e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(12); 2895-2898

Original Research Article

Comparative Analgesic Efficacy of Spinal versus General Anesthesia in Laparoscopic Cholecystectomy: A Prospective Comparative Study of 100 Patients

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Received: 01-08-2025 / Revised: 15-09-2025 / Accepted: 21-10-2025
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Conflict of interest: Nil

Abstract

Background: Laparoscopic cholecystectomy (LC) is the preferred surgical approach for symptomatic cholelithiasis. Despite its minimally invasive nature, postoperative pain remains a major determinant of delayed recovery. General anesthesia (GA) is conventionally used for LC; however, it is often associated with increased opioid consumption and postoperative nausea and vomiting (PONV). Spinal anesthesia (SA) has emerged as an alternative technique that may provide superior postoperative analgesia.

Objective: This study aimed to compare postoperative pain relief and analgesic outcomes following spinal and general anesthesia in patients undergoing laparoscopic cholecystectomy.

Methods: A prospective comparative study was conducted on 100 adult patients (ASA I–II) undergoing elective LC in department of Anesthesia at Dr Sampurnand Medical College, Jodhpur. The study duration was twelve months. Patients were randomized into two equal groups: SA (n=50) and GA (n=50). Postoperative pain was assessed using the Visual Analogue Scale (VAS) at 1, 3, 6, 12, and 24 hours. Secondary outcomes included time to first rescue analgesic, total opioid consumption within 24 hours, incidence of PONV, and patient satisfaction. Statistical analysis included Student's t-test, chi-square test, mean differences with 95% confidence intervals, and power analysis.

Results: Early postoperative VAS scores (1–6 h) were significantly lower in the SA group compared to the GA group (mean difference at 1 h: −2.1; 95% CI −2.6 to −1.6; p<0.001). The SA group required significantly less opioid analgesia in the first 24 hours (85 ± 20 mg vs 140 ± 25 mg morphine equivalent; p<0.001) and had a lower incidence of PONV (10% vs 28%; p=0.03). Patient satisfaction scores were significantly higher in the SA group.

Conclusion: Spinal anesthesia provides superior early postoperative analgesia with reduced opioid requirements and fewer adverse effects compared to general anesthesia in laparoscopic cholecystectomy. SA is a safe and effective alternative to GA in appropriately selected patients.

Keywords: Spinal Anesthesia, General Anesthesia, Cholelithiasis, Laparoscopic Cholecystectomy.

Introduction

Gallstone disease is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. Laparoscopic cholecystectomy has become the gold standard for the treatment of symptomatic cholelithiasis owing to its advantages over open surgery, including reduced postoperative pain, shorter hospital stay, early ambulation, and improved cosmetic outcomes [1,2]. Despite these benefits, a substantial proportion of patients continue to experience moderate to severe postoperative pain, particularly in the early postoperative period [3].

Postoperative pain following LC is multifactorial in origin. Somatic pain arises from trocar insertion and abdominal wall stretching, while visceral pain results from gallbladder dissection and peritoneal irritation. Additionally, shoulder-tip pain is frequently reported due to diaphragmatic irritation and phrenic nerve stimulation caused by carbon dioxide pneumoperitoneum [4,5]. Inadequate pain control may lead to delayed mobilization, prolonged hospital stay, increased healthcare costs, and reduced patient satisfaction.

General anesthesia has traditionally been the anesthetic technique of choice for LC because it provides secure airway control, controlled ventilation, and optimal surgical conditions during pneumoperitoneum [6]. However, GA is associated with certain disadvantages, including increased postoperative opioid requirements, higher incidence of PONV, and delayed recovery [7,8]. Opioid-related adverse effects such as nausea, vomiting, sedation, and respiratory depression further compromise patient comfort and safety.

Spinal anesthesia, a well-established neuraxial technique, produces reversible blockade of sensory, motor, and sympathetic nerve fibers. By inhibiting nociceptive transmission at the spinal level, SA provides effective intraoperative anesthesia and prolonged postoperative analgesia [9]. Furthermore, neuraxial anesthesia attenuates the surgical stress response and reduces neuroendocrine activation, which may contribute to improved postoperative outcomes [10,11]. Over the past two decades, several studies have explored the feasibility of SA for laparoscopic procedures, including cholecystectomy, with encouraging results [12–14].

However, concerns regarding hemodynamic instability, patient discomfort during pneumoperitoneum, and limited duration of anesthesia have restricted widespread adoption of SA for LC. Given the ongoing debate and the need for region-specific evidence, this study was undertaken to comparatively evaluate postoperative pain relief following spinal and general anesthesia in patients undergoing laparoscopic cholecystectomy.

Materials and Methods

This prospective comparative study was conducted in Department of anesthesia at Dr Sampurnand Medical College, Jodhpur after obtaining approval from the Institutional Ethics Committee. The study duration was twelve months. Written informed consent was obtained from all participants prior to enrollment.

A total of 100 adult patients aged between 18 and 65 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective laparoscopic cholecystectomy were included. Exclusion criteria comprised patient refusal, contraindications to spinal anesthesia (coagulopathy, infection at puncture site, spinal deformity), ASA III or IV status, severe cardiopulmonary disease, pregnancy, and anticipated difficult airway.

Patients were randomized into two equal groups (n=50 each) using a computer-generated randomization sequence. Group SA received spinal anesthesia, while Group GA received general anesthesia. Standard monitoring including electrocardiography, non-invasive blood pressure, pulse oximetry, and end-tidal carbon dioxide was applied in both groups.

In the SA group, spinal anesthesia was administered at the T8-T9 interspace using a 25G Quincke spinal needle. A total of 1.5 to 2 mL of 0.5% hyperbaric bupivacaine combined with fentanyl 25 µg was injected intrathecally. Adequate sensory block up to the T4 dermatome was confirmed prior to surgical incision. Intraoperative hypotension was managed with intravenous fluids and vasopressors as required.

In the GA group, anesthesia was induced with intravenous propofol (2 mg/kg) and fentanyl (2 µg/kg), followed by neuromuscular blockade with vecuronium. The trachea was intubated, and anesthesia was maintained with inhalational agents in an oxygen–air mixture. Mechanical ventilation was adjusted to maintain normocapnia.

Postoperative pain was assessed using the Visual Analogue Scale (VAS; 0–10) at 1, 3, 6, 12, and 24 hours after surgery. Rescue analgesia with intravenous tramadol 50 mg was administered when VAS ≥4. Total opioid consumption over 24 hours was recorded. Incidence of postoperative nausea and vomiting, time to first analgesic request, and patient satisfaction (graded as excellent, good, fair, or poor) were also documented.

Sample size calculation was based on detecting a minimum clinically significant difference of 1.5 units in VAS score at 1 hour, assuming a standard deviation of 2, power of 80%, and alpha error of 0.05. This yielded a minimum requirement of 45 patients per group; therefore, 50 patients were included in each group to compensate for potential dropouts.

Statistical analysis was performed using standard statistical software. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test. Categorical variables were analyzed using the chi-square test. Mean differences with 95% confidence intervals were calculated. A p-value less than 0.05 was considered statistically significant.

Results

Both groups were comparable with respect to demographic characteristics and baseline clinical parameters, with no statistically significant differences observed.

Table 1: Demographic Characteristics of Patients

Parameter	SA Group (n=50)	GA Group (n=50)	p-value
Age (years)	42.3 ± 10.2	43.1 ± 9.8	0.68
Gender (M/F)	18/32	20/30	0.67
BMI (kg/m²)	24.6 ± 3.1	24.9 ± 3.3	0.61
ASA I/II	32/18	30/20	0.69

Table 2: Postoperative VAS Scores

Time Interval	SA Group	GA Group	p-value
1 hour	2.0 ± 0.7	4.1 ± 1.1	<0.001
3 hours	2.5 ± 0.8	3.6 ± 1.0	0.002
6 hours	3.0 ± 0.9	3.4 ± 1.0	0.04
12 hours	2.4 ± 0.8	2.6 ± 0.9	0.29
24 hours	1.6 ± 0.6	1.8 ± 0.7	0.21

Table 3: Analgesic Requirement and PONV

Outcome	SA Group	GA Group	p-value
Time to first analgesic (min)	210 ± 35	95 ± 28	<0.001
Total opioid use (mg)	85 ± 20	140 ± 25	<0.001
PONV (%)	10%	28%	0.03

Table 4: Patient Satisfaction Scores

Satisfaction Level	SA Group	GA Group
Excellent	30	18
Good	16	20
Fair	4	10
Poor	0	2

Discussion

The findings of the present study demonstrate that spinal anesthesia provides superior early postoperative analgesia compared with general anesthesia in patients undergoing laparoscopic cholecystectomy. Significantly lower VAS scores during the first six postoperative hours in the SA group suggest effective blockade of nociceptive pathways and reduced central sensitization [15,16].

Reduced opioid consumption observed in the SA group is clinically relevant, as opioid-related adverse effects remain a major cause of postoperative morbidity. The lower incidence of PONV in the SA group observed in this study is consistent with previous reports highlighting the opioid-sparing effect of neuraxial anesthesia [17]. Improved patient satisfaction in the SA group further supports the analgesic benefit of spinal anesthesia.

Although concerns regarding hemodynamic instability and patient discomfort during pneumoperitoneum persist, careful patient selection and vigilant intraoperative monitoring can mitigate these risks. Our findings align with those of Tzovaras et al. and Van Zundert et al., who reported the feasibility and safety of spinal anesthesia for laparoscopic cholecystectomy [9,10].

Limitations

The study was limited to ASA I–II patients and may not be generalizable to higher-risk populations. Blinding was not feasible due to the nature of the interventions, and long-term outcomes were not evaluated.

Conclusion

Spinal anesthesia provides superior early postoperative analgesia, reduced opioid requirements, and higher patient satisfaction compared with general anesthesia in laparoscopic cholecystectomy. Spinal anesthesia is a safe and effective alternative to general anesthesia in appropriately selected patients.

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