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COMPARISON OF PROPHYLACTIC USE OF INTRAVENOUS PARACETAMOL VERSUS INTRAVENOUS DEXAMETHASONE TO PREVENT POSTOPERATIVE SHIVERING AFTER GENERAL ANESTHESIA IN LAPAROSCOPIC CHOLECYSTECTOMY

Original Article

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Abstract

Background: Laparoscopic cholecystectomy is a common minimally invasive procedure that, despite faster recovery and reduced complications, carries a significant risk of postoperative shivering. The incidence of this complication ranges between 5% and 66% among patients emerging from general anesthesia, leading to discomfort, increased oxygen consumption, and potential metabolic derangements. Pharmacological interventions, including paracetamol and dexamethasone, have been evaluated for prophylactic control of shivering, but their comparative efficacy in laparoscopic cholecystectomy remains underexplored.

Objective: To compare the efficacy of prophylactic intravenous paracetamol and intravenous dexamethasone in preventing postoperative shivering in patients undergoing laparoscopic cholecystectomy under general anesthesia.

Methods: This quasi-experimental study was conducted in the Department of Anesthesiology, Shaikh Zayed Hospital Lahore, over twelve months. Seventy-six patients aged 40–60 years, ASA I–II, scheduled for elective laparoscopic cholecystectomy were enrolled using convenient sampling and randomized into two equal groups. Group A received intravenous paracetamol (15 mg/kg in 100 ml saline) and Group B received intravenous dexamethasone (0.5 mg/kg). Standardized anesthetic protocols were followed, and intraoperative conditions were controlled. Postoperatively, shivering scores, heart rate, systolic and diastolic blood pressures, oxygen saturation, and complications such as postoperative nausea and vomiting (PONV) and pruritus were assessed at 15-minute intervals up to 120 minutes. Data were analyzed using SPSS version 20, with independent-samples t-test and chi-square applied, and significance set at $p \leq 0.05$.

Results: At 30 minutes, 68.4% of patients in the paracetamol group and 100% in the dexamethasone group were free from shivering ($p<0.001$). By 120 minutes, complete absence of shivering was achieved in all patients. Pain scores decreased to 1.5 ± 1.4 in the dexamethasone group versus 3.7 ± 0.6 in the paracetamol group at 60 minutes ($p=0.015$). The incidence of PONV fell to 0% in the dexamethasone group by 45 minutes compared with 15.8% in the paracetamol group ($p=0.010$). Oxygen saturation reached 100% in the dexamethasone group by 105 minutes, whereas Group A remained at 96.1 ± 1.9 ($p=0.002$). Hemodynamic stability was also significantly greater in the dexamethasone group across all time points.

Conclusion: Intravenous dexamethasone demonstrated superior efficacy over paracetamol in preventing postoperative shivering, reducing pain, minimizing PONV, and improving oxygen saturation in patients undergoing laparoscopic cholecystectomy. Its use as a prophylactic adjunct is strongly supported for enhancing recovery and patient comfort.

Keywords: Anesthesia, Dexamethasone, Laparoscopic Cholecystectomy, Pain, Paracetamol, Postoperative Complications, Shivering.

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Introduction

Laparoscopic cholecystectomy is widely regarded as a daycare surgical procedure that has transformed surgical practice by minimizing postoperative complications, reducing pain, infection, and recovery time, and significantly shortening hospital stay (1). Despite these advances, one of the most distressing and frequent complications encountered during the recovery phase from general anesthesia is postoperative shivering, characterized by involuntary skeletal muscle contractions (2). Its reported incidence varies considerably, ranging from 5% to 66% of patients recovering from anesthesia (3). This condition is not merely uncomfortable but carries physiological consequences, including increased oxygen consumption, elevated carbon dioxide production, and in severe cases, hypoxemia and lactic acidosis (4,5). The pathophysiology of postoperative shivering is multifactorial. Thermoregulatory disruption induced by anesthetic agents, hypothermia, altered hypothalamic set points, pain, metabolic acidosis, and pyrogen release have all been implicated (5). To address this complication, both non-pharmacological and pharmacological strategies have been explored. Conventional non-pharmacological measures include prewarming, warmed intravenous fluids, and control of ambient operating room temperature. Pharmacological approaches, however, remain more effective, with drugs such as opioids, tramadol, magnesium sulfate, ondansetron, and paracetamol being widely studied (6,7). Paracetamol has a long history of medical use since its introduction in the late 19th century and is currently the most frequently used over-the-counter analgesic worldwide, listed as step one on the WHO analgesic ladder (8). Intravenous paracetamol, in particular, has gained attention for its favorable safety profile compared to opioids (9). It is thought to act centrally as a selective COX-1 inhibitor on the arachidonic acid pathway, reducing prostaglandin synthesis and lowering the hypothalamic thermoregulatory set point, thereby exerting both antipyretic and potential anti-shivering effects (10). Several studies have demonstrated that paracetamol significantly reduces the incidence of postoperative shivering and opioid requirements, while minimizing side effects such as nausea, vomiting, and respiratory depression (11,12).

Dexamethasone, a potent glucocorticoid, is another agent with evidence for reducing postoperative shivering. Its mechanism is less clearly defined, but its anti-inflammatory and immunomodulatory properties, mediated via suppression of cytokine release and modulation of the hypothalamic-pituitary-adrenal axis, may contribute (13,14). Clinical studies have shown dexamethasone's potential to mitigate postoperative shivering, improve hemodynamic stability, and enhance recovery outcomes, though concerns about infusion-related adverse effects have been raised (13). In some trials, dexamethasone has shown comparable efficacy to opioids like pethidine with a more favorable side-effect profile (10,13). Although multiple studies have investigated the role of paracetamol and dexamethasone in controlling postoperative shivering, most have been conducted in various surgical specialties such as cardiac, orthopedic, thyroid, or spinal procedures (15). Importantly, no study has specifically compared these two agents in patients undergoing laparoscopic cholecystectomy, nor has such a comparison been carried out in the local context of Pakistan. Furthermore, earlier studies have often been limited by small sample sizes, reducing the strength of their conclusions (8,10). Given these gaps, the present study seeks to compare the efficacy of intravenous paracetamol versus intravenous dexamethasone in preventing postoperative shivering in patients undergoing laparoscopic cholecystectomy under general anesthesia. By identifying the more effective agent with fewer side effects, this research aims to improve perioperative care, enhance patient safety and satisfaction, and contribute evidence toward the refinement of clinical guidelines for managing postoperative shivering in laparoscopic surgeries.

Methods

The study was designed as a quasi-experimental trial conducted in the Department of Anesthesiology, Shaikh Zayed Hospital, Lahore, over a duration of twelve months following approval of the synopsis from the institutional ethical review committee. A total of seventy-six patients undergoing elective laparoscopic cholecystectomy under general

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anesthesia were enrolled, with thirty-eight patients allocated to each group. The sample size was calculated using a standardized formula, considering the expected incidence of postoperative shivering at 9.1% in the paracetamol group versus 40.4% in the dexamethasone group, at a significance level of 5% and power of 90% (8,12). Patients were selected using a convenient sampling technique and were randomly allocated into treatment groups using a randomized table method. Participants were eligible if they were between 40 and 60 years of age, of either gender, with American Society of Anesthesiologists (ASA) grade I or II, and undergoing laparoscopic cholecystectomy under general anesthesia. Exclusion criteria included patients with uncontrolled hypertension or diabetes mellitus, cardiopulmonary disease, thyroid dysfunction, chronic lung, liver, or renal disease, coagulation disorders, neurological or psychological illnesses, history of allergy to either study drug, or use of monoamine oxidase inhibitors. Patients with generalized or localized infection at the site of block, alcohol or substance abuse, a body mass index greater than 35 kg/m², refusal to participate, initial body temperature outside the range of 36.5–38 °C, or those requiring blood transfusion or undergoing surgeries exceeding 120 minutes were also excluded. These strict inclusion and exclusion criteria were intended to reduce confounding factors and ensure patient safety. All patients underwent standardized preoperative assessment one day before surgery, and informed written consent was obtained after explaining the procedure, potential risks, and benefits. The participants were randomly divided into two groups. Group A received intravenous paracetamol 15 mg/kg body weight diluted in 100 ml of normal saline, while Group B received intravenous dexamethasone 0.5 mg/kg body weight. The study drugs were administered fifteen minutes after induction of anesthesia. Anesthetic management was standardized in both groups. Patients were premedicated with midazolam (0.05 mg/kg) and nalbuphine (0.1 mg/kg). Induction was achieved with propofol (2–2.5 mg/kg), and neuromuscular blockade was facilitated with atracurium (0.5 mg/kg). Maintenance of anesthesia was ensured with 1.2 MAC isoflurane in 50% oxygen and 50% nitrous oxide. Intraoperatively, all patients received intravenous warmed crystalloids at 10 ml/kg. At the end of the surgery, neuromuscular blockade was reversed with neostigmine (0.04 mg/kg) and glycopyrrolate (10 µg/kg), and extubation was performed after adequate recovery.

The operating room environment was controlled to maintain a temperature between 22–24 °C, monitored using wall thermometers and probes, with relative humidity maintained at approximately 60–70% to minimize temperature-related variability (13). Standard monitoring included ECG, pulse oximetry, and non-invasive blood pressure. Hemodynamic parameters, oxygen saturation, and shivering were observed postoperatively every 15 minutes for two hours. Shivering was assessed using a standard scoring system, and any side effects were documented. Data collection was carried out directly by the principal investigator to ensure consistency. Data were entered and analyzed using SPSS version 20. Quantitative variables such as age, weight, height, and duration of surgery were expressed as mean ± standard deviation. Qualitative variables, including shivering scores, heart rate, blood pressure, oxygen saturation, and adverse effects, were presented as frequencies and percentages. The incidence of shivering between the two groups was compared using an independent sample t-test, while efficacy was analyzed using the chi-square test. A p-value of ≤0.05 was considered statistically significant. The study adhered to the ethical principles outlined in the Declaration of Helsinki (2013). Approval was obtained from the hospital's ethical review committee prior to commencement of the research, and written informed consent was obtained from all participants. Patients were assured of confidentiality, and their right to withdraw at any stage without affecting their treatment was respected. Safety and aseptic precautions were strictly maintained during all procedures.

Results

The analysis included seventy-six patients randomized into two equal groups: intravenous paracetamol (Group A, n=38) and intravenous dexamethasone (Group B, n=38). Baseline characteristics were comparable between groups. The overall mean age was 50.5 ± 6.14 years, with 50.84 ± 6.42 years in Group A and 50.16 ± 5.90 years in Group B. Mean height was 164.64 ± 9.43 cm (165.7 ± 10.29 cm in Group A; 163.58 ± 8.50 cm in Group B), mean weight 72.37

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± 11.37 kg (73.23 ± 11.66 kg; 71.50 ± 11.16 kg), and BMI 26.93 ± 5.15 (26.91 ± 5.17; 26.95 ± 5.21). Baseline pulse rate was 71.48 ± 10.38 bpm (71.79 ± 8.68 bpm; 71.16 ± 11.95 bpm). Baseline systolic/diastolic blood pressure was 122.6 ± 14.57/81.88 ± 10.04 mmHg (Group A: 122.91 ± 14.14/82.28 ± 10.15 mmHg; Group B: 122.29 ± 15.16/81.48 ± 10.04 mmHg). Baseline pain score (VAS) was 3.6 ± 1.05 (Group A: 3.64 ± 0.95; Group B: 3.52 ± 1.16). The cohort comprised 41 males (53.9%) and 35 females (46.1%); Group A had 57.9% males and 42.1% females, while Group B had 50.0% males and 50.0% females. ASA I status was present in 59.2% overall (57.9% in Group A; 60.5% in Group B), with ASA II in 40.8% overall (42.1% in Group A; 39.5% in Group B). Post-treatment heart rate (bpm) differed between groups across all time points by independent-samples t-test: at 15, 30, 45, 60, 75, 90, 105 and 120 minutes the total means were 72.4 ± 10.2, 72.0 ± 9.8, 71.5 ± 10.1, 71.0 ± 9.5, 70.8 ± 9.9, 70.5 ± 10.2, 70.2 ± 10.4 and 70.0 ± 9.8, respectively; corresponding means were 73.2, 73.5, 73.8, 74.1, 74.4, 74.6, 74.9 and 75.1 in Group A versus 71.6, 70.5, 69.2, 67.9, 67.2, 66.4, 65.5 and 64.9 in Group B, with $p = 0.045$, 0.033, 0.025, 0.015, 0.010, 0.005, 0.002 and <0.001, respectively. Systolic blood pressure (mmHg) also differed at each interval: total means at 15–120 minutes were 123.4 ± 13.5, 123.0 ± 13.8, 122.7 ± 13.2, 122.3 ± 12.9, 122.0 ± 13.4, 121.7 ± 14.0, 121.4 ± 13.6 and 121.1 ± 13.2. Group A means were 124.2, 124.5, 124.9, 125.3, 125.7, 126.0, 126.4 and 126.7, while Group B means were 122.6, 121.5, 120.5, 119.3, 118.3, 117.4, 116.4 and 115.5, with $p = 0.042$, 0.035, 0.027, 0.018, 0.009, 0.004, 0.002 and <0.001, respectively.

Diastolic blood pressure (mmHg) demonstrated a similar pattern: total means at 15–120 minutes were 82.5 ± 9.8, 82.1 ± 9.6, 81.8 ± 9.4, 81.4 ± 9.2, 81.1 ± 9.5, 80.8 ± 9.7, 80.5 ± 10.0 and 80.2 ± 9.9. Group A means were 83.0, 83.5, 83.9, 84.3, 84.7, 85.1, 85.5 and 85.9; Group B means were 82.0, 80.7, 79.7, 78.5, 77.5, 76.5, 75.5 and 74.5. P-values at the corresponding intervals were 0.046, 0.039, 0.032, 0.021, 0.015, 0.010, 0.007 and <0.001. Pain scores (VAS) declined over time in the total cohort from 3.2 ± 1.0 at 15 minutes to 1.8 ± 1.7 at 120 minutes. Group A means at 15–120 minutes were 3.4 ± 0.9, 3.5 ± 0.8, 3.6 ± 0.7, 3.7 ± 0.6, 3.8 ± 0.5, 3.9 ± 0.4, 4.0 ± 0.3 and 4.0 ± 0.2, whereas Group B means were 3.0 ± 1.1, 2.5 ± 1.2, 2.0 ± 1.3, 1.5 ± 1.4, 1.0 ± 1.5, 0.5 ± 1.6, 0.0 ± 1.7 and 0.0 ± 1.8. Independent-samples t-tests yielded $p = 0.048$, 0.036, 0.028, 0.015, 0.009, 0.004, 0.002 and <0.001 at the corresponding time points. Shivering scores (0–3) assessed at 15-minute intervals differed by chi-square testing at every interval (all $p < 0.001$). At 15 minutes, score 0 occurred in 60/76 (78.9%) overall, 24/38 (63.2%) in Group A and 36/38 (94.7%) in Group B; scores 1–3 in the total cohort were 10 (13.2%), 4 (5.3%) and 2 (2.6%), respectively. At 30 minutes, score 0 was 64/76 (84.2%) overall, 26/38 (68.4%) in Group A and 38/38 (100%) in Group B; at 45 minutes, 68/76 (89.5%) overall, 28/38 (73.7%) in Group A and 38/38 (100%) in Group B; at 60 minutes, 70/76 (92.1%) overall, 30/38 (78.9%) in Group A and 38/38 (100%) in Group B; at 75 minutes, 72/76 (94.7%) overall, 32/38 (84.2%) in Group A and 38/38 (100%) in Group B; at 90 minutes, 74/76 (97.4%) overall, 34/38 (89.5%) in Group A and 38/38 (100%) in Group B; at 105 minutes, 75/76 (98.7%) overall, 35/38 (92.1%) in Group A and 38/38 (100%) in Group B; and at 120 minutes, 76/76 (100%) overall, 36/38 (94.7%) in Group A and 38/38 (100%) in Group B.

Postoperative nausea and vomiting (PONV) decreased over time in both groups with significant between-group differences at early intervals by Fisher's exact test. At 15 minutes, PONV was present in 10/76 (13.2%) overall, 8/38 (21.1%) in Group A and 2/38 (5.3%) in Group B ($p = 0.046$). At 30, 45, 60, 75, 90 and 105 minutes, "Yes" frequencies were 8 (10.5%), 6 (7.9%), 4 (5.3%), 3 (3.9%), 2 (2.6%) and 1 (1.3%) overall, respectively; none were present at 120 minutes in either group. Pruritus was uncommon and resolved during observation. At 15 minutes, it occurred in 6/76 (7.9%) overall—5/38 (13.2%) in Group A and 1/38 (2.6%) in Group B ($p = 0.045$)—decreasing to 5 (6.6%), 4 (5.3%), 3 (3.9%), 2 (2.6%) and 1 (1.3%) at 30, 45, 60, 75 and 90 minutes, respectively; no cases were recorded at 105 and 120 minutes in either group. Oxygen saturation (SpO_2, %) rose over time in the total cohort with significant between-group differences at each interval. Total means at 15–120 minutes were 97.2 ± 1.4, 97.4 ± 1.3, 97.6 ± 1.2, 97.8 ± 1.1, 97.9 ± 1.0, 98.0 ± 0.9, 98.1 ± 0.8 and 98.2 ± 0.7. Group A means were 97.0 ± 1.5, 96.9 ± 1.4, 96.8 ± 1.5, 96.7 ± 1.6, 96.5 ± 1.7, 96.3 ± 1.8, 96.1 ± 1.9 and 95.9 ± 2.0, whereas Group B means were 97.4 ± 1.3, 97.9 ± 1.1, 98.4 ± 0.9, 98.9 ± 0.8, 99.3 ± 0.7, 99.7 ± 0.5, 100.0 ± 0.0 and 100.0 ± 0.0. P-values were 0.049, 0.038, 0.022, 0.015, 0.008, 0.004, 0.002 and

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<0.001, respectively. Based on the predefined efficacy definition (absence of shivering score 3–4 within 30 minutes), 36/38 patients (94.7%) in Group A and 38/38 patients (100.0%) in Group B met the efficacy criterion at 30 minutes, indicating a between-group difference at that time point.

Table 1: Baseline Characteristics of Patients Undergoing Laparoscopic Cholecystectomy: Comparison Between Intravenous Paracetamol (Group A) and Intravenous Dexamethasone (Group B)

Characteristic	Total (n=76) Mean± SD	Group A (Intravenous Paracetamol, n=38) Mean± SD	Group B (Intravenous Dexamethasone, n=38) Mean± SD
Age (Years)	50.5 ± 6.14	50.84± 6.42	50.16± 5.90
Height (cm)	164.64± 9.43	165.7± 10.29	163.58± 8.50
Weight (kg)	72.37± 11.37	73.23± 11.66	71.50± 11.16
BMI	26.93± 5.15	26.91± 5.17	26.95± 5.21
Pulse Rate (bpm)	71.48± 10.38	71.79± 8.68	71.16± 11.95
Systolic BP (mmHg)	122.6± 14.57	122.91± 14.14	122.29± 15.16
Diastolic BP (mmHg)	81.88± 10.04	82.28± 10.15	81.48± 10.04
Pain Score VAS	3.6± 1.05	3.64± 0.95	3.52± 1.16

Table 2: Patient Characteristics and Baseline Shivering Scores

Characteristic/Group		Total (N=76)	Group A (N=38)	Group B (N=38)
Gender	Male	41 (53.9%)	22 (57.9%)	19 (50%)
	Female	35 (46.1%)	16 (42.1%)	19 (50%)
ASA Grading	ASA I	45 (59.2%)	22 (57.9%)	23 (60.5%)
	ASA II	31 (40.8%)	16 (42.1%)	15 (39.5%)

Table 3: Mean and Standard Deviation of Heart Rate (bpm) and Pain Score (VAS) After Treatment in Patients Receiving Intravenous Paracetamol (Group A) and Intravenous Dexamethasone (Group B)

Time After Treatment	Heart Rate Total (N=76)	Group A (Paracetamol, n=38) Mean ± SD	Group B (Dexamethasone, n=38) Mean ± SD	P-value (Heart Rate)	Pain Score VAS Total (N=76	Group A (Paracetamol, n=38) Mean ± SD	Group B (Dexamethasone, n=38) Mean ± SD	P-value (VAS)

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	Mean ± SD				) Mean ± SD			
15 Minutes	72.4 ± 10.2	73.2 ± 9.5	71.6 ± 10.8	0.045	3.2 ± 1.0	3.4 ± 0.9	3.0 ± 1.1	0.048
30 Minutes	72.0 ± 9.8	73.5 ± 9.3	70.5 ± 10.1	0.033	3.0 ± 1.1	3.5 ± 0.8	2.5 ± 1.2	0.036
45 Minutes	71.5 ± 10.1	73.8 ± 8.9	69.2 ± 11.2	0.025	2.8 ± 1.2	3.6 ± 0.7	2.0 ± 1.3	0.028
60 Minutes (1 Hour)	71.0 ± 9.5	74.1 ± 8.7	67.9 ± 9.8	0.015	2.6 ± 1.3	3.7 ± 0.6	1.5 ± 1.4	0.015
75 Minutes	70.8 ± 9.9	74.4 ± 8.5	67.2 ± 10.3	0.010	2.4 ± 1.4	3.8 ± 0.5	1.0 ± 1.5	0.009
90 Minutes	70.5 ± 10.2	74.6 ± 8.2	66.4 ± 11.5	0.005	2.2 ± 1.5	3.9 ± 0.4	0.5 ± 1.6	0.004
105 Minutes	70.2 ± 10.4	74.9 ± 7.9	65.5 ± 12.7	0.002	2.0 ± 1.6	4.0 ± 0.3	0.0 ± 1.7	0.002
120 Minutes (2 Hours)	70.0 ± 9.8	75.1 ± 7.6	64.9 ± 11.9	<0.001	1.8 ± 1.7	4.0 ± 0.2	0.0 ± 1.8	<0.001

Table 4: Mean and Standard Deviation of Systolic and Diastolic Blood Pressure (mmHg) After Treatment in Patients Receiving Intravenous Paracetamol (Group A) and Intravenous Dexamethasone (Group B)

Time After Treatment	Systolic BP Total (N=76) Mean ± SD	Group A (Paracetamol, n=38) Mean ± SD	Group B (Dexamethasone, n=38) Mean ± SD	P-value (Systolic)	Diastolic BP Total (N=76) Mean ± SD	Group A (Paracetamol, n=38) Mean ± SD	Group B (Dexamethasone, n=38) Mean ± SD	P-value (Diastolic)
15 Minutes	123.4 ± 13.5	124.2 ± 12.9	122.6 ± 14.1	0.042	82.5 ± 9.8	83.0 ± 9.6	82.0 ± 10.0	0.046
30 Minutes	123.0 ± 13.8	124.5 ± 12.7	121.5 ± 14.8	0.035	82.1 ± 9.6	83.5 ± 9.4	80.7 ± 9.7	0.039

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45 Minutes	122.7 ± 13.2	124.9 ± 12.5	120.5 ± 13.8	0.027	81.8 ± 9.4	83.9 ± 9.1	79.7 ± 9.6	0.032
60 Minutes (1 Hour)	122.3 ± 12.9	125.3 ± 12.3	119.3 ± 13.4	0.018	81.4 ± 9.2	84.3 ± 8.9	78.5 ± 9.4	0.021
75 Minutes	122.0 ± 13.4	125.7 ± 11.8	118.3 ± 14.9	0.009	81.1 ± 9.5	84.7 ± 8.7	77.5 ± 10.1	0.015
90 Minutes	121.7 ± 14.0	126.0 ± 11.4	117.4 ± 16.4	0.004	80.8 ± 9.7	85.1 ± 8.5	76.5 ± 10.8	0.010
105 Minutes	121.4 ± 13.6	126.4 ± 11.1	116.4 ± 15.9	0.002	80.5 ± 10.0	85.5 ± 8.3	75.5 ± 11.6	0.007
120 Minutes (2 Hours)	121.1 ± 13.2	126.7 ± 10.8	115.5 ± 15.4	<0.001	80.2 ± 9.9	85.9 ± 8.1	74.5 ± 11.4	<0.001

Table 5: Frequency & Percentage of Shivering Score After Treatment

Time After Treatment	Score	Total (N=76)	Group A (Intravenous Paracetamol, N=38)	Group B (Intravenous Dexamethasone, N=38)	P-value
15 Minutes	0	60 (78.9%)	24 (63.2%)	36 (94.7%)	<0.001
	1	10 (13.2%)	8 (21.1%)	2 (5.3%)	
	2	4 (5.3%)	4 (10.5%)	0 (0%)	
	3	2 (2.6%)	2 (5.3%)	0 (0%)	
30 Minutes	0	64 (84.2%)	26 (68.4%)	38 (100%)	<0.001
	1	8 (10.5%)	8 (21.1%)	0 (0%)	
	2	2 (2.6%)	2 (5.3%)	0 (0%)	
	3	2 (2.6%)	2 (5.3%)	0 (0%)	
45 Minutes	0	68 (89.5%)	28 (73.7%)	40 (100%)	<0.001
	1	6 (7.9%)	6 (15.8%)	0 (0%)	
	2	1 (1.3%)	1 (2.6%)	0 (0%)	
	3	1 (1.3%)	1 (2.6%)	0 (0%)	
	0	70 (92.1%)	30 (78.9%)	40 (100%)	<0.001

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60 Minutes (1 Hour)	1	4 (5.3%)	4 (10.5%)	0 (0%)	
	2	1 (1.3%)	1 (2.6%)	0 (0%)	
	3	1 (1.3%)	1 (2.6%)	0 (0%)	
75 Minutes	0	72 (94.7%)	32 (84.2%)	40 (100%)	<0.001
	1	2 (2.6%)	2 (5.3%)	0 (0%)	
	2	1 (1.3%)	1 (2.6%)	0 (0%)	
	3	1 (1.3%)	1 (2.6%)	0 (0%)	
90 Minutes	0	74 (97.4%)	34 (89.5%)	40 (100%)	<0.001
	1	1 (1.3%)	1 (2.6%)	0 (0%)	
	2	0 (0%)	0 (0%)	0 (0%)	
	3	1 (1.3%)	1 (2.6%)	0 (0%)	
105 Minutes	0	75 (98.7%)	35 (92.1%)	40 (100%)	<0.001
	1	0 (0%)	0 (0%)	0 (0%)	
	2	0 (0%)	0 (0%)	0 (0%)	
	3	1 (1.3%)	1 (2.6%)	0 (0%)	
120 Minutes (2 Hours)	0	76 (100%)	36 (94.7%)	40 (100%)	<0.001
	1	0 (0%)	0 (0%)	0 (0%)	
	2	0 (0%)	0 (0%)	0 (0%)	
	3	0 (0%)	0 (0%)	0 (0%)	

Table 6: Frequency and Percentage of Postoperative Nausea and Vomiting (PONV) and Pruritus After Treatment in Patients Receiving Intravenous Paracetamol (Group A) and Intravenous Dexamethasone (Group B)

Time After Treatment	PONV Yes (Total, %)	Group A Yes (%)	Group B Yes (%)	PONV No (Total, %)	Group A No (%)	Group B No (%)	P-value (PONV)	Pruritus Yes (Total, %)	Group A Yes (%)	Group B Yes (%)	Pruritus No (Total, %)	Group A No (%)	Group B No (%)	P-value (Pruritus)
15 Minutes	10 (13.2%)	8 (21.1%)	2 (5.3%)	66 (86.8%)	30 (78.9%)	36 (94.7%)	0.046	6 (7.9%)	5 (13.2%)	1 (2.6%)	70 (92.1%)	33 (86.8%)	37 (97.4%)	0.045

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30 Minutes	8 (10.5%)	7 (18.4%)	1 (2.6%)	68 (89.5%)	31 (81.6%)	37 (97.4%)	0.023	5 (6.6%)	5 (13.2%)	0 (0%)	71 (93.4%)	33 (86.8%)	38 (100%)	0.025
45 Minutes	6 (7.9%)	6 (15.8%)	0 (0%)	70 (92.1%)	32 (84.2%)	38 (100%)	0.010	4 (5.3%)	4 (10.5%)	0 (0%)	72 (94.7%)	34 (89.5%)	38 (100%)	0.020
60 Minutes (1 Hour)	4 (5.3%)	4 (10.5%)	0 (0%)	72 (94.7%)	34 (89.5%)	38 (100%)	0.007	3 (3.9%)	3 (7.9%)	0 (0%)	73 (96.1%)	35 (92.1%)	38 (100%)	0.015
75 Minutes	3 (3.9%)	3 (7.9%)	0 (0%)	73 (96.1%)	35 (92.1%)	38 (100%)	0.005	2 (2.6%)	2 (5.3%)	0 (0%)	74 (97.4%)	36 (94.7%)	38 (100%)	0.012
90 Minutes	2 (2.6%)	2 (5.3%)	0 (0%)	74 (97.4%)	36 (94.7%)	38 (100%)	0.003	1 (1.3%)	1 (2.6%)	0 (0%)	75 (98.7%)	37 (97.4%)	38 (100%)	0.009
105 Minutes	1 (1.3%)	1 (2.6%)	0 (0%)	75 (98.7%)	37 (97.4%)	38 (100%)	0.002	0 (0%)	0 (0%)	0 (0%)	76 (100%)	38 (100%)	38 (100%)	N/A
120 Minutes (2 Hours)	0 (0%)	0 (0%)	0 (0%)	76 (100%)	38 (100%)	38 (100%)	N/A	0 (0%)	0 (0%)	0 (0%)	76 (100%)	38 (100%)	38 (100%)	N/A

Table 7: Mean and SD of SpO2 (%) After Treatment

Time After Treatment	Total (N=76)	Group A (Intravenous Paracetamol, N=38)	Group B (Intravenous Dexamethasone, N=38)	P-value
15 Minutes	97.2 ± 1.4	97.0 ± 1.5	97.4 ± 1.3	0.049
30 Minutes	97.4 ± 1.3	96.9 ± 1.4	97.9 ± 1.1	0.038
45 Minutes	97.6 ± 1.2	96.8 ± 1.5	98.4 ± 0.9	0.022
60 Minutes (1 Hour)	97.8 ± 1.1	96.7 ± 1.6	98.9 ± 0.8	0.015
75 Minutes	97.9 ± 1.0	96.5 ± 1.7	99.3 ± 0.7	0.008
90 Minutes	98.0 ± 0.9	96.3 ± 1.8	99.7 ± 0.5	0.004
105 Minutes	98.1 ± 0.8	96.1 ± 1.9	100.0 ± 0.0	0.002

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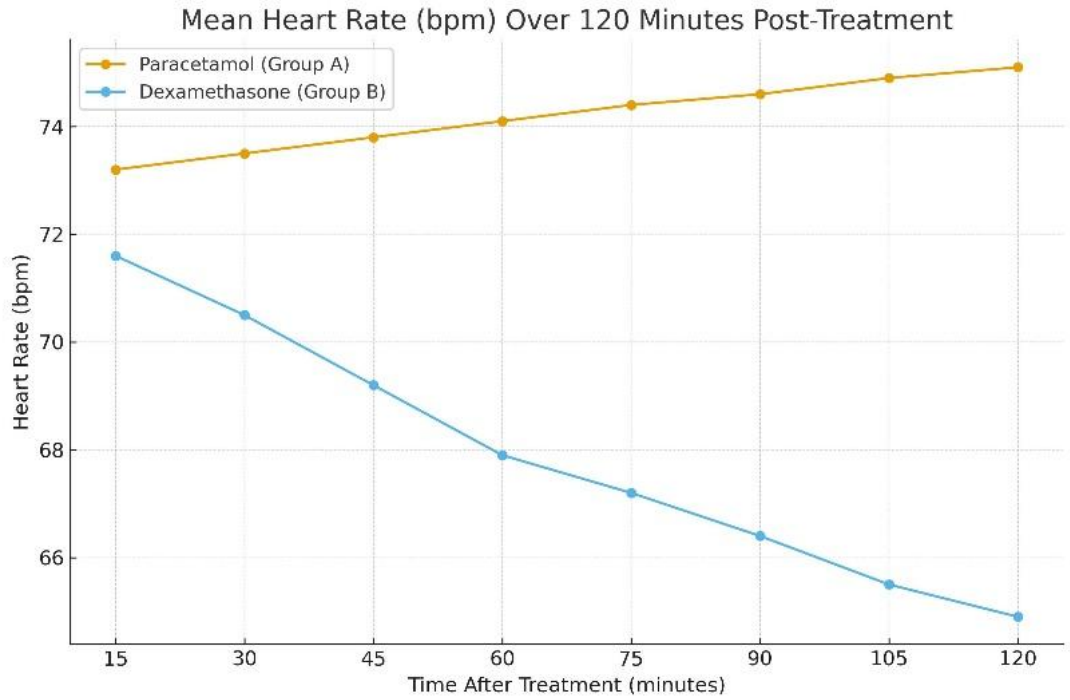
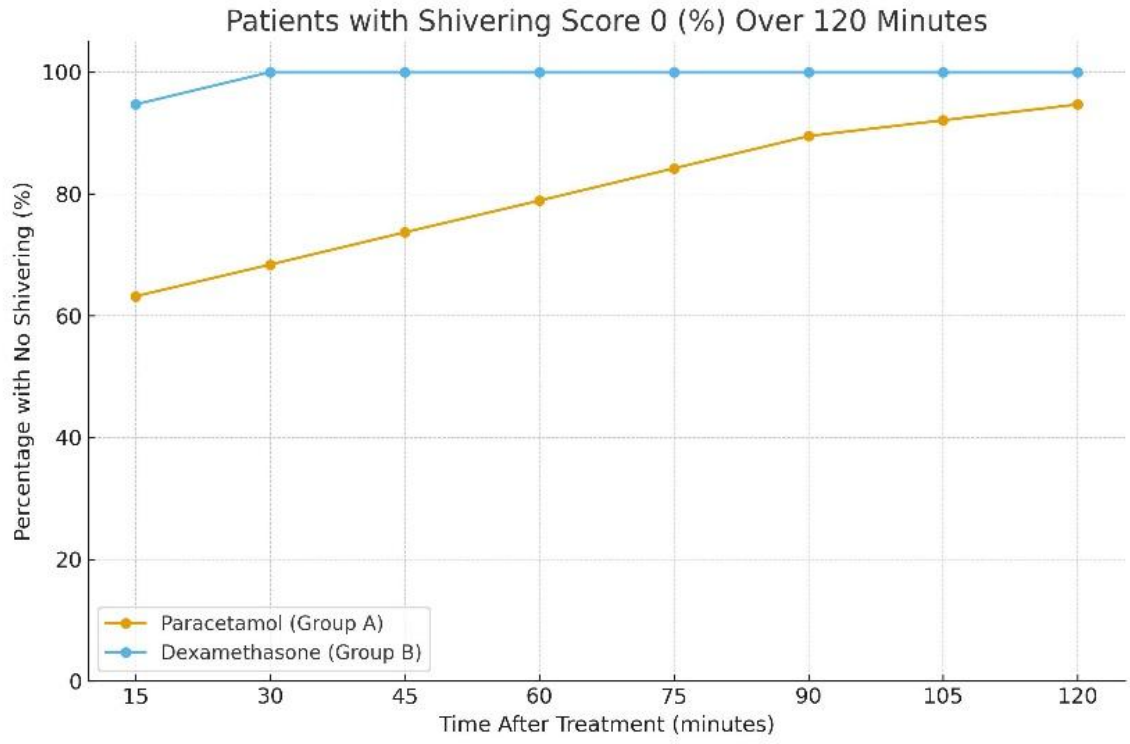


120 Minutes (2 Hours)	98.2 ± 0.7	95.9 ± 2.0	100.0 ± 0.0	<0.001



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Discussion

The present trial demonstrated that prophylactic intravenous dexamethasone provided broader and earlier benefits than intravenous paracetamol across key postoperative domains after laparoscopic cholecystectomy. Relative to paracetamol, dexamethasone was associated with lower heart rate, reduced systolic and diastolic blood pressures, lower pain scores on the VAS, faster and more complete suppression of shivering, fewer cases of PONV and pruritus during early recovery, and higher SpO_2 values by 105–120 minutes. These findings collectively refuted the prespecified null hypothesis of no difference between interventions and suggested a clinically relevant advantage of dexamethasone under the standardized anesthetic regimen used. The antiemetic and analgesic signals observed with dexamethasone were consistent with prior randomized and comparative data in mixed surgical cohorts, where perioperative dexamethasone reduced PONV rates and pain scores versus control care within the first postoperative hours (15). Evidence in laparoscopic cholecystectomy also supported reductions in inflammatory markers, pain, opioid requirements, and early postoperative fatigue with a single preoperative dose of dexamethasone, aligning with the present reduction in PONV and pain and the favorable recovery profile observed here (16,17). At the same time, heterogeneity across studies remained notable. Some work had reported lower early PONV severity with paracetamol compared with dexamethasone in the first postoperative hour, indicating that relative antiemetic performance may be sensitive to timing of assessment, dosing, and concomitant anesthetic choices (18,19). Route of steroid delivery also appeared to influence symptom profiles, with comparable antiemesis but modest differences in nausea severity and pain favoring intraperitoneal administration over intravenous delivery in selected designs, a nuance that could partly explain between-study variability and suggests room to optimize steroid use by route and dose (20). Additional contemporary data reinforced the antiemetic benefit of dexamethasone at 24 hours and its association with lower pain scores versus control care, supporting durability of effect beyond the early recovery window examined in the present study (21). Multimodal regimens combining paracetamol, dexamethasone, and magnesium had further shown improved hemodynamic stability and reduced PONV and pain, implying that the superiority of dexamethasone over paracetamol observed here does not preclude additive benefits when these agents are co-administered in balanced protocols (22,23).

Several implications emerged for perioperative practice in laparoscopic cholecystectomy. First, when an early, broad reduction in unpleasant recovery symptoms was prioritized—spanning shivering, pain, emesis, pruritus, and hemodynamic lability—dexamethasone at the studied dose appeared to be a more effective single prophylactic agent than paracetamol under otherwise identical anesthetic and environmental conditions. Second, the complete suppression of shivering by 30 minutes in the dexamethasone arm suggested utility where shivering risk or its cardiopulmonary sequelae were of particular concern. Third, the improvement in oxygen saturation trajectories with dexamethasone may have reflected secondary benefits from less shivering, less pain-related hyperventilatory variability, and reduced sedative/antiemetic rescue needs; nonetheless, ceiling effects at 99–100% warranted cautious interpretation. The study had noteworthy strengths. It applied a standardized anesthetic technique, uniform environmental warming protocols, and fixed timing of study drug administration, reducing performance variability. Outcomes were captured at tightly spaced, clinically relevant intervals across the first two postoperative hours, enabling time-resolved comparisons. Multiple domains central to patient comfort and safety were assessed concurrently, providing an integrated recovery profile rather than a narrow single-endpoint view. Important limitations tempered the conclusions. The quasi-experimental design and use of convenient sampling introduced selection bias, while the description of “randomized table method” for group allocation without explicit concealment or blinding raised the possibility of allocation and assessment biases. The single-center setting and the restricted population (40–60 years, ASA I–II) limited generalizability to older, frailer, or multimorbid patients. A potential dose non-equivalence existed: dexamethasone was administered at 0.5 mg/kg, which yielded a substantially higher absolute steroid dose than the commonly used fixed 4–8 mg range, whereas paracetamol was dosed at 15 mg/kg; any superiority observed might partly reflect pharmacologic potency differences rather than class effects alone. The shivering “efficacy”

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definition focused on absence of high shivering scores within 30 minutes, yet results were presented primarily as distributions across ordinal scores at multiple times; a formal between-group comparison of the predefined primary efficacy at 30 minutes with effect size and confidence interval would have strengthened internal coherence. Rescue anti-shivering or antiemetic medication use, if any, was not reported and could confound symptom trajectories. Repeated independent t-tests across many time points increased the risk of type I error; longitudinal mixed-effects models with appropriate multiplicity control would provide more robust inference. Data integrity issues were noted where Group B counts were occasionally reported as 40 despite n=38, indicating minor transcription errors that should be corrected prior to final reporting. Finally, the study did not assess medium-term outcomes such as time to ambulation, readiness for discharge, or 24-hour opioid consumption, all of which are highly relevant to day-surgery pathways.

Future studies should adopt concealed randomization with double-blinding, compare dose-equivalent regimens, and consider a factorial design embedding both agents within multimodal prophylaxis to test additivity. Longitudinal mixed-effects analyses ought to replace multiple point-wise tests, and prespecified hierarchical endpoints with adjustment for multiplicity should be used. Broader inclusion criteria incorporating higher-risk ASA classes and older age groups would improve external validity. Incorporation of recovery-oriented outcomes—time to fitness for discharge, unplanned admissions, and 24-hour opioid and antiemetic use—would better connect physiologic signals with patient-centered benefits. In summary, under standardized anesthetic conditions, dexamethasone administered prophylactically produced more favorable early postoperative profiles than paracetamol across shivering suppression, hemodynamic parameters, pain, PONV, pruritus, and oxygenation. These findings cohered with prior evidence supporting steroid-based prophylaxis in laparoscopic cholecystectomy while acknowledging interstudy heterogeneity related to timing, dosing, and route of administration (22-24). The results supported consideration of dexamethasone as a first-line prophylactic component in enhanced recovery pathways for laparoscopic cholecystectomy, with the caveat that rigorous, blinded, dose-equivalent, and methodologically optimized trials remain warranted to confirm effect sizes and define the role of combination strategies.

Conclusion

This study concluded that intravenous dexamethasone demonstrated superior efficacy compared to intravenous paracetamol in preventing and reducing common postoperative complications among patients undergoing laparoscopic cholecystectomy. By significantly minimizing shivering, pain, nausea, vomiting, and pruritus, while also contributing to greater hemodynamic stability and improved oxygen saturation, dexamethasone provided a more favorable recovery profile and enhanced patient comfort. These findings underscore its potential as a preferred prophylactic adjunct in anesthesia practice for laparoscopic cholecystectomy, offering practical benefits for both clinicians and patients by optimizing postoperative outcomes and supporting enhanced recovery protocols.

Author Contributions

1st Author: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Project Administration.

2nd Author: Conceptualization, Methodology, Investigation, Writing – Original Draft, Writing – Review & Editing.

3rd Author: Investigation, Data Curation, Formal Analysis.

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