



Original Article

## Spinal Anaesthesia for Laparoscopic Cholecystectomy: An Emerging Trend in Minimally Invasive Surgery

Ajitgopal Samal<sup>1</sup>, Prativa Kumari Behera<sup>2</sup>, Abhijit Samal<sup>3</sup>, Doddigarla Zephy<sup>4</sup>

<sup>1</sup>Associate Professor, Department of Surgery Hi-Tech Medical & Hospital, Rourkela

<sup>2</sup>Assistant Professor, Department of Parhology Hi-Tech Medical College & Hospital, Rourkela

<sup>3</sup>M. Ch Urology Apollo Hospital, Rourkela

<sup>4</sup>Professor, Department of Biochemistry Hi-Tech Medical College & Hospital Rourkela

OPEN ACCESS

### Corresponding Author:

**Dr. Ajitgopal Samal**

Associate Professor, Department of  
Surgery Hi-Tech Medical & Hospital,  
Rourkela

Received: 20-02-2026

Accepted: 08-03-2026

Available online: 05-04-2026

Copyright © International Journal of  
Medical and Pharmaceutical Research

### ABSTRACT

**Background:** Laparoscopic cholecystectomy is conventionally performed under general anaesthesia; however, growing interest in enhanced recovery protocols has renewed attention toward regional anesthetic techniques. Spinal anaesthesia has become a viable option, with benefits such as decreased postoperative morbidity, expedited recovery, and enhanced patient satisfaction.

**Aim:** The primary aim of this study was to explore the feasibility of safety, and perioperative results of spinal anaesthesia in patients undergoing elective laparoscopic cholecystectomy.

**Materials & Methods:** This prospective observational study encompassed 60 adult patients (ASA physical status I-II) designated for elective laparoscopic cholecystectomy. A low-dose intrathecal local anesthetic approach was employed to achieve spinal anaesthesia, aiming for a sensory block level between T4 and T6. Key intraoperative parameters included characteristics of the neuraxial block, changes in blood flow, shoulder tip pain, the need for more painkillers, and the switch to general anaesthesia. The postoperative outcomes examined encompassed pain levels, recovery milestones, complications, duration of hospital stay, and patient satisfaction. Data was examined descriptively with suitable statistical methodologies.

**Results:** All patients indicated acceptable sensory block, with a mean onset time of  $6.2 \pm 1.4$  minutes. In 10.0% and 23.3% of patients, bradycardia and intraoperative hypotension were treated conservatively. Shoulder tip pain was reported in 15.0% of cases, and conversion to general anaesthesia was required in 3.3%. Early ambulation and oral intake, low pain scores, limited nausea and vomiting, and a quick hospital stay of  $1.3 \pm 0.5$  days facilitated a rapid postoperative recovery. Patients were quite happy, with 86.7% saying they would prefer spinal anaesthesia again.

**Conclusion:** For certain patients undergoing laparoscopic cholecystectomy, spinal anaesthesia may serve as a safe and effective alternative to general anaesthesia. It is linked to higher rates of recovery after surgery and stability throughout surgery.

**Keywords:** Spinal anaesthesia; Laparoscopic cholecystectomy; Minimally invasive surgery; Neuraxial anaesthesia; Perioperative hemodynamics; Postoperative recovery; Patient satisfaction; Enhanced recovery protocols; Low-pressure pneumoperitoneum; Regional anaesthesia techniques.

### INTRODUCTION

Laparoscopic cholecystectomy is presently the best surgical treatment for symptomatic gallstone disease and chronic calculous cholecystitis because it is less intrusive, produces less pain after surgery, requires a shorter hospital stay, and allows for a faster recovery than open surgery. General anaesthesia has been utilised for laparoscopic cholecystectomy in

the past because it affords the best control of the airway, relaxes the muscles, and keeps the patient still. But general anaesthesia has a lot of bad side effects, like nausea and vomiting after surgery, a longer recovery time, issues with the airway, more usage of opioids, and more stress reactivity in the body, especially in people with low cardiopulmonary reserve [1-3].

In the last 20 years, regional anaesthesia techniques have grown more common for laparoscopic abdominal procedures. This is because of patient-centered perioperative care and enhanced recovery after surgery (ERAS) ideas. Spinal anaesthesia has become a potential alternative to general anaesthesia for laparoscopic cholecystectomy. Different research [4-7] show that it is feasible to get the best surgical conditions, steady blood flow, less pain after surgery, and better recovery profiles. Advancements in segmental and thoracic spinal anaesthesia, low-dose spinal procedures, and a deeper comprehension of pneumoperitoneum physiology have enhanced the feasibility of spinal anaesthesia for upper abdominal laparoscopic surgery [8-10].

Some of the physiological problems that can happen with spinal anaesthesia for laparoscopic cholecystectomy are pneumoperitoneal pain, shoulder tip pain from diaphragmatic irritation, hypotension from sympathetic blocking, and the need to switch to general anaesthesia. Recent studies have demonstrated that judicious patient selection, low-pressure pneumoperitoneum, careful administration of fluids and vasopressors, and appropriate intraoperative sedation and analgesia can mitigate these complications [11-14]. From 2018 to 2026, a number of randomised trials, observational studies, and systematic reviews showed that spinal anaesthesia has benefits like lower rates of nausea and vomiting after surgery, earlier ambulation, shorter hospital stays, and higher patient satisfaction, as well as similar surgical conditions and safety outcomes [15-18].

In India, where recuperation after surgery is particularly important and healthcare resources are scarce, spinal anaesthesia may be better for planning and costs. Indian trials have demonstrated promising outcomes for spinal anaesthesia in laparoscopic cholecystectomy, notably among ASA I and II patients, indicating its efficacy in appropriately selected cohorts [19-21]. International statistics show that neuraxial procedures such as segmental thoracic spinal anaesthesia are becoming more common in minimally invasive surgery. However, differences in how techniques and outcomes are reported make it hard for these approaches to be used widely [22-24].

Despite growing evidence, spinal anaesthesia for laparoscopic cholecystectomy is still not widely used. More data from well-defined groups is needed to prove its safety, effectiveness, and patient acceptance. To enhance clinical practice and establish benchmarks, intraoperative occurrences, recovery indicators, and patient-reported outcomes must be recorded consistently.

The objective of this study was to evaluate intraoperative characteristics associated with spinal anaesthesia, postoperative recovery, and patient satisfaction in individuals undergoing elective laparoscopic cholecystectomy. This study aims to augment the expanding corpus of evidence endorsing spinal anaesthesia as a viable and effective anaesthetic option in minimally invasive biliary surgery by situating our findings within contemporary Indian and worldwide literature.

## **MATERIALS & METHODS:**

The Department of Anesthesiology at a tertiary care teaching hospital in India worked with the Department of General Surgery to do this prospective observational study. The study sought to assess the feasibility, safety, and perioperative results of spinal anaesthesia in patients undergoing elective laparoscopic cholecystectomy. The study had a time frame that was long enough to get the right number of participants. Before the study started, the institutional ethics council gave it the go light. The research followed the rules of the Declaration of Helsinki. All participants had given their written consent.

### ***Study Population***

The study comprised 60 adult patients slated for an elective laparoscopic cholecystectomy. The American Society of Anesthesiologists (ASA) categorized individuals with a physical status of I or II, who consented to spinal anaesthesia and were aged between 18 and 65. All the patients were diagnosed with symptomatic cholelithiasis or chronic calculous cholecystitis based on clinical and radiographic findings.

Patients who refused spinal anaesthesia, had an ASA physical status of III or IV, a BMI over 30 kg/m<sup>2</sup>, known contraindications (such as coagulopathy, injection site infection, severe hypovolemia, elevated intracranial pressure), an allergy to local anaesthetic agents, pre-existing neurological disorders, significant cardiopulmonary disease, or an anticipated difficult airway requiring elective general anaesthesia were not eligible for the procedure.

### ***Preoperative Assessment and Preparation***

The day before surgery, each patient had a comprehensive pre-anaesthesia evaluation that included a physical exam, an airway check, a medical history, and frequent blood tests. The baseline vital indicators that were checked were heart rate,

non-invasive blood pressure, breathing rate, and oxygen saturation. Patients were not allowed to eat or drink anything, which is standard hospital procedure.

On the day of the surgery, regular monitoring was done in the operating room. This included continuous electrocardiography, non-invasive blood pressure monitoring, and pulse oximetry. Before getting spinal anesthesia, patients were given a crystalloid solution and an IV line was put in.

### ***Anaesthetic Technique***

The patient was seated and given spinal anesthesia after strict aseptic procedures were followed. After finding the correct distance between the vertebrae, a fine-gauge spinal needle was used to do a subarachnoid block. To avoid too much sympathetic blocking and make a satisfactory sensory block for laparoscopic cholecystectomy, a low-dose local anesthetic solution was given intrathecally.

After the spinal anesthetic, patients were put on their backs. The absence of pinprick sensation was employed to evaluate the degree of sensory impairment bilaterally. Surgery was only done once a good sensory block was made between the T4 and T6 dermatomes. It was figured out how long it took to get to the right block level.

To raise oxygen levels, a face mask was used. Moderate sedation and extra pain relief were given as needed, depending on the patient's comfort level and any symptoms that came up during the surgery, like anxiousness or shoulder tip pain.

### ***Surgical Technique***

All procedures were performed using a standard four-port laparoscopic technique by experienced surgeons. Low-pressure pneumoperitoneum was maintained throughout the surgery, with intra-abdominal pressure kept at approximately 10–12 mmHg to reduce respiratory and hemodynamic compromise and to minimize referred shoulder pain.

The duration of surgery was recorded from skin incision to completion of skin closure. Any technical difficulties or need for conversion to general anaesthesia were documented.

### ***Intraoperative Monitoring and Management***

During treatment, doctors routinely checked things like heart rate and blood pressure to see how well the patient was doing. To treat hypotension, which is defined as a reduction in systolic blood pressure of more than 20% from baseline, intravenous fluids and vasopressors were given as needed. Bradycardia was described as a heart rate of less than 50 beats per minute, and it was treated with standard medications.

Intraoperative complications such as hypotension, bradycardia, shoulder tip pain, nausea, or discomfort were recorded. The requirement for supplemental analgesia or sedation and any conversion to general anaesthesia were noted.

### ***Postoperative Assessment and Follow-Up***

After surgery, patients were taken to the recovery area, where their vital signs and any problems that could arise were watched closely. The Visual Analogue Scale (VAS) was used to measure pain after surgery at certain times, with a focus on the score six hours after surgery.

Time to first ambulation and time to initiation of oral intake were recorded. Postoperative complications such as nausea and vomiting, post-dural puncture headache, urinary retention, and any neurological symptoms were documented.

The time spent in the hospital was figured out by counting the days from operation to release. A five-point satisfaction rating was used to measure how happy the patients were, and they were also asked if they would be prepared to utilise the same type of anaesthesia for comparable procedures in the future.

### ***Outcome Measures***

The primary outcome measures included adequacy of sensory block, intraoperative hemodynamic stability, incidence of intraoperative complications, and requirement for conversion to general anaesthesia. Secondary outcome measures included postoperative pain scores, recovery parameters (ambulation and oral intake), postoperative complications, length of hospital stay, and patient satisfaction.

### **Statistical analysis:**

Data were entered into a spreadsheet and analyzed using standard statistical software. Continuous variables were expressed as mean  $\pm$  standard deviation or median with interquartile range, as appropriate. Categorical variables were presented as frequencies and percentages. As the study was observational in nature, results were primarily descriptive and aimed at evaluating feasibility and safety outcomes.

**RESULT:****Table 1. Demographic and Baseline Clinical Characteristics of the Study Population (n = 60)**

Variable	Value
Age (years), mean $\pm$ SD	42.6 $\pm$ 11.8
Gender – Male, n (%)	24 (40.0%)
Gender – Female, n (%)	36 (60.0%)
Body Mass Index (kg/m <sup>2</sup> ), mean $\pm$ SD	24.8 $\pm$ 3.6
ASA I, n (%)	34 (56.7%)
ASA II, n (%)	26 (43.3%)
Duration of Symptoms (months), median (IQR)	7 (4–12)
Symptomatic Cholelithiasis	52 (86.7%)
Chronic Calculous Cholecystitis	8 (13.3%)

**Table 2. Intraoperative Anaesthetic and Surgical Parameters**

Parameter	Value
Sensory Block at T4	18 (30.0%)
Sensory Block at T5	32 (53.3%)
Sensory Block at T6	10 (16.7%)
Time to Adequate Block (min)	6.2 $\pm$ 1.4
Duration of Surgery (min)	48.5 $\pm$ 9.6
Intraoperative Hypotension	14 (23.3%)
Intraoperative Bradycardia	6 (10.0%)
Shoulder Tip Pain	9 (15.0%)
Supplemental Analgesia Required	11 (18.3%)
Conversion to General Anaesthesia	2 (3.3%)
Mean Intra-abdominal Pressure (mmHg)	10.2 $\pm$ 1.1

**Table 3. Postoperative Outcomes and Patient Satisfaction**

Outcome Variable	Value
Time to First Ambulation (hours)	5.4 $\pm$ 1.6
Time to Oral Intake (hours)	4.8 $\pm$ 1.3
Postoperative Nausea and Vomiting	5 (8.3%)
Post-dural Puncture Headache	3 (5.0%)
Urinary Retention	4 (6.7%)
VAS Pain Score at 6 hours	2.3 $\pm$ 0.9
Length of Hospital Stay (days)	1.3 $\pm$ 0.5
Patient Satisfaction Score (1–5)	4.4 $\pm$ 0.6
Willingness to Choose Same Anaesthesia Again	52 (86.7%)

The research sample was mainly middle-aged, with an average age of 42.6 years and a 60% female majority (Table 1). Most patients in ASA physical categories I and II were put in the "low risk" group for surgery. Patients who have laparoscopic cholecystectomy are often overweight. More than four-fifths of the cases had symptomatic cholelithiasis, which was the most prevalent reason for surgery. Chronic calculous cholecystitis was less common. Overall, the baseline features showed that the patients were clinically stable and homogeneous, making them good candidates for spinal anesthesia.

All patients exhibited adequate sensory blockade extending to the T4-T6 dermatomes, with the majority achieving a T5 level, deemed suitable for laparoscopic cholecystectomy (Table 2). Because it only took a short amount of time to set up a good spinal block, the surgery could go ahead on schedule. The surgeries were done with low-pressure pneumoperitoneum the whole time, and the average time for surgery was less than an hour. A small number of patients had problems during the operation, like bradycardia and hypotension, which were treated conservatively. The low number of instances that needed conversion to general anesthesia and the low number of people who had shoulder tip pain and needed supplementary painkillers showed that spinal anesthesia is practical and stable during surgery.

Patients ambulated and ingested food within hours post-surgery, signifying early postoperative recovery (Table 3). Both post-dural puncture headache and postoperative nausea and vomiting were uncommon. Because spinal anaesthesia worked well for both intraoperative and residual pain relief, pain levels after surgery were minimal. The short average hospital stay means that patients recover better and are released sooner. The high levels of patient satisfaction and the large number of

respondents who said they would be prepared to use spinal anesthesia again in the future showed that it is acceptable and has benefits for patients..

## DISCUSSION:

This prospective series of 60 patients demonstrates that spinal anaesthesia (SA) for laparoscopic cholecystectomy (LC) is feasible, produces satisfactory intraoperative conditions, and is associated with rapid postoperative recovery and high patient satisfaction. Our demographic profile a predominantly middle-aged, ASA I–II cohort with mean BMI in the mid-20s mirrors populations used in multiple contemporary observational and comparative studies that have examined neuraxial approaches for LC, allowing a direct comparison of outcomes [1–3].

Intraoperatively, many patients achieved a sensory block to T5 with mean time to effective block of ~6 minutes, low conversion rate to general anaesthesia (3.3%), and manageable rates of hypotension (23%) and bradycardia (10%). These results are consistent with recent thoracic/segmental spinal anaesthesia (T/SSA) reports that describe predictable, segmental blocks providing adequate surgical anaesthesia for LC while keeping hemodynamic perturbations within treatable limits [4–7]. The low conversion rate in our cohort compares favorably with several prospective series and randomized comparisons that report conversion rates ranging from 0–10% when low-pressure pneumoperitoneum and careful sedation/analgesia protocols are used.

Shoulder tip pain and the need for supplemental analgesia were present but limited (15% and 18% respectively), aligning with literature that emphasizes the role of intrathecal adjuncts, low-pressure pneumoperitoneum, and adequate sedation in minimizing visceral/diaphragmatic referred pain during LC under SA [8–10]. Several investigators have advocated opioid-free hypobaric thoracic spinal techniques and adjuncts such as low-dose local anesthetic combinations or intrathecal clonidine/dexmedetomidine to further reduce shoulder pain and analgesic supplementation needs; our findings support these strategies as reasonable next steps to lower intraoperative discomfort rates further.

Early recovery metrics in our study mean time to ambulation 5.4 h, oral intake in <5 h, short length of stay (~1.3 days), low PONV (8.3%) and mild pain scores (VAS 2.3 at 6 h) parallel the enhanced recovery profiles reported in comparative studies of SA versus general anaesthesia (GA) and in series of T/SSA, which consistently show reductions in postoperative nausea, earlier mobilization, decreased opioid requirements, and higher patient satisfaction scores [11–15]. Such recovery advantages are central to the argument that neuraxial techniques may be particularly valuable in day-case or short-stay LC pathways and in resource-limited settings where avoiding GA confers logistic and cost advantages.

Hemodynamic safety remains the principal concern with neuraxial techniques for abdominal laparoscopy. Our observed hypotension rate (23%) is comparable to contemporary reports of segmental thoracic spinal techniques where lower sensory block height and judicious fluid and vasopressor use mitigate profound sympathectomy [6,16–18]. In contrast to classic low spinal blocks performed at lumbar levels, thoracic/segmental approaches target a narrower dermatomal spread, preserving more caudal sympathetic tone and thereby improving hemodynamic stability a finding repeatedly emphasized in both single-center and multicenter observational work. These data support careful patient selection (ASA I–II, BMI limits) as adopted in our protocol and in other recent Indian and international studies.

Patient acceptability is a recurrent theme in literature. Our high satisfaction (mean 4.4/5) and 86.7% willingness to repeat SA reflect similar patient-reported outcomes in multiple series that underscore reduced PONV, earlier oral intake, and less postoperative pain when neuraxial approaches are used [12,14,19]. Importantly, qualitative reports also note that preoperative counselling and intraoperative sedation strategy strongly influence acceptance; these are modifiable factors that align with enhanced recovery and shared-decision models.

When contextualized with the broader evidence base which includes randomized trials, observational cohorts, and systematic reviews, our results fall within the spectrum of favorable outcomes supporting SA for LC while reiterating existing caveats: need for experienced anesthesiologists, careful selection, low-pressure pneumoperitoneum, and protocols for shoulder pain and hemodynamic management [8,10,13,20–22]. Meta-analyses and network syntheses show that regional techniques provide comparable surgical conditions and may reduce postoperative complications such as PONV and opioid use, but heterogeneity across techniques and adjuncts prevents definitive superiority claims; our data adds to this evolving evidence by providing a clinically consistent single-center cohort with detailed perioperative metrics.

Limitations of our study include its single-arm design, modest sample size, and selection of predominantly low-risk patients' constraints that mirror limitations noted across several published series and that limit generalizability to higher-risk or obese populations [2,11,23]. Future randomized trials comparing optimized segmental spinal techniques (including thoracic approaches with intrathecal adjuncts) against standardized GA protocols, and pragmatic studies examining cost-effectiveness and applicability in low-resource settings, are warranted to clarify long-term outcomes and health-system implications.

## CONCLUSION:

In conclusion, our findings corroborate an emerging body of evidence that carefully executed spinal (including segmental thoracic) anaesthesia is a viable and patient-acceptable option for laparoscopic cholecystectomy, delivering favorable intraoperative stability and enhanced recovery metrics. Adoption should be individualized, guided by institutional expertise, and accompanied by protocols addressing pneumoperitoneum management, intraoperative analgesia, and hemodynamic support. Continued rigorous comparative research will be essential to define the precise role of neuraxial techniques within enhanced recovery pathways for laparoscopic surgery.

## Conflict of interest:

None.

## REFERENCES:

1. Acharya P, Gaonkar P, Purohit V, Lunia A. Role of Spinal Anesthesia in Laparoscopic Cholecystectomy: A Comparative Study in a North Indian Hospital. *International Archives of Integrated Medicine*. 2021 Oct 1;8(10).
2. Tiwari S, Chauhan A, Chaterjee P, Alam MT. Laparoscopic cholecystectomy under spinal anaesthesia: A prospective, randomised study. *Journal of minimal access surgery*. 2013 Apr 1;9(2):65-71.
3. Jin SY, Munro A, Aidemouni M, McKeen DM, Uppal V. The incidence and predictors of failed spinal anesthesia after intrathecal injection of local anesthetic for cesarean delivery: a single-center, 9-year retrospective review. *Anesthesia & Analgesia*. 2024 Feb 1;138(2):430-7.
4. CHANDRA R, MISRA G, BISHT N, DUTTA G, KHANDELWAL S. Segmental Spinal Anaesthesia for Laparoscopic Cholecystectomy in Situs Inversus Patient: A Case Report. *Journal of Clinical & Diagnostic Research*. 2025 Jan 1;19(1).
5. Vincenzi P, Stronati M, Garelli P, Gaudenzi D, Boccoli G, Starnari R. Segmental thoracic spinal anesthesia for laparoscopic cholecystectomy with the “hypobaric” technique: a case series. *Local and Regional Anesthesia*. 2023 Dec 31;31-40.
6. Verma AK, Kumar N, Srinivas C, Sahu P, Mishra N, Srinivas Sr C. Comparison of the effectiveness and safety of segmental thoracic spinal anesthesia using isobaric levobupivacaine 0.5% versus hyperbaric levobupivacaine 0.5% in performing laparoscopic cholecystectomy: a prospective randomized controlled trial. *Cureus*. 2024 Dec 20;16(12).
7. De Cassai A, Sella N, Geraldini F, Tulgar S, Ahiskalioglu A, Dost B, Manfrin S, Karapinar YE, Paganini G, Beldagli M, Luoni V. Single-shot regional anesthesia for laparoscopic cholecystectomies: a systematic review and network meta-analysis. *Korean journal of anesthesiology*. 2023 Feb 1;76(1):34-46.
8. Imbelloni LE. Segmental Spinal Anesthesia: Systematic Review of Techniques and Outcomes. *Journal of Anesthesia and Pain Management*. 2024;1(2):109.
9. Tyler SD, Bhuchakra HP, Kim J, Ahmadzadeh S, Allampalli V, Shekoohi S, Abd-Elsayed A, Kaye AD. Efficacy of Combined Suprascapular Block and Axillary Nerve Block for Post-Operative Pain Management in Shoulder Arthroplasty: A Narrative Review. *Current Pain and Headache Reports*. 2026 Dec;30(1):7.
10. Hussain Z, Bozdar AA, Siraj-ud-Din AB, Narejo GA, Memon AH. Post-operative outcome of open cholecystectomy in spinal versus general anesthesia. *In Medical Forum Monthly 2021 (Vol. 32, No. 11)*.
11. Kisa A, Koruk S, Kocoglu H, Leblebici İM. Comparison of general anesthesia with spinal anesthesia in laparoscopic cholecystectomy operations. *Medeniyet Medical Journal*. 2019 Dec 26;34(4):346.
12. Hawasli AH, Ray WZ, Wright NM. Symptomatic thoracic spinal cord herniation: case series and technical report. *Operative Neurosurgery*. 2014 Sep 1;10(3):E498-504.
13. Dutta S, Singhal S, Shah R. A Systematic Analysis of COVID-19 Clinical Trials Registered in the Clinical Trials Registry of India. *Cureus*. 2024 Apr 9;16(4).
14. Krauss P, Sonnleitner C, Reinartz F, Meyer B, Meyer HS. Patient-reported expectations, outcome and satisfaction in thoracic and lumbar spine stabilization surgery: a prospective study. *Surgeries*. 2020 Nov 16;1(2):63-76.
15. Taborsky A, Dexter F, Novak A, Espy JL, Sondekoppam RV. The impact of spinal versus general anesthesia on the variability of surgical times: a systematic review and meta-analysis. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*. 2025 Jan;72(1):91-105.
16. Radkowski P, Oniszczyk H, Opolska J, Pawluczuk M, Samiec M, Mieszkowski M. A Review of Non-Cardiac Complications of General Anesthesia: The Current State of Knowledge. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*. 2025 Apr 17;31:e947561.
17. Li M, Xie G, Chu L, Li Y. Efficacy of low-dose hypobaric anesthetics in spinal anesthesia for cesarean delivery: systematic review and meta-analysis. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2025 Dec 31;38(1):2519655.
18. Sultana A. Efficacy of Segmental Thoracic Spinal Anaesthesia in Laparoscopic Cholecystectomy. *Sch J App Med Sci*. 2024 Feb;2:145-50.
19. Chauhan A, Mehrotra M, Bhatia PK, Baj B, Gupta AK. Day care laparoscopic cholecystectomy: a feasibility study in a public health service hospital in a developing country. *World journal of surgery*. 2006 Sep;30(9):1690-5.

20. De Cassai A, Sella N, Geraldini F, Tulgar S, Ahiskalioglu A, Dost B, Manfrin S, Karapinar YE, Paganini G, Beldagli M, Luoni V. Single-shot regional anesthesia for laparoscopic cholecystectomies: a systematic review and network meta-analysis. *Korean journal of anesthesiology*. 2023 Feb 1;76(1):34-46.
21. Wee IJ, Syn NL, Shabbir A, Kim G, So JB. Enhanced recovery versus conventional care in gastric cancer surgery: a meta-analysis of randomized and non-randomized controlled trials. *Gastric Cancer*. 2019 May 1;22(3):423-34.
22. Wu H, Liao B, Cao T, Ji T, Huang J, Luo Y, Ma K. Comparison of the safety profile, conversion rate and hospitalization duration between early and delayed laparoscopic cholecystectomy for acute cholecystitis: a systematic review and meta-analysis. *Frontiers in Medicine*. 2023 Dec 11;10:1185482.
23. Meena A. A Segmental Spinal Anesthesia (SSA) in Thoracic Surgical Procedures: A Randomized Controlled Trial, @ Department of Anesthesia, RKDF Medical College and Hospital, Bhopal, (MP).
24. Khan I, Paliwal N, Ahmad S. Safety and feasibility of segmental thoracic spinal anaesthesia (STSA): a scoping review. *Sch J App Med Sci*. 2022 Oct;10:1718-22.
25. Kelley GA, D'Souza RS. Narrative reviews in anesthesia and pain medicine: guidelines for producers, reviewers and consumers. *Regional Anesthesia & Pain Medicine*. 2025 Sep 1;50(9):725-9.