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Comparison Of Iv Infusion Of Remifentanyl And Iv Bolus Fentanyl In Patients Undergoing Lap Cholecystectomy

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Abstract

Background:
Laparoscopic cholecystectomy is the gold standard for the management of gallstone disease; however, effective postoperative pain control remains a key determinant of recovery and patient satisfaction. Opioids such as fentanyl and remifentanil are commonly used for intraoperative analgesia, but their differing pharmacokinetic profiles may influence postoperative pain, analgesic requirements, and adverse effects.

Aim:
To compare the analgesic efficacy of continuous intravenous remifentanil infusion with intermittent bolus intravenous fentanyl in patients undergoing laparoscopic cholecystectomy under general anesthesia.

Methods:
This hospital-based comparative study was conducted in the Department of Anaesthesia, Santosh Medical College and Hospital, Ghaziabad. Sixty adult patients (ASA I–III) scheduled for elective laparoscopic cholecystectomy were allocated into two groups: Group F (bolus fentanyl) and Group RF (continuous remifentanil infusion). Postoperative pain was assessed using the Visual Analogue Scale (VAS) at 1, 6, 12, and 24 hours. Time to first rescue analgesia, total 24-hour tramadol consumption, postoperative nausea, vomiting, pruritus, and hemodynamic parameters were recorded and analyzed.

Results:
Baseline demographic variables and duration of surgery were comparable between groups. Group RF demonstrated significantly higher VAS pain scores in the early postoperative period (1 and 6 hours; $p < 0.01$), with no significant difference at 12 and 24 hours. Time to first rescue analgesia was significantly shorter in Group RF, and total 24-hour tramadol consumption and rescue analgesic requirement within the first 6 hours were significantly higher ($p < 0.01$). Postoperative vomiting and antiemetic requirements were more frequent and occurred earlier in Group RF. Hemodynamic parameters remained stable and comparable in both groups.

Conclusion:
Bolus fentanyl provides longer-lasting postoperative analgesia with lower the early pain scores and reduced analgesic and antiemetic requirements compared to continuous remifentanil infusion, while maintaining similar hemodynamic stability. Careful postoperative analgesic planning is essential when remifentanil is used.

Keywords: NIL

Introduction

The technique of laparoscopic cholecystectomy has gained immense popularity and has become the gold standard from the purpose of surgically managing gallstones and is offering several advantages over conventional open procedure which includes small incisions, less postoperative pain, fast recovery with lesser duration of hospital stay, and improved cosmetic outcomes.[1] Inspite of these pros, postoperative pain after undergoing laparoscopic cholecystectomy is a common issue frequently experience postoperative pain that can vary in intensity and duration.[2] Inadequately managed pain may delay discharge, increase the incidence of postoperative complications, prolong the use of analgesics, and negatively impact patient satisfaction. Therefore, the effective management of postoperative pain remains a key element of enhanced recovery protocols and an essential determinant of surgical success following laparoscopic cholecystectomy.[3]

The physiological response to postoperative pain involves complex interactions between peripheral and central nervous system pathways, leading to neuroendocrine activation, sympathetic stimulation, and stress-related hormonal release. These responses can result in increased heart rate, blood pressure, oxygen consumption, and catabolism, ultimately delaying wound healing and recovery. Effective perioperative analgesia thus aims to attenuate these physiological stress responses while ensuring patient comfort and facilitating early mobilization.[4] In the context of laparoscopic surgery, the choice of analgesic technique is particularly important because patients are often discharged within 24 hours, necessitating reliable pain control with minimal side effects. Various pharmacological and non-pharmacological strategies have been employed to manage pain, including nonsteroidal anti-inflammatory drugs (NSAIDs), local anaesthetic infiltration, regional nerve blocks, and systemic opioids. Among these, opioids continue to play a central role in providing potent analgesia during and after laparoscopic procedures.[5]

Fentanyl, a synthetic μ-opioid receptor agonist, is known for its high lipid solubility, rapid onset, and short duration of action relative to morphine.[8] Remifentanil, in contrast, is an ultra-short-acting synthetic opioid with unique pharmacokinetic properties.[9] In the context of laparoscopic cholecystectomy, both agents have been widely studied, but the optimal method of administration, whether through continuous infusion of remifentanil or intermittent boluses of fentanyl, remains an area of ongoing clinical research.[10]

In our study we have compared continuous infusion of remifentanil with bolus doses of fentanyl, this study aims to provide evidence-based insights into optimising analgesic efficacy, reducing rescue analgesic requirements, and minimising opioid-related side effects. Effective control of postoperative pain not only enhances recovery and patient satisfaction but also represents a critical step toward improving the overall quality of perioperative care in minimally invasive surgery.

Material And Methods

Study Design: Comparative study

Duration of Study: December 2024 to July 2025

Organisation of study : Santosh Medical College And Hospital

Place of Study: Department of Anaesthesia, Santosh Medical College and Hospital, Ghaziabad.

Study Population: Patients admitted in Santosh Medical College and Hospital undergoing lap cholecystectomy surgery.

Sample Size: 30 in each group.

N = 60

Inclusion Criteria:

1. Age - 20-55 years
2. ASA grade - 1,2,3
3. BMI - 22 to 30
4. Patient who underwent lap cholecystectomy under general anaesthesia
5. Patient who has given written and informed consent

Exclusion Criteria:

1. Age <20 years and >55 year
2. ASA grade - 4
3. BMI <22 and >30
4. Patients who have not given consent

After ethical clearance, eligible adults meeting inclusion criteria were enrolled. Pre-anesthetic check-up was done and one day prior with surgery with consent; 60 ASA I-III patients for elective

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laparoscopic cholecystectomy were randomized into two groups of 30 via odd-even numbers.

Procedure

IV access, fluids, and monitors (SBP, DBP, MAP, ECG, SpO_2) were established post-baseline recording. Both groups got glycopyrrolate 0.2 mg, midazolam 0.02 mg/kg, 3-min 100% O_2 pre-oxygenation, and vecuronium 1 mg/kg; Group F received fentanyl 50 mcg, Group R remifentanil 1 mcg/kg then 0.1 mcg/kg/min infusion until suture placement.

Post-op Assessment

Patients shifted to PACU post-extubation; trained nurses evaluated pain (VAS 0-10), PONV, dizziness, pruritus, respiratory depression at 1, 6, 12, 24 h. Tramadol 100 mg IV given for pain (VAS noted), repeatable after 8 h; first analgesia time and antiemetic needs recorded.

Statistical analysis

The collected data was entered into Microsoft Excel and were subsequently analyzed and statistically evaluated using SPSS version 25 and MS Excel 365. Quantitative data was expressed as mean with standard deviation or median with interquartile range, depending on the distribution. Qualitative data were expressed as percentages, and differences between proportions were tested using the chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

Results:

Baseline characteristics showed excellent comparability between fentanyl bolus (Group F) and remifentanil infusion (Group RF) groups across all demographic and anthropometric parameters. Postoperative pain assessment revealed significantly worse early analgesia in the remifentanil group, with highly significant differences at both 1-hour and 6-hour time points that resolved by 12 hours [Table 2]. Time to first rescue analgesic request demonstrated a clear pattern favoring fentanyl, with the majority of remifentanil patients requiring intervention within the first hour postoperatively [Table 2]. Total 24-hour tramadol consumption followed the same trend, confirming substantially higher opioid requirements in the infusion group [Table 2]. Nearly all remifentanil patients required rescue analgesia within the critical first 6 postoperative hours compared to only two-thirds of fentanyl patients [Table 2].

Postoperative nausea and vomiting (PONV) occurred more frequently and earlier in the remifentanil group, with nearly all patients requiring antiemetic intervention compared to fewer than two-thirds in the fentanyl group [Table 3]. Time to first antiemetic administration showed a similar pattern, with most remifentanil patients needing treatment within the first hour postoperatively [Table 3]. Pruritus incidence remained low and comparable between groups throughout the observation period [Table 3].

Both opioid regimens provided equivalent intraoperative and postoperative hemodynamic control across all measured parameters and time points, demonstrating comparable cardiovascular safety profiles [Table 4]. No clinically significant differences emerged in systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate, or respiratory rate at any assessment interval [Table 4]. These findings establish bolus fentanyl as superior for postoperative analgesia and PONV prophylaxis while maintaining equivalent hemodynamic stability to continuous remifentanil infusion in laparoscopic cholecystectomy patients.

Table 1: Baseline Characteristics

Characteristic	Group F (n=30)	Group RF (n=30)	p-value
Age (years), mean ± SD	40.67 ± 12.86	36.67 ± 11.77	0.94 NS
Age distribution			0.11 NS
18-30 years	11 (36.7%)	13 (43.3%)	

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Characteristic	Group F (n=30)	Group RF (n=30)	p-value
31-45 years	8 (26.7%)	9 (30.0%)	
46-60 years	11 (36.7%)	8 (26.7%)	
BMI (kg/m²), mean ± SD	23.52 ± 3.56	23.02 ± 3.28	0.59 NS
BMI categories			1.90 NS
Underweight (<18.5)	2 (6.7%)	1 (3.3%)	
Normal (18.5-24.9)	18 (60.0%)	19 (63.3%)	
Overweight (25-29.9)	8 (26.7%)	10 (33.3%)	
Obese (≥30)	2 (6.7%)	0 (0%)	
Gender, Male	16 (53.3%)	14 (46.7%)	0.30 NS
Surgical duration (min), mean ± SD	69.30 ± 15.54	63.17 ± 13.16	0.10 NSpaste.txt

Table 2: Primary Outcomes - Pain Control & Analgesic Requirements

Parameter	Group F (n=30)	Group RF (n=30)	p-value
VAS Pain Scores (mean ± SD)			
1 hour	4.20 ± 2.10	**7.47 ± 1.90**	**<0.01***
6 hours	4.53 ± 1.80	**5.53 ± 2.05**	**<0.001***
12 hours	3.90 ± 1.75	4.00 ± 1.85	0.79 NS
24 hours	3.23 ± 1.65	2.70 ± 1.50	0.09 NS
Time to 1st analgesic (min)			**<0.01***
≤60 min	10 (33.3%)	**27 (90.0%)**	

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Parameter	Group F (n=30)	Group RF (n=30)	p-value
60-120 min	5 (16.7%)	3 (10.0%)	
120-240 min	4 (13.3%)	0	
>240 min	11 (36.7%)	0	
Total 24h tramadol (mg)			**<0.001***
100 mg	17 (56.7%)	**2 (6.7%)**	
200 mg	7 (23.3%)	16 (53.3%)	
300 mg	6 (20.0%)	12 (40.0%)	
Rescue analgesia ≤6h	19 (63.3%)	**30 (100%)**	**<0.001***paste.txt

Table 3: Secondary Outcomes - PONV & Antiemetic Use

Parameter	Group F (n=30)	Group RF (n=30)	p-value
Any PONV (24h)	17 (56.7%)	**27 (90.0%)**	**<0.01***
Time to 1st antiemetic (min)			**<0.01***
Not required	11 (36.7%)	**2 (6.7%)**	
≤60 min	6 (20.0%)	**25 (83.3%)**	
60-120 min	1 (3.3%)	0	
>120 min	12 (40.0%)	3 (10.0%)	
Antiemetic required (24h)	19 (63.3%)	**28 (93.3%)**	**<0.01***
Vomiting episodes (24h)			
1 hour	6 (20.0%)	**16 (53.3%)**	

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Parameter	Group F (n=30)	Group RF (n=30)	p-value
6 hours	6 (20.0%)	8 (26.7%)	
12 hours	7 (23.3%)	5 (16.7%)	
24 hours	6 (20.0%)	6 (20.0%)	
Pruritus (any time)	5 (16.7%)	7 (23.3%)	0.52 NSpaste.txt

Table 4: Hemodynamic Stability (Mean ± SD)

Parameter	Time	Group F	Group RF	p-value
SBP (mmHg)	Pre-op	125.3 ± 13.4	122.9 ± 16.7	0.47 NS
	1h	129.1 ± 11.1	123.7 ± 10.6	0.08 NS
	6h	126.3 ± 11.7	123.9 ± 9.7	0.42 NS
DBP (mmHg)	Pre-op	77.3 ± 8.0	75.6 ± 5.6	0.33 NS
	1h	77.3 ± 6.4	76.4 ± 5.8	0.62 NS
MAP (mmHg)	Pre-op	93.3 ± 5.2	91.4 ± 8.0	0.28 NS
	1h	94.6 ± 8.0	92.2 ± 5.6	0.24 NS
HR (bpm)	Pre-op	79.2 ± 11.0	76.0 ± 11.9	0.31 NS
	1h	80.0 ± 9.2	80.6 ± 10.7	0.77 NS
RR (bre/min)	Pre-op	18.5 ± 2.9	19.9 ± 3.3	0.14 NS
	1h	19.5 ± 2.3	18.7 ± 2.3	0.32 NSpaste.txt

Legend: Group F = Fentanyl bolus; Group RF = Remifentanil infusion;

***p<0.01, ***p<0.001 (highly significant); NS = non-significant (p≥0.05);

VAS = Visual Analogue Scale (0-10); PONV = postoperative nausea/vomiting

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Discussion

Postoperative pain management is a critical determinant of recovery and patient satisfaction following laparoscopic cholecystectomy, which is currently considered the gold-standard procedure for the management of cholelithiasis. The present study was designed to compare the efficacy and safety of continuous remifentanil infusion with bolus fentanyl for postoperative analgesia, with the objectives of optimizing pain control, reducing rescue analgesic requirements, and minimizing opioid-related adverse effects. Sixty patients undergoing elective laparoscopic cholecystectomy were enrolled and allocated into two groups, Group F receiving bolus fentanyl and Group RF receiving continuous remifentanil infusion, with both groups demonstrating comparable baseline demographic and clinical characteristics, including age, body mass index, gender distribution, and preoperative hemodynamic parameters ($p > 0.05$). This baseline comparability allowed for valid intergroup comparisons and attribution of postoperative outcomes to the analgesic regimen. Postoperatively, both fentanyl and remifentanil provided comparable hemodynamic stability, with no statistically or clinically significant differences observed in systolic and diastolic blood pressure, heart rate, or respiratory rate at any assessed time point, indicating a similar cardiovascular and respiratory safety profile for both opioids in this surgical population.

In the present study, the baseline demographic and anthropometric characteristics of participants in Group F and Group RF were comparable, confirming appropriate group matching prior to intervention and minimizing potential confounding. Similarly **Fan (2023)** [11], **Chen et al. (2021)** [12] and **Son et al. (2021)** [13] also reported comparable baseline characteristics. Similar to our study **Subramaniam et al. (2020)** [14], **Ren et al. (2022)** [15] and **Garg et al. (2024)**[16] demonstrated comparable surgical durations between clonidine and fentanyl groups.

Regarding postoperative adverse effects , the present study demonstrated a distinct temporal pattern in the incidence of vomiting, pruritus, and nausea between continuous remifentanil infusion (Group RF) and bolus fentanyl (Group F). Vomiting was notably more frequent in the remifentanil group during the early postoperative period, with higher incidence at 1 hour (16 vs 6 patients) and 6 hours (8 vs 6 patients), while the difference diminished at later time points, becoming comparable at 12 hours (5 vs 7 patients) and 24 hours (6 vs 6 patients). This early predominance of vomiting in the remifentanil group is consistent with findings by **Lee et al. (2006)** [17] and **Muellejans et al. (2003)** [18].

Patients receiving continuous remifentanil infusion (Group RF) experienced significantly higher pain scores during the early postoperative period compared to those receiving bolus fentanyl (Group F). However, by 12 hours and 24 hours, pain scores converged, indicating no statistically significant difference between the groups. This pattern highlights inferior early postoperative analgesia with remifentanil, followed by comparable pain control at later time points. These findings closely parallel those reported by **Moharari et al. (2021)** [19] and **De Hoogd et al. (2018)** [20]

The time to first postoperative analgesic request was significantly shorter in the remifentanil group (Group RF). This highly significant difference confirms that fentanyl provided a considerably longer duration of postoperative analgesia, which can be attributed to its slower offset of action and longer context-sensitive half-time, allowing sustained analgesic effects into the postoperative period, whereas remifentanil undergoes rapid metabolism with abrupt loss of analgesic effect following discontinuation. These findings are in close agreement with those reported by **Finkel et al. (1999)** [21] and **Möllhoff et al. (2001)** [22].

Total postoperative tramadol consumption during the first 24 hours was significantly higher in the remifentanil group (Group RF) compared to the fentanyl group (Group F). This marked difference in rescue analgesic requirement reinforces the observation of higher postoperative pain intensity and shorter duration of analgesia associated with remifentanil. Findings from the present study closely align with those of **Moharari et al. (2021)** [19].

The findings of the study indicated that both bolus fentanyl and continuous remifentanil infusion provided equivalent hemodynamic stability in patients undergoing laparoscopic cholecystectomy, an important consideration in anesthesia practice given that significant fluctuations in blood pressure or heart rate may predispose patients to adverse cardiovascular events. Overall, the consistent findings across multiple

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clinical settings suggest that both continuous remifentanil infusion and bolus fentanyl administration offer comparable and reliable hemodynamic stability. In the context of laparoscopic cholecystectomy, where surgical stress is moderate and patient profiles are relatively stable, the choice between these opioids appears unlikely to influence cardiovascular outcomes, provided vigilant monitoring and appropriate perioperative management are maintained.

Conclusion

This study shows that, although continuous remifentanil infusion leads to substantial intraoperative analgesia, it is associated with early postoperative pain of greater magnitude, faster time to first analgesic request, higher 24-hour rescue opioid consumption, and greater early antiemetics requirements as compared with bolus fentanyl. And bolus fentanyl delivers a more prolonged postoperative analgesic effect with similar hemodynamic stability. These data emphasize the necessity of anticipating remifentanil-induced hyperalgesia and a proactive postoperative management approach such as the early introduction of longer-acting opioids or multimodal analgesia to facilitate patient comfort and recovery after laparoscopic cholecystectomy. On balance, bolus fentanyl seems to be beneficial for long-lasting postoperative analgesia without sacrificing cardiovascular stability, while remifentanil requires thoughtful perioperative treatment planning to prevent early postoperative pain and nausea.

Ethical Approval: Obtained

Consent: Written consent secured.

References:

1. Zhang Y, Dai X, Duan R, Wei L. Research progress in the treatment of gallstones with laparoscopic and endoscopic surgery: a narrative review. BMC Surg. 2025;25(1):238–245. https://doi.org/10.1186/s12893-025-02977-8.
2. Shrestha BB, Lakhe G, Ghimire P. Postoperative Pain after Laparoscopic Cholecystectomy in a Tertiary Care Center: A Descriptive Cross-sectional Study. Journal of Nepal Medical Association. 2024;62(276):502–506. https://doi.org/10.31729/jnma.8719.
3. Gan TJ. Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res. 2017;Volume 10:2287–2298. https://doi.org/10.2147/JPR.S144066.
4. Chapman CR, Tuckett RP, Song CW. Pain and Stress in a Systems Perspective: Reciprocal Neural, Endocrine, and Immune Interactions. J Pain. 2008;9(2):122–145. https://doi.org/10.1016/j.jpain.2007.09.006.
5. Niyonkuru E, Iqbal MA, Zhang X, Ma P. Complementary Approaches to Postoperative Pain Management: A Review of Non-pharmacological Interventions. Pain Ther. 2025;14(1):121–144. https://doi.org/10.1007/s40122-024-00688-1.
6. Zhu K, Wen X, Mei X, Fang F, Zhang T. Mechanisms of Remifentanil-Induced Postoperative Hyperalgesia: A Comprehensive Review. Drug Des Devel Ther. 2025;Volume 19:7445–7457. https://doi.org/10.2147/DDDT.S550335.
7. Ramirez MF, Kamdar BB, Cata JP. Optimizing Perioperative Use of Opioids: a Multimodal Approach. Curr Anesthesiol Rep. 2020;10(4):404–415. https://doi.org/10.1007/s40140-020-00413-6.
8. Comer SD, Cahill CM. Fentanyl: Receptor pharmacology, abuse potential, and implications for treatment. Neurosci Biobehav Rev. 2019;106:49–57. https://doi.org/10.1016/j.neubiorev.2018.12.005.
9. Davis PJ, Cladis FP. The Use of Ultra-Short-Acting Opioids in Paediatric Anaesthesia. Clin Pharmacokinet. 2005;44(8):787–796. https://doi.org/10.2165/00003088-200544080-00002.
10. Choi SH, Koo B-N, Nam SH, Lee SJ, Kim KJ, Kil HK, et al. Comparison of Remifentanil and Fentanyl for Postoperative Pain Control after Abdominal Hysterectomy. Yonsei Med J. 2008;49(2):204–211. https://doi.org/10.3349/ymj.2008.49.2.204.
11. Fan L. The Clinical Anesthesia Effect of Remifentanil Combined with Propofol in Laparoscopic Cholecystectomy in the Elderly. Advances in Obstetrics and Gynecology Research. 2023;1(2):51–56. https://doi.org/10.26689/AOGR.V1I2.5293.

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12. Chen J, Ying X, Yang D. Propofol combined with remifentanil reduces the adverse reactions of patients undergoing laparoscopic cholecystectomies. Am J Transl Res. 2021;13(6):6560–6567.
13. Son HW, Lee JM, Park SH, Lee YJ, Oh JM, Hwang SK. Fentanyl versus Remifentanil for Cough Suppression and Recovery after Video-Assisted Thoracic Surgery. J Chest Surg. 2021;54(3):200–205. https://doi.org/10.5090/JCS.20.136.
14. Subramaniam K, Ibarra A, Ruppert K, Mallikarjun K, Orebaugh S. Intraoperative Remifentanil Infusion and Postoperative Pain Outcomes After Cardiac Surgery—Results from Secondary Analysis of a Randomized, Open-Label Clinical Trial. J Cardiothorac Vasc Anesth. 2020;35(2):458. https://doi.org/10.1053/J.JVCA.2020.08.064.
15. Ren W, Matsusaki T, Bright AO, Morimatsu H. Association between the Remifentanil Dose during Anesthesia and Postoperative pain. Acta Med Okayama. 2022;76(2):187–193. https://doi.org/10.18926/AMO/63413.
16. Garg PK, Joshi NK, Chauhan S. A Comparative Study of Clonidine Versus Fentanyl for Intraoperative Hemodynamic Stability in Patients Undergoing Laparoscopic Cholecystectomy Under General Anesthesia: Randomized, Double-Blind, Interventional Study. Int J Curr Pharm Res. 2024:30–35. https://doi.org/10.22159/IJCPR.2024V16I3.4059.
17. Lee WK, Kim YB, Choi SH, Chae YK, Hong NG, Kim J. The Effect of Fentanyl and Remifentanil on Postoperative Nausea and Vomiting, and Pain after Gynecologic Laparoscopic Ovarian Cyst Enucleation by Balanced Anesthesia with Sevoflurane. Korean J Anesthesiol. 2006;50(4):390–395. https://doi.org/10.4097/KJAE.2006.50.4.390.
18. Muellejans B, López A, Cross MH, Bonome C, Morrison L, Kirkham AJT. Remifentanil versus fentanyl for analgesia based sedation to provide patient comfort in the intensive care unit: a randomized, double-blind controlled trial [ISRCTN43755713]. Crit Care. 2003;8(1):R1. https://doi.org/10.1186/CC2398.
19. Moharari RS, Shahinpour S, Saeedi N, Sahraei E, Najafi A, Etezadi F, et al. Comparison of Intraoperative Infusion of Remifentanil Versus Fentanyl on Pain Management in Patients Undergoing Spine Surgery: A Double Blinded Randomized Clinical Trial. Anesth Pain Med. 2021;11(4):e115576. https://doi.org/10.5812/AAPM.115576.
20. de Hoogd S, Ahlers SJGM, van Dongen EPA, van de Garde EMW, Daeter EJ, Dahan A, et al. Randomized Controlled Trial on the Influence of Intraoperative Remifentanil versus Fentanyl on Acute and Chronic Pain after Cardiac Surgery. Pain Practice. 2018;18(4):443–451. https://doi.org/10.1111/PAPR.12615.
21. Finkel J, Davis P, Orr R, Kurth D, Mulroy J, Hummer K, et al. Comparison of Remifentanil and Fentanyl for Tonsillectomy Surgery in Children. Anesth Analg. 1999;88(2S):294S. https://doi.org/10.1097/00000539-199902001-00291.
22. Möllhoff T, Herregods L, Moerman A, Blake D, MacAdams C, Demeyere R, et al. Comparative efficacy and safety of remifentanil and fentanyl in 'fast track' coronary artery bypass graft surgery: a randomized, double-blind study. Br J Anaesth. 2001;87(5):718–726. https://doi.org/10.1093/BJA/87.5.718

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