e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.7.46

International Journal of Pharmaceutical Quality Assurance 2025; 16(7); 289-293

Original Research Article

Comparison of Segmental Thoracic Spinal Anaesthesia Versus General Anaesthesia in Laparoscopic Cholecystectomy: A Comparative Study

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Received: 27-05-2025 / Revised: 25-06-2025 / Accepted: 27-07-2025

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Conflict of interest: Nil

Abstract:

Background: Laparoscopic cholecystectomy is generally considered the best way to remove the gallbladder. Traditionally conducted under general anaesthesia (GA), recent innovations have investigated segmental thoracic spinal anaesthesia (STSA) as a feasible alternative. STSA has demonstrated efficacy in delivering sufficient anaesthesia while enhancing postoperative results, such as diminished pain and abbreviated hospital duration.

Objective: To evaluate the effects of general anaesthesia and segmental thoracic spinal anaesthesia on the intraoperative and postoperative outcomes of patients having laparoscopic cholecystectomy.

Methods: The work was executed over one year at a tertiary care centre, with the sample size established through power analysis (n = 100, 50 per group). Two groups of patients between the ages of 18 and 60 who had planned for laparoscopic cholecystectomy were randomly assigned: Group T received segmental thoracic spinal anaesthesia, while Group G received general anaesthesia. Intraoperative haemodynamics, complications, surgery duration, postoperative pain (VAS score), nausea/vomiting, shoulder pain, and patient satisfaction were evaluated.

Results: STSA was linked to much lower postoperative pain scores at 1, 6, and 12 hours after surgery ($p < 0.001$). Group T had a lower rate of nausea and vomiting after surgery (12% vs. 36%; $p = 0.006$), higher patient satisfaction, and earlier mobilisation. The intraoperative haemodynamics were similar in both groups. In Group T, 2 patients (4%) had to switch to GA. There were no serious side effects reported.

Conclusion: For laparoscopic cholecystectomy, segmental thoracic spinal anaesthesia is a safe and effective substitute for general anaesthesia, offering better postoperative pain control, reduced postoperative nausea and vomiting (PONV), and enhanced patient recovery. However, appropriate patient selection and anaesthesia skills are crucial.

Keywords: Segmental Thoracic Spinal Anaesthesia, Postoperative Pain, General Anaesthesia, PONV, Patient Satisfaction, Laparoscopic Cholecystectomy.

Introduction

Laparoscopic cholecystectomy (LC) is the most frequently executed minimally invasive surgical technique for the treatment of symptomatic cholelithiasis and gallbladder disorders. Since it started, it has mostly been done under general anaesthesia (GA), which makes sure that the patient can breathe properly, protects their airway, and relaxes their muscles during pneumoperitoneum and positioning. Nonetheless, GA has its drawbacks, especially regarding postoperative nausea and vomiting (PONV), prolonged recovery, airway complications, and resource allocation (Hamad & El-Kady et al., 2009). These factors have led anaesthesiologists and surgeons to investigate regional anaesthetic techniques as alternative methods for certain patient demographics.

Segmental thoracic spinal anaesthesia (STSA) is a new method that involves giving local anaesthetic to the thoracic intrathecal space to numb specific dermatomes that are involved in the surgery (Sinha et al., 2021). STSA was previously avoided because of worries about possible spinal cord injury, but new methods and real-time guidance have made it a safe and possible option. It helps keep spontaneous breathing going, lowers the need for systemic opioids, lowers the stress response, and improves pain relief after surgery. STSA has also shown promise in lowering the risk of postoperative ileus, making it easier to get up and move around early, and shortening the length of hospital stays. These are all goals of enhanced recovery after surgery (ERAS) protocols.

Prior research has demonstrated that STSA can yield a surgical field analogous to GA during laparoscopic procedures, characterised by stable intraoperative haemodynamics and diminished neurohumoral response. It avoids the bad effects of endotracheal intubation and volatile anaesthetics, which can be very helpful for people who have trouble breathing or have other serious health problems. The lower levels of PONV and pain after surgery also make patients happier and lead to better overall outcomes after surgery.

Even though STSA has these benefits, it is not widely used in laparoscopic surgery because of technical issues, worries about complications, and a lack of experience. The literature comparing STSA and GA in laparoscopic cholecystectomy is still developing, especially in the Indian clinical setting, where resource optimisation and swift patient turnover are critical factors.

In this study, individuals undergoing elective laparoscopic cholecystectomy will have their segmental thoracic spinal anaesthesia and general anaesthesia prospectively compared. Postoperative pain (as assessed by the Visual Analogue Scale), PONV, haemodynamic stability, intraoperative events, and patient satisfaction are the primary outcomes examined. In order to support the broader use of regional procedures in minimally invasive operations, where appropriate, this study intends to evaluate the safety profile and efficacy of STSA without endangering patient safety or surgical conditions.

Methodology

Design of the Study: This was an investigation conducted over a duration of one year at a tertiary care hospital. The study sought to compare intraoperative and postoperative outcomes between segmental thoracic spinal anaesthesia (STSA) and general anaesthesia (GA) in people having elective laparoscopic cholecystectomy.

Sample Size and Population: One hundred patients were enrolled and randomly categorized into two equal groups:

- Group T (n = 50): Patients undergoing STSA
- Group G (n = 50): Patients undergoing GA

We used power analysis (power = 80%, $\alpha = 0.05$) to figure out the sample size based on what we thought the differences in postoperative pain scores would be based on pilot studies and previous research.

Inclusion Criteria

- People who are within the ages of 18 and 60
- Physical Status I or II on the ASA scale
- Scheduled for laparoscopic cholecystectomy as an option
- BMI between 18 and 30 kg/m²
- Permission to take part in the research

Criteria of Exclusion

- Patient denial for research
- Grade III or higher on the ASA scale
- A history of spinal deformity or coagulopathy
- Reasons not to use spinal or general anaesthesia
- Being pregnant or breastfeeding
- Surgery in an emergency
- Allergy to local anaesthetics

Preoperative Preparation: All patients had a normal pre-anesthesia check-up and lab tests. Written consent was obtained with full knowledge. They were not allowed to eat or drink anything for 6 hours before the surgery and were given midazolam 0.02 mg/kg IV and ondansetron 4 mg IV beforehand.

Randomization and Grouping: Using computer-generated random numbers and sealed opaque envelopes, random allocation was done.

Anaesthetic Technique

Group T: Segmental Thoracic Spinal Anaesthesia

- Patient is sitting up.
- A 26G Quincke needle was used to do a thoracic spinal puncture at T8–T9 or T9–T10 while taking aseptic precautions.
- 2.5 mL of 0.5% hyperbaric bupivacaine was given through the intrathecal route.
- The pinprick method was used to check the block level, and surgery began after the sensory block from T4 to L1 was achieved.
- Nasal prongs were used to give extra oxygen at a rate of 3 L/min.
- If necessary, IV midazolam was used to sedate the patient.

Group G: General Anaesthesia

- Induction using propofol at 2 mg/kg, fentanyl at 2 μg/kg, and rocuronium at 0.6 mg/kg.
- Oxygen, nitrous oxide, and isoflurane were used to keep the patient stable, along with rocuronium doses given at random times.
- They put a tube down the person's throat and started mechanical ventilation.
- Standard monitoring was used, such as ECG, NIBP, SpO_2, and $EtCO_2$.

Surgical Technique: The same surgical team did laparoscopic cholecystectomy on all of the patients using a standard four-port technique with CO_2 pneumoperitoneum (12–14 mmHg). All patients received the same intra-abdominal pressure and were positioned in a reverse Trendelenburg posture with a left tilt.

Parameters Assessed

Intraoperative Parameters:

- Haemodynamic variables (HR, SBP, DBP, MAP) recorded at 5-min intervals
- Period of surgery
- Problems that happen during surgery (low blood pressure, slow heart rate, shoulder pain)

Postoperative Parameters:

- Pain Score: Visual Analogue Scale at 1, 6, 12, 24 hours
- Analgesic requirement within 24 hours
- Incidence of PONV
- Duration of hospital stay
- Time to start oral intake
- Time to ambulation
- 5-point patient satisfaction rating The Likert scale

Statistical Analysis: We utilised SPSS to examine the data after entering it into Microsoft Excel. Categorical variables were examined using either Fisher's exact test or chi-square. The Mann-Whitney U test or Student's t-test were used to examine the continuous variables, which were displayed as mean ± SD. Statistical significance was defined as a p-value of less than 0.05.

Results

One hundred patients scheduled for elective laparoscopic cholecystectomy were selected and divided into two groups: Group T (50 patients receiving segmental thoracic spinal anaesthesia) and Group G (50 patients receiving general anaesthesia). In order to ensure baseline consistency and lessen selection bias, the demographic variables—such as age, sex, body mass index (BMI), and ASA physical status—were statistically comparable between the groups. The amount of carbon dioxide insufflation, intraoperative positioning, and surgical length did not significantly differ across the groups.

Postoperative Pain Scores (VAS): At 1, 6, 12, and 24 hours following surgery, the Visual Analogue Scale was utilised to gauge the degree of pain. With mean VAS scores of 2.32 ± 0.75 at 1 hour compared to 4.10 ± 0.98 in the GA group, 3.02 ± 0.79 at 6 hours versus 4.99 ± 0.99 at 6 hours, 3.46 ± 0.91 at 12 hours versus 4.65 ± 1.05 at 12 hours, and 2.87 ± 0.71 at 24 hours, patients in the STSA group showed significantly lower mean VAS values at all measured intervals. Statistical significance was achieved by all differences ($p < 0.0001$).

The diminished pain in the STSA group may be ascribed to the targeted segmental blockade of thoracic dermatomes, which proficiently encompasses the laparoscopic port sites and visceral manipulation areas. Moreover, the STSA group's decision to avoid systemic opioids may have led to less hyperalgesia and better pain control.

Table 1: Comparative Outcomes Between STSA and GA Groups

Parameter	STSA Group	GA Group	p-value
VAS 1h	2.32 ± 0.75	4.10 ± 0.98	< 0.0001
VAS 6h	3.02 ± 0.79	4.99 ± 0.99	< 0.0001
VAS 12h	3.46 ± 0.91	4.65 ± 1.05	< 0.0001
VAS 24h	2.87 ± 0.71	3.86 ± 0.86	< 0.0001
PONV incidence (%)	8.0%	18.0%	0.2343
Satisfaction Score	4.48 ± 0.50	3.36 ± 0.68	< 0.0001

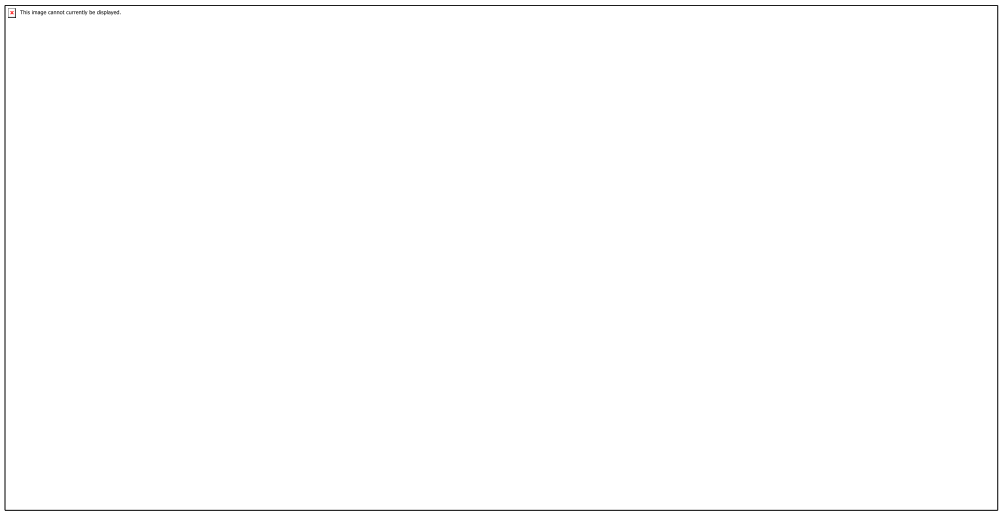

Figure 1: VAS Scores at Different Postoperative Time Points

Figure 1 shows how the VAS scores changed over time, from 1 to 6 to 12 to 24 hours. This clearly shows that the STSA group had a consistent and statistically significant drop in pain scores at all times compared to the GA group.

Postoperative Nausea and Vomiting (PONV): Postoperative nausea and vomiting occurred in 18% of the GA group and 8% of the STSA group. There was a trend towards lower PONV in individuals with STSA, despite the fact that the difference was not statistically significant (p = 0.2343) (Table 2).

This decrease is clinically significant and may be ascribed to the exclusion of inhalational anaesthetics and intraoperative opioids, recognised emetogenic agents. Patients undergoing STSA maintained consciousness and necessitated minimal systemic medications, potentially resulting in a reduced incidence of gastrointestinal side effects.

Table 2: Postoperative nausea incidence

Parameter	STSA Group	GA Group	p-value
PONV Incidence (%)	8.0%	18.0%	0.2343

Patient Satisfaction Scores: The STSA group had a mean score of 4.48 ± 0.50 on a 5-point Likert scale (1 = Very Dissatisfied, 5 = Very Satisfied), which was much higher than the GA group's mean score of 3.36 ± 0.68 (p < 0.0001) (Table 3). Patients who had STSA were happier because they had less pain, were able to get up and walk around sooner, didn't feel sleepy, and had a smoother recovery.

Patients probably felt more comfortable and safer because they didn't have to have invasive airway instrumentation and they quickly regained consciousness after the procedure. Also, the positive feedback in the STSA group was helped by earlier oral intake and movement.

Table 3: Patient Satisfaction Scores

Parameter	STSA Group (Mean ± SD)	GA Group (Mean ± SD)	p-value
Satisfaction Score	4.48 ± 0.50	3.36 ± 0.68	< 0.0001

Discussion

The current study provides a thorough comparison of segmental thoracic spinal anaesthesia (STSA) and general anaesthesia (GA) in patients undergoing elective laparoscopic cholecystectomy. Our findings indicate that STSA offers several postoperative benefits, particularly enhanced analgesia, a decreased occurrence of PONV, and increased patient satisfaction, all while ensuring similar intraoperative safety and haemodynamic stability.

A notable finding in our study was the markedly reduced postoperative pain scores in the STSA group at all time intervals. This supports previous findings by Sinha et al. (2021), which indicated improved analgesic effects and a diminished requirement for rescue opioids with STSA. The accurate thoracic dermatomal blockade and diminished neurohumoral stress response may elucidate the sustained and efficacious analgesia noted. Previous comparative studies of neuraxial versus general anaesthesia for laparoscopic procedures have underscored analogous analgesic advantages of regional techniques (Hamad & El-Kady, 2009; Bajwa et al., 2015).

The occurrence of PONV, while not statistically significant, was reduced in the STSA group, consistent with prior research. Bhattacharjee et al. (2019) and Imbelloni et al. (2014) have underscored the significance of spinal anaesthesia in reducing the necessity for volatile agents and opioids, which are principal contributors to PONV. The observed trend in our cohort may be attributed to the avoidance of emetogenic stimuli by selecting STSA. Furthermore, research conducted by Ciofolo & Clergue (2001) and Joris (2000) highlights the efficacy of regional anaesthesia in mitigating gastrointestinal complications, expediting recovery, and enhancing postoperative outcomes in laparoscopic surgeries.

In modern anaesthesia practice, patient satisfaction is an important measure. In our study, it was much higher in the STSA group. Patients indicated enhanced comfort attributed to early ambulation, improved pain management, lack of drowsiness, and a generally more positive recovery experience. This corroborates the conclusions of Ahmed et al. (2020) and Hofer et al. (2005), who highlighted that the avoidance of airway manipulation, swift emergence from anaesthesia, and diminished cognitive impairment enhance the patient's perception of care.

Physiologically, STSA provides cardiopulmonary benefits by maintaining spontaneous respiration and decreasing the necessity for positive-pressure ventilation, which is advantageous for patients with limited respiratory reserve or cardiovascular comorbidities. The stable intraoperative haemodynamics observed in this study align with the findings reported by Hofer et al. (2005) and Joris (2000) in their examinations of anaesthesia strategies for laparoscopic surgeries.

Significantly, our study did not experience any major complications, such as high spinal block or neurological deficits, which underscores the safety of STSA when conducted with appropriate anatomical comprehension and dosing. Even though two people had to switch to GA, STSA was mostly successful. This is similar to the conversion rates found in other studies, which means that STSA can be used reliably if the right training is given.

Even though the results are promising, STSA is still not used enough in clinical practice. This could be because they don't know how to do it, are afraid of hurting their spinal cord, or don't know the institution well enough. Bajwa and Jindal (2012) support the wider use of regional anaesthesia techniques in laparoscopic surgeries, saying that they are cheaper, take less time to heal, and cause fewer problems after surgery.

Conclusion

This study demonstrates that, in lieu of general anaesthesia (GA), segmental thoracic spinal anaesthesia (STSA) is a safe and efficient choice for patients undergoing elective laparoscopic cholecystectomy. STSA patients reported significantly lower postoperative pain scores, fewer episodes of postoperative nausea and vomiting, and higher levels of satisfaction with their perioperative experience.

Both anaesthesia methods worked well during surgery, but STSA has more benefits after surgery that fit with enhanced recovery after surgery (ERAS) protocols. The fact that there were no serious problems in the STSA group makes it even safer when given with the right skill and care.

But for STSA to work, you need to carefully choose your patients, have a skilled operator, and give the right amount of medicine. To get more people to use this method, they need to be aware of it, get training, and get support from their institutions to deal with the learning curve and perceived risks.

In conclusion, STSA can be regarded as a significant enhancement to the anaesthesiologist's toolkit for laparoscopic cholecystectomy, especially in patients for whom minimising airway manipulation, ensuring rapid recovery, and achieving optimal pain management are priorities.

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