12.8 ± 3.0 minutes), indicating faster emergence from anaesthesia. This finding is clinically important as rapid recovery reduces airway-related complications and improves operating room turnover. Similar observations have been reported in previous studies where remifentanil, due to its ultra-short acting nature and rapid metabolism by plasma esterases, allowed quicker awakening and recovery when compared with longer-acting opioids such as fentanyl [13,14].

The duration of PACU stay was also significantly shorter among patients receiving remifentanil, reflecting improved early postoperative recovery. Shorter PACU times contribute to better resource utilization and enhanced patient flow in busy surgical centres. Earlier research has likewise demonstrated reduced recovery room stays in remifentanil-based anaesthesia protocols, supporting the findings of the present study [15].

Haemodynamic stability, measured by maintenance of mean arterial pressure within acceptable limits, was superior in the remifentanil group. This may be attributed to the predictable pharmacokinetics of remifentanil, allowing precise titration and rapid adjustment according to surgical stimulus. Better cardiovascular control is particularly beneficial in patients with limited physiological reserve. Previous comparative studies have also reported improved intra-operative haemodynamic control with remifentanil infusion [16].

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Although episodes of hypotension were slightly higher in the remifentanil group, the difference was not statistically significant. This suggests that both opioids are relatively safe when appropriately dosed and monitored. Similarly, the incidence of PONV did not show significant variation between groups, indicating comparable postoperative tolerability profiles.

The demographic characteristics of the two groups were similar, reducing the likelihood of confounding due to age or gender. Surgical duration was also comparable, suggesting that differences in recovery outcomes were primarily related to the opioid used rather than procedural complexity [17,18].

Overall, the findings support the use of remifentanil as an effective intra-operative analgesic agent offering faster recovery and better haemodynamic control compared to fentanyl. Its pharmacological profile makes it particularly suitable for procedures requiring rapid emergence from anaesthesia and early postoperative assessment.

Generalizability

The findings of this study may be generalizable to similar tertiary care hospitals in resource-limited settings where general anaesthesia practices are comparable. However, variations in surgical complexity and anaesthetic protocols may influence outcomes.

Limitations

This study was retrospective and conducted in a single centre with a limited sample size. Potential confounders such as adjunct anaesthetic agents and surgical variability could not be fully controlled.

Recommendation

Remifentanil may be preferred in surgeries where rapid postoperative awakening and stable haemodynamics are required.

Conclusion

In this retrospective analysis of patients undergoing general anesthesia, the use of remifentanil as the primary intra-operative opioid was associated with faster extubation and shorter PACU stay compared with fentanyl. Remifentanil also demonstrated more consistent intra-operative haemodynamic control, while the overall incidence of hypotension, postoperative nausea and vomiting, and need for rescue analgesia remained comparable between groups. These findings suggest that remifentanil may provide advantages in clinical settings where rapid recovery and stable intra-operative conditions are prioritized. However, careful planning for postoperative analgesia remains essential due to its rapid offset. The results support the use of remifentanil as a suitable option for procedures requiring timely postoperative assessment or efficient patient turnover. Future prospective, randomized studies with larger sample sizes are needed to confirm these observations and to further evaluate postoperative pain management strategies when remifentanil is used in routine anesthetic practice.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

Dr. Dhananjay Kumar Suman conceptualized the study and supervised data collection. Dr. Khushbu Rani performed data extraction and analysis. Dr. Preeti Sinha contributed to manuscript drafting and literature review.

Author Biography

Dr. Dhananjay Kumar Suman is an Associate Professor and Head of the Department of Anaesthesiology at BMIMS Pawapuri with over 12 years of clinical and academic experience in perioperative care and pain management.

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List of Abbreviations

PACU – Post Anaesthesia Care Unit

MAP – Mean Arterial Pressure

PONV – Postoperative Nausea and Vomiting

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Conflict of Interest

None declared.

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