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Original Article

The Effect of Propofol-Remifentanil and Isoflurane-Remifentanil Anaesthesia on Postoperative Quality of Recovery after Laparoscopic Cholecystectomy

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ABSTRACT

Background: Anaesthesia is an essential component of modern surgery, enabling most surgical procedures through the induction and maintenance of unconsciousness using intravenous and inhalational agents. It is widely regarded as one of the most significant advances in medicine, and the choice of anaesthetic technique plays a crucial role in determining postoperative recovery quality and overall patient outcomes. **Objective:** The aim of the study was to compare the effects of propofol–remifentanil and isoflurane–remifentanil anaesthesia on postoperative quality of recovery after laparoscopic cholecystectomy. **Methods & Materials:** This quasi-experimental study was conducted in the operation theatre of the Department of General Surgery, Bangladesh Medical University, Dhaka, Bangladesh, from October 2024 to September 2025. Seventy-two patients undergoing elective laparoscopic cholecystectomy under general anaesthesia were equally allocated to Group PR (propofol–remifentanil) and Group IR (isoflurane–remifentanil) to compare postoperative recovery, pain, haemodynamics, opioid use, and complications. Data were analyzed using SPSS version 29.0 with $p < 0.05$ considered significant. **Results:** The study included 72 patients (36 per group) undergoing laparoscopic cholecystectomy. Baseline characteristics were comparable ($p > 0.05$). Group PR showed significantly better QoR-15 scores at 12 and 24 hours ($p < 0.01$), shorter recovery room stay ($p < 0.01$), and lower post-induction blood pressure ($p < 0.01$), while heart rate remained similar. Group PR also had lower pain scores, reduced opioid requirement (27.78% vs. 77.77%), and lower opioid consumption (28.6 ± 12.3 vs. 46.9 ± 15.8 mg; $p < 0.001$). Nausea was higher in Group IR (30.5% vs. 8.3%; $p = 0.03$), with other complications comparable. **Conclusion:** Propofol–remifentanil anaesthesia provides superior postoperative recovery compared with isoflurane–remifentanil anaesthesia after laparoscopic cholecystectomy.

Keywords: *Propofol-Remifentanil, Isoflurane-Remifentanil, Anaesthesia, Postoperative Quality of Recovery, Laparoscopic Cholecystectomy.*

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INTRODUCTION

Anaesthesia is an integral part of surgery and many surgical procedures cannot be performed without general anaesthesia, widely considered as one of the most significant discoveries in modern medicine. General anaesthesia involves inducing and maintaining unconsciousness in patients to eliminate pain using an appropriate combination of intravenous and inhaled anaesthetic agents [1]. As anaesthesia directly influences both intraoperative stability and postoperative outcome, the choice of anaesthetic technique is a key determinant of patient's postoperative quality of recovery.

Recovery from anaesthesia is defined as "a state of consciousness of an individual when he is awake or easily arousable and aware of his surroundings and identity" [2]. More broadly, it refers to the process by which patients return to normal functioning and daily activities after anaesthesia [3]. The quality of recovery includes physical, psychological, and emotional aspects of well-being. It reflects how effectively a patient regains physical comfort, cognitive function, emotional stability, and independence [4]. Quality of recovery varies due to the diverse effects of anaesthetic agents and patient's intrinsic factors [2,5].

For improving the quality of recovery, it is necessary to minimize complications, shorten hospital stays, and promote an early return to normal activities [6]. In this regard, optimization of perioperative anaesthetic management is vital which includes preoperative assessment, appropriate intraoperative anaesthetic choices, and postoperative support [5]. Recent practice emphasizes the use of modern fast-acting agents such as propofol, isoflurane, and remifentanil.

Propofol is the most commonly used intravenous anaesthetic, widely recognized for its rapid onset, smooth induction, and quick recovery. In addition, it has antiemetic, anti-inflammatory, antioxidant, organ-protective, and analgesic properties [7]. However, it also reduces arterial blood pressure, myocardial contractility, and the sympathetic response to tracheal intubation [8].

Isoflurane is a widely used volatile anaesthetic for maintenance, with a relatively rapid recovery profile [9]. However, it may cause nausea, vomiting, coughing, laryngospasm, hypotension, arrhythmias, and, rarely, malignant hyperthermia [10].

Remifentanil, a potent opioid frequently used in anaesthesia, is valued for its rapid onset, ultra-short duration, and metabolism that is independent of renal and hepatic

function. This allows predictable recovery regardless of infusion duration [11,12].

Laparoscopic cholecystectomy has become the standard procedure for treating gallbladder diseases such as cholelithiasis, chronic cholecystitis and symptomatic gallbladder polyps or masses. Introduced in the early 1990s, it has largely replaced open cholecystectomy because of its clear advantages. These include smaller incisions, less postoperative pain, shorter hospital stays, faster recovery, earlier return to daily activities, and better cosmetic results [13,14]. Despite these benefits, the patient' overall postoperative experience and quality of recovery remain important issues requiring further exploration.

Most published research has emphasized immediate postoperative outcomes such as time to emergence from anaesthesia, tracheal extubation time, cardiovascular and respiratory changes, pain intensity, nausea and vomiting, length of hospital stay, and incidence of adverse effects. However, these measures do not fully reflect the overall recovery experience of patients [15].

Lee et al. [15] reported that patients receiving propofol-remifentanil total intravenous anaesthesia experienced higher quality of recovery compared with those receiving desflurane–remifentanil anaesthesia. In their research, however, they focused on thyroidectomy and the comparison was done with desflurane rather than isoflurane, leaving unclear how propofol–remifentanil compares with isoflurane-remifentanil specifically.

To assess postoperative recovery, validated patient-reported outcome measures are essential. The QoR-40 is a comprehensive tool consisting of 40 items, but it can be lengthy to complete in clinical settings. The Quality of Recovery-15 (QoR-15) is a validated and reliable shortened version with similar psychometric properties, yet it is easier to use in routine practice [16].

The aim of this study was to assess and compare the effects of propofol–remifentanil and isoflurane–remifentanil anaesthesia on postoperative quality of recovery using the QoR-15 after laparoscopic cholecystectomy. Identifying an anaesthesia regimen that provides superior recovery profiles will contribute to evidence-based anaesthetic practice in minimally invasive surgery. This, in turn, is expected to enhance patient recovery, indirectly reduce costs and postoperative complications, and improve overall healthcare outcomes after laparoscopic cholecystectomy.

OBJECTIVE

To compare the effects of propofol–remifentanil and isoflurane–remifentanil anaesthesia on postoperative quality of recovery after laparoscopic cholecystectomy.

METHODS & MATERIALS

This quasi-experimental study was conducted in the operation theatre of the Department of General Surgery, Bangladesh Medical University, Dhaka, Bangladesh, from October 2024 to September 2025. A total of 72 patients scheduled for elective laparoscopic cholecystectomy under general anaesthesia were included in the study and selected by purposive sampling according to predefined inclusion and exclusion criteria. The calculated sample size was 36 patients in each group. Participants were allocated equally into Group PR (propofol–remifentanil anaesthesia) and Group IR (isoflurane–remifentanil anaesthesia) to compare postoperative quality of recovery, pain outcomes, haemodynamic parameters, opioid requirements, and postoperative complications following laparoscopic cholecystectomy.

Inclusion Criteria

- Patients scheduled for elective laparoscopic cholecystectomy.
- Patients aged 20–64 years.
- Expected duration of surgery ≤3 hours.
- Patients with an American Society of Anesthesiologists (ASA) physical status classification of I or II.

Exclusion Criteria

- Patients with known hypersensitivity to propofol, isoflurane, or remifentanil.
- Patients currently receiving sedative, opioid, or sleep-aid medications.
- Emergency surgical cases.
- Obese patients (BMI >30 kg/m²).
- Patients with pre-existing cardiac, respiratory, renal, or hepatic disease.
- Patients with diagnosed psychiatric disorders.

Outcomes and Variables

The primary outcome was Quality of Recovery-15 (QoR-15) score at 12 and 24 hours postoperatively. Secondary outcomes included Visual Analogue Scale (VAS) pain score, heart rate, systolic and diastolic blood pressure, duration of recovery room stay, Modified Aldrete Recovery Score, total opioid consumption within 24 hours, and postoperative complications. Demographic and clinical variables included age, sex, BMI, ASA physical status, and intraoperative duration.

Anaesthetic Management and Study Procedure

Standard preoperative fasting and premedication were ensured. Monitoring included ECG, non-invasive blood pressure, and pulse oximetry, with baseline haemodynamic parameters recorded. Anaesthesia was induced with remifentanil infusion (0.5 µg/kg/min), followed by a propofol bolus and suxamethonium-facilitated intubation.

Maintenance anaesthesia consisted of propofol (75 µg/kg/min) with remifentanil (0.1 µg/kg/min) in Group PR and isoflurane (0.8 MAC) with remifentanil (0.1 µg/kg/min) in Group IR. All patients received vecuronium for muscle relaxation and standard mechanical ventilation. Haemodynamic variables were recorded at predefined intraoperative and postoperative time points.

At the end of surgery, anaesthetic agents were discontinued, and neuromuscular blockade was reversed with neostigmine and atropine. Patients were extubated and transferred to recovery, where monitoring continued until discharge based on a Modified Aldrete score ≥9.

Postoperative Assessment and Data Collection

Postoperative analgesia included paracetamol and ketorolac, with rescue pethidine administered when VAS ≥4. QoR-15 scores were assessed at 12 and 24 hours, while VAS scores were recorded on arrival in the postoperative ward, and at 12 and 24 hours. Additional recorded outcomes included opioid consumption, recovery room stay, haemodynamic changes, and postoperative complications. Data were collected by an independent assessor using a structured form.

Statistical Analysis and Ethics

Data were analyzed using SPSS version 29.0. Continuous variables were expressed as mean ± SD and compared using independent t-test, while categorical variables were analyzed using Chi-square or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board of Bangladesh Medical University, and written informed consent was obtained from all participants in accordance with the Declaration of Helsinki.

RESULTS

Table I presents the baseline demographic and clinical characteristics of the study participants. The mean age was comparable between Group PR (44.6 ± 8.9 years) and Group IR (43.1 ± 9.3 years), with no statistically significant difference (p = 0.26). Both groups had a predominantly female distribution, with 4 males (11.1%) and 32 females (88.9%) in Group PR, and 5 males (13.9%) and 31 females (86.1%) in Group IR. Mean body weight, height, and BMI were similar between groups, with no statistically significant differences (p > 0.05). ASA physical status was comparable, with 19 (52.8%) ASA I and 17 (47.2%) ASA II patients in Group PR,

compared to 21 (58.3%) ASA I and 15 (41.7%) ASA II in Group IR. Comorbidities were also evenly distributed, with hypertension present in 10 (27.8%) vs 9 (25.0%) and diabetes mellitus in 7 (19.4%) vs 6 (16.7%) in Group PR and Group IR respectively.

Table I
Baseline Demographic and Clinical Characteristics of the Study Groups (*n* = 72).

Variable		Group PR (n=36)	Group IR (n=36)	p-value
Age (years), Mean ± SD		44.6 ± 8.9	43.1 ± 9.3	0.26
Sex	Male	4 (11.1%)	5 (13.9%)	1.00
	Female	32 (88.9%)	31 (86.1%)	
Weight (kg), Mean ± SD		64.7 ± 8.9	65.5 ± 8.8	0.36
Height (cm), Mean ± SD		160.1 ± 1.4	160.5 ± 1.7	0.16
BMI (kg/m²), Mean ± SD		25.3 ± 3.6	25.4 ± 3.4	0.46
ASA Physical Status	ASA I	19 (52.8%)	21 (58.3%)	0.23
	ASA II	17 (47.2%)	15 (41.7%)	
Comorbidity	Hypertension	10 (27.8%)	9 (25.0%)	1.00
	Diabetes mellitus	7 (19.4%)	6 (16.7%)	

Table II presents the postoperative Quality of Recovery-15 (QoR-15) scores at 12 and 24 hours. At 12 hours, 30 patients (83.3%) in Group PR reported good recovery and 6 (16.7%) moderate recovery, whereas all 36 patients (100%) in Group IR reported moderate recovery ($p < 0.01$). At 24 hours, 20 patients (55.6%) in Group PR achieved excellent recovery and 16 (44.4%) good recovery. In contrast, no patients (0%) in Group IR achieved excellent recovery, while 19 (52.8%) had good recovery and 17 (47.2%) remained in the moderate category ($p < 0.01$).

Table II
QoR-15 Scores at 12 and 24 Hours Postoperatively in the Study Groups (*n* = 72).

Variable		Group PR (n=36)	Group IR (n=36)	p-value
QoR-15 at 12 hours	Excellent (136–150)	0 (0%)	0 (0%)	<0.01
	Good (121–135)	30 (83.3%)	0 (0%)	
	Moderate (90–121)	6 (16.7%)	36 (100%)	
	Poor (0–89)	0 (0%)	0 (0%)	
QoR-15 at 24 hours	Excellent (136–150)	20 (55.6%)	0 (0%)	<0.01
	Good (122–135)	16 (44.4%)	19 (52.8%)	
	Moderate (90–121)	0 (0%)	17 (47.2%)	
	Poor (0–89)	0 (0%)	0 (0%)	

Table III shows intraoperative and recovery room time parameters. The duration of surgery was similar between Group PR (84.4 ± 20.7 min) and Group IR (84.6 ± 22.1 min) with no significant difference ($p = 0.48$). Anaesthesia duration was also comparable, 96.6 ± 23.3 min in Group PR and 100.3 ± 26.0 min in Group IR ($p = 0.28$). However, duration of stay in the recovery room was significantly shorter in Group PR, with 43.1 ± 1.7 minutes compared to 47.6 ± 1.7 minutes in Group IR ($p < 0.01$).

Table-III
Duration of Surgery, Anaesthesia, and Recovery Room Stay in the Study Groups (*n* = 72).

Variable	Group PR (n=36) Mean±SD	Group IR (n=36) Mean±SD	p-value
Surgery Duration (min)	84.4 ± 20.7	84.6 ± 22.1	0.48
Anaesthesia Duration (min)	96.6 ± 23.3	100.3 ± 26.0	0.28
Duration of Stay at Recovery Room (min)	43.1 ± 1.7	47.6 ± 1.7	<0.01

Table IV presents the Modified Aldrete Recovery Scores at discharge from the recovery room. The mean score was 9.7 ± 0.3 in Group PR and 9.6 ± 0.4 in Group IR, with no statistically significant difference between the groups ($p = 0.23$), indicating comparable immediate postoperative recovery.

Table IV
Modified Aldrete Recovery Score at Discharge from Recovery Room (*n* = 72).

Variable	Group PR (n=36)	Group IR (n=36)	p-value
Modified Aldrete Recovery Score	9.7 ± 0.3	9.6 ± 0.4	0.23

Table V presents heart rate changes at different perioperative time points. At baseline, heart rate was 78.5 ± 12.0 beats/min in Group PR and 78.9 ± 11.6 beats/min in Group IR. After induction, it decreased to 61.8 ± 6.9 (PR) and 62.3 ± 8.8 (IR). During maintenance, it was 64.6 ± 8.5 vs 65.7 ± 8.2, after cessation 75.0 ± 5.4 vs 76.5 ± 7.2, and in recovery room 71.1 ± 7.6 vs 73.7 ± 6.5, respectively. No statistically significant differences were observed at any time point ($p > 0.05$).

Table V
Heart Rate at Different Perioperative Time Points in the Study Groups (*n* = 72).

Variable	Group PR (n=36) Mean±SD	Group IR (n=36) Mean±SD	p-value
At Baseline	78.5 ± 12.0	78.9 ± 11.6	0.44
10 min After Induction	61.8 ± 6.9	62.3 ± 8.8	0.80
During Maintenance 30 min After Induction	64.6 ± 8.5	65.7 ± 8.2	0.60
After Cessation of Anaesthesia	75.0 ± 5.4	76.5 ± 7.2	0.35
At Recovery Room	71.1 ± 7.6	73.7 ± 6.5	0.10

Table VI shows systolic blood pressure changes over time. At baseline, values were similar: 124.9 ± 9.1 mmHg (PR) and 126.0 ± 9.7 mmHg (IR). After induction, SBP decreased to 96.7 ± 7.9 (PR) vs 111.9 ± 7.5 (IR). During maintenance, it was 107.1 ± 9.4 vs 116.6 ± 8.4, after cessation 113.4 ± 7.2 vs 126.5 ± 10.0, and in recovery room 112.9 ± 8.1 vs 117.5 ± 8.2. All post-induction values were significantly lower in Group PR ($p < 0.01$).

Table-VI
Systolic Blood Pressure at Different Perioperative Time Points in the Study Groups (*n* = 72).

Variable	Group PR (n=36) Mean±SD	Group IR (n=36) Mean±SD	p-value
At Baseline	124.9 ± 9.1	126.0 ± 9.7	0.62
10 min After Induction	96.7 ± 7.9	111.9 ± 7.5	<0.01
During Maintenance 30 min After Induction	107.1 ± 9.4	116.6 ± 8.4	<0.01
After Cessation of Anaesthesia	113.4 ± 7.2	126.5 ± 10.0	<0.01
At Recovery Room	112.9 ± 8.1	117.5 ± 8.2	<0.01

Table VII presents diastolic blood pressure trends. Baseline DBP was similar between groups: 80.4 ± 5.9 mmHg in Group PR and 80.0 ± 5.5 mmHg in Group IR. After induction, values decreased to 59.9 ± 6.7 vs 68.3 ± 7.7. During maintenance, it was 64.3 ± 6.1 vs 70.4 ± 8.0, after cessation 70.0 ± 5.6 vs 92.6 ± 11.8, and in recovery room 71.7 ± 8.1 vs 76.8 ± 8.4. All post-induction differences were statistically significant ($p < 0.01$), with lower values in Group PR.

Table-VII
Diastolic Blood Pressure at Different Perioperative Time Points in the Study Groups (*n* = 72).

Variable	Group PR (n=36) Mean±SD	Group IR (n=36) Mean±SD	p-value
At Baseline	80.4 ± 5.9	80.0 ± 5.5	0.38
10 min After Induction	59.9 ± 6.7	68.3 ± 7.7	<0.01
During Maintenance 30 min After Induction	64.3 ± 6.1	70.4 ± 8.0	<0.01
After Cessation of Anaesthesia	70.0 ± 5.6	92.6 ± 11.8	<0.01
At Recovery Room	71.7 ± 8.1	76.8 ± 8.4	<0.01

Table VIII presents postoperative pain intensity and opioid analgesic requirements in the study groups. On arrival at the postoperative ward, no patient in either group reported severe pain; however, 25 patients (69.4%) in Group PR experienced mild pain and 11 (30.6%) moderate pain, whereas all patients in Group IR (100%) reported moderate pain ($p < 0.01$). At 12 hours postoperatively, all patients in Group PR (100%) reported mild pain, while 20 patients (55.6%) in Group IR continued to experience moderate pain and 16 (44.4%) reported mild pain ($p < 0.01$). By 24 hours, all patients in both groups (100%) reported only mild pain, with no significant difference between groups ($p = 1.00$). Rescue opioid analgesia was required in 10 patients (27.78%) in Group PR compared with 28 patients (77.77%) in Group IR ($p < 0.001$). Furthermore, total opioid consumption was significantly lower in Group PR (28.6 ± 12.3 mg) than in Group IR (46.9 ± 15.8 mg) ($p < 0.001$).

Table VIII
Postoperative Pain Intensity and Opioid Analgesic Requirement in the Study Groups (*n* = 72).

Variable		Group PR (n=36)	Group IR (n=36)	p-value
On Arrival at Postoperative Ward	Severe	0 (0%)	0 (0%)	<0.01
	Moderate	11 (30.6%)	36 (100%)	
	Mild	25 (69.4%)	0 (0%)	
At 12 Hours	Severe	0 (0%)	0 (0%)	<0.01
	Moderate	0 (0%)	20 (55.6%)	
	Mild	36 (100%)	16 (44.4%)	
At 24 Hours	Severe	0 (0%)	0 (0%)	1.00
	Moderate	0 (0%)	0 (0%)	
	Mild	36 (100%)	36 (100%)	
Opioid Analgesic Requirement	Cases requiring rescue opioid analgesia	10 (27.78%)	28 (77.77%)	<0.001
	Total opioid consumption (mg), Mean ± SD	28.6 ± 12.3	46.9 ± 15.8	<0.001

Table IX presents postoperative complications. Tachycardia occurred in 2 patients (5.5%) in Group PR and 7 (19.4%) in Group IR. Bradycardia was seen in 5 (13.9%) vs 2 (5.5%), hypertension in 2 (5.5%) vs 7 (19.4%), and hypotension in 10 (27.78%) vs 3 (8.3%), respectively. Nausea occurred significantly more in Group IR (11 patients, 30.5%) compared to Group PR (3 patients, 8.3%) (p = 0.03). Vomiting occurred in 2 (5.5%) vs 6 (16.7%), respectively, with no statistically significant difference (p = 0.26).

Table IX
Incidence of Postoperative Complications in the Study Groups (*n* = 72).

Variable	Group PR (n=36)	Group IR (n=36)	p-value
Tachycardia	2 (5.5%)	7 (19.4%)	0.15
Bradycardia	5 (13.9%)	2 (5.5%)	0.43
Hypertension	2 (5.5%)	7 (19.4%)	0.15
Hypotension	10 (27.78%)	3 (8.3%)	0.06
Nausea	3 (8.3%)	11 (30.5%)	0.03
Vomiting	2 (5.5%)	6 (16.7%)	0.26

DISCUSSION

This quasi-experimental study was conducted at Bangladesh Medical University after approval by the Institutional Review Board. Seventy-two patients scheduled for laparoscopic cholecystectomy were enrolled based on predefined inclusion and exclusion criteria. Group PR received propofol–remifentanil, and Group IR received isoflurane–remifentanil. The study aimed to compare these two anaesthetic regimens in terms of postoperative quality of recovery, assessed using QoR-15 scores, recovery room stay, Modified Aldrete Score, pain intensity, opioid consumption, haemodynamic parameters, and postoperative complications.

When comparing baseline characteristics with previous reports, a clear consistency is observed, supporting the generalizability of the findings. Age distribution showed no significant difference between groups (p = 0.26) and was comparable to earlier studies such as Rowbotham et al. [17] and Wilhelm et al. [18]. Sex distribution demonstrated a predominance of females (88.9% vs. 86.1%), with males comprising 11.1% and 13.9%, respectively (p = 1.00), which is consistent with the higher prevalence of gallstone disease among women. Body measurements showed no meaningful variation between groups in weight (p = 0.36), height (p = 0.16), or BMI (p = 0.46). Although mean anthropometric values were lower than those reported in Western populations (Schneider et al. [19]; Rowbotham et al. [17]), this likely reflects regional and ethnic differences. Importantly, BMI remained comparable between groups, minimizing confounding. ASA physical status was also well balanced, with 52.8% ASA I and 47.2% ASA II in Group PR versus 58.3% and 41.7% in Group IR (p = 0.23). Surgical duration was similar between groups (p = 0.48). Comorbidities such as hypertension (27.8% vs. 25.0%; p = 1.00) and diabetes mellitus (19.4% vs. 16.7%; p = 1.00) were evenly distributed.

In this study, Group PR demonstrated superior postoperative recovery compared to Group IR as measured by QoR-15. At 12 hours, 83.3% of patients in Group PR reported "good" recovery and 16.7% "moderate" recovery, whereas all patients in Group IR (100%) reported "moderate" recovery (p < 0.01). At 24 hours, 55.6% of Group PR achieved "excellent" recovery and 44.4% "good" recovery. In contrast, no patients in Group IR achieved "excellent" recovery, while 52.8% reported "good" recovery and 47.2% remained "moderate" (p < 0.01).

These findings are consistent with Lee et al. [15], who demonstrated superior recovery quality with propofol–remifentanil compared to desflurane–remifentanil anaesthesia in thyroidectomy patients. Despite differences in surgical procedure and scoring system (QoR-15 vs QoR-40), both studies support improved recovery outcomes with propofol-based total intravenous anaesthesia.

Although Lee et al. [15] used desflurane while this study used isoflurane, the comparison remains appropriate because both are volatile anaesthetics with similar pharmacological profiles. Isoflurane and desflurane both provide dose-dependent hypnosis and amnesia, reduce systemic vascular resistance via vasodilation, and facilitate relatively rapid emergence compared to older agents (Talukdar et al. [20]; Temple [10]). These similarities support the interpretation that the observed superiority of propofol–remifentanil reflects a true advantage of intravenous over volatile maintenance techniques.

Pharmacologically, propofol offers several advantages, including rapid redistribution, antiemetic effects, and suppression of postoperative neuroinflammatory responses, which may contribute to improved recovery quality. In contrast, isoflurane, although effective for maintenance of anaesthesia, is more commonly associated with postoperative nausea, vomiting, and slightly delayed cognitive recovery. Remifentanil, being ultra–short acting, provides comparable intraoperative analgesia in both groups but does not eliminate differences attributable to the hypnotic agents.

The duration of surgery (84.4 vs. 84.6 minutes) and anaesthesia time (96.6 vs. 100.3 minutes) were comparable between groups. However, recovery room stay was significantly shorter in Group PR (43.1 minutes) compared to Group IR (47.6 minutes) (p < 0.01), indicating faster early recovery in the propofol group.

The Modified Aldrete Recovery Scores were comparable between Group PR (9.7 ± 0.3) and Group IR (9.6 ± 0.4), with no statistically significant difference (p = 0.23). Sezen et al. [21] also reported similar findings, supporting that both anaesthetic techniques provide equivalent immediate recovery as assessed by standard discharge criteria.

Heart rate remained stable across all perioperative time points, with no significant differences between groups (p > 0.05). Both regimens produced an expected reduction in heart rate after induction, followed by a return toward baseline. These findings are consistent with Wilhelm et al. [18], who also reported comparable heart rate profiles with propofol–remifentanil and isoflurane–remifentanil anaesthesia.

In contrast, systolic blood pressure (SBP) showed significant intergroup differences. Although baseline SBP was comparable (p = 0.62), Group PR demonstrated significantly lower SBP after induction, during maintenance, after cessation of anaesthesia, and in the recovery room (all p < 0.01), indicating a more pronounced hypotensive effect of propofol–remifentanil anaesthesia.

A similar pattern was observed for diastolic blood pressure (DBP). Baseline values were similar (p = 0.38), but Group PR showed significantly lower DBP at all subsequent time points (p < 0.01). These findings suggest greater vasodilatory effects with propofol compared to isoflurane.

These results partially align with Wilhelm et al. [18], who reported blood pressure reductions with both regimens but less pronounced intergroup differences. Variability in anaesthetic dosing, surgical stimulation, and patient characteristics may

explain these differences. Overall, propofol–remifentanil was associated with more consistent and sustained reductions in blood pressure.

Postoperative pain was significantly lower in Group PR at arrival and at 12 hours postoperatively ($p < 0.01$). At 24 hours, pain scores were similar between groups, with all patients reporting only mild pain. These findings are consistent with Schraag et al. [22], who reported improved postoperative pain outcomes with propofol-based anaesthesia.

In contrast, total opioid consumption was significantly lower in Group PR compared to Group IR (27.78% vs. 77.77% required rescue analgesia; $p < 0.001$), indicating a clinically meaningful reduction in analgesic requirement with propofol–remifentanil anaesthesia.

The incidence of postoperative complications was generally comparable between groups. Most complications, including tachycardia, bradycardia, hypotension, and hypertension, did not differ significantly. However, hypotension was relatively more frequent in Group PR (27.78% vs. 8.3%), though this was not statistically significant ($p = 0.06$). This finding is consistent with known vasodilatory effects of propofol.

A notable finding was the significantly higher incidence of postoperative nausea in Group IR (30.5%) compared to Group PR (8.3%) ($p = 0.03$). This is consistent with the established antiemetic properties of propofol and aligns with findings from Chung et al. [23], who reported reduced PONV with propofol-based anaesthesia.

Vomiting rates were also lower in Group PR (5.5% vs. 16.7%), although this difference was not statistically significant ($p = 0.26$). This trend is consistent with Rowbotham et al. [17], and may reflect improved antiemetic prophylaxis and modern anaesthetic techniques.

Overall, the findings suggest that propofol–remifentanil anaesthesia provides superior postoperative recovery quality, improved early pain control, reduced opioid requirements, and a lower incidence of nausea compared with isoflurane–remifentanil anaesthesia. These advantages are particularly relevant in laparoscopic cholecystectomy, where rapid recovery is essential for early mobilization, discharge, and improved patient satisfaction.

LIMITATIONS

Variations in surgical technique and perioperative management may have influenced the hemodynamic parameters and postoperative recovery outcomes.

CONCLUSION

It can be concluded that both anaesthetic regimens provide safe and effective postoperative recovery after laparoscopic cholecystectomy. However, the propofol–remifentanil anaesthetic regimen demonstrates a superior quality of recovery compared with isoflurane–remifentanil anaesthesia.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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