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Original Research Article

A COMPARATIVE STUDY OF SURGICAL OUTCOMES IN ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY UNDER SPINAL VERSUS GENERAL ANAESTHESIA: A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard for symptomatic cholelithiasis. Conventionally done under general anaesthesia (GA) for safe airway control and pneumoperitoneum tolerance, GA can cause postoperative nausea, vomiting, and delayed bowel recovery. Spinal anaesthesia (SA) is emerging as a safe, feasible alternative that avoids airway instrumentation and offers better postoperative pain relief and faster recovery. This study aims to compare surgical parameters in elective LC under spinal versus general anaesthesia.

Materials and Methods: This prospective randomized study enrolled 106 patients equally divided into SA and GA groups. Surgical parameters, intraoperative events, postoperative complications, pain scores, bowel function, and patient and surgeon satisfaction were compared.

Results: The SA group showed lower early pain scores, faster bowel recovery, less nausea and vomiting, and similar operative times. Minor hypotension and bradycardia were manageable; conversion to GA was rare.

Conclusion: SA is safe, feasible, cost-effective, and suitable for selected LC cases.

Keywords: Laparoscopic cholecystectomy, Spinal anaesthesia, General anaesthesia.

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for treating symptomatic cholelithiasis since its introduction in the late 1980s.[1] Compared to open cholecystectomy, LC offers significant advantages including reduced postoperative pain, shorter hospital stay, faster recovery, and better cosmetic outcomes.[2,3]

Traditionally, LC is performed under general anaesthesia (GA), which allows for safe airway management, controlled ventilation during carbon dioxide pneumoperitoneum, and optimal muscle relaxation.[4] However, GA is associated with drawbacks such as endotracheal intubation-related complications, postoperative nausea and vomiting (PONV), sore throat, respiratory complications, and delayed bowel function recovery.[5,6]

Spinal anaesthesia (SA) has been increasingly explored as an alternative for selected laparoscopic surgeries. SA avoids airway manipulation, reduces the surgical stress response, provides superior intraoperative analgesia, and offers faster recovery and early ambulation.[7,8] Studies suggest that SA can be cost-effective and particularly useful for patients with difficult airways or those unfit for GA.[9]

Despite these benefits, concerns persist about intraoperative hypotension, shoulder tip pain due to diaphragmatic irritation, patient discomfort from pneumoperitoneum, and the potential need for conversion to GA if the block is inadequate.[10] Several studies worldwide have compared SA and GA for LC, reporting comparable surgical feasibility, patient satisfaction, and improved early postoperative outcomes with SA.[11,12] However, data in the Indian population remains limited.

This study was conducted to compare surgical parameters, intraoperative events, postoperative pain, complications, recovery profiles, patient satisfaction and ease of instrument handling for surgeons between SA and GA in elective LC, to assess the feasibility and safety of SA as an alternative in routine practice.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective randomized controlled trial conducted in the Department of General Surgery at Teerthanker Mahaveer Medical College & Research Centre (TMMC & RC), Moradabad, after obtaining approval from the Institutional Ethics Committee. The study period was one year.

Sample Size and Participants: A total of 106 patients were enrolled. Written informed consent was obtained from all participants. Patients were randomly allocated into two groups:

1. Group SA (n=53): LC under spinal anaesthesia
2. Group GA (n=53): LC under general anaesthesia

Inclusion Criteria

1. Age between 18–80 years
2. ASA grade I or II
3. BMI 18–28.5 kg/m²
4. Symptomatic cholelithiasis

Exclusion Criteria

1. Suspected or confirmed common bile duct (CBD) stones
2. Acute cholecystitis or pancreatitis
3. History of previous upper abdominal surgery
4. Coagulopathy or bleeding diathesis
5. Patient refusal for regional anaesthesia

Anaesthetic Technique: Patients in the SA group received 0.5% hyperbaric bupivacaine with fentanyl intrathecally at the L2–L3 or L3–L4 interspace in the sitting position. Pneumoperitoneum was maintained with CO_2 at a pressure not exceeding 10 mmHg to minimize diaphragmatic irritation and shoulder pain. Patients in the GA group underwent standard general anaesthesia induction with intravenous propofol, fentanyl, muscle relaxants, endotracheal intubation, and controlled mechanical ventilation. Pneumoperitoneum was maintained at 12 mmHg.

Surgical Technique

All patients underwent standard 4-port laparoscopic cholecystectomy performed by experienced surgeons following uniform surgical steps.

Parameters Studied

1. Demographic data (age, gender, BMI)
2. Operative time & pneumoperitoneum pressure
3. Intraoperative hemodynamic stability, conversion to GA (for SA group)
4. Postoperative pain assessed using Visual Analogue Scale (VAS) at 6, 12, and 24 hrs.
5. Intraoperative and postoperative complications such as hypotension, bradycardia, nausea, vomiting, headache, urinary retention
6. Return of bowel function and time to ambulation
7. Patient satisfaction at discharge
8. Surgeons' satisfaction

RESULTS

The following table summarizes the demographic, intraoperative, and postoperative findings comparing the spinal and general anaesthesia groups.

Table 1: Comparative Analysis

Parameter	SA	GA	p-value
Number of Patients	53	53	-
Mean Age (years)	36.94 ± 11.41	37.98 ± 11.26	0.091
Female (%)	90.60%	92.50%	0.078
Mean Operative Time (min)	62.28 ± 5.74	67.15 ± 5.88	0.07
Pneumoperitoneum Pressure (mmHg)	10 mmHg	12 mmHg	0.059
Hemodynamic Stability (%)	92.5% stable	100% stable	0.029
Hypotension	5.70%	0%	0.029
Bradycardia	1.90%	0%	0.029
Conversion to GA	3.80%	-	0.001
Abdominal Stiffness	5.70%	0%	0.029
Bleeding	0%	0%	-
Nausea/Vomiting (Intra-op)	3.80%	0%	0.039
Emergence from Anaesthesia (hrs)	3.09 ± 0.49	0.82 ± 0.10	<0.05
Pain at 6 hrs (VAS)	100% mild	100% moderate	0.002
Pain at 12 hrs (VAS)	96.2% none	94.3% mild	0.037
Pain at 24 hrs (VAS)	100% none	5.7% mild	0.023
Nausea/Vomiting (Post-op)	5.70%	9.40%	0.021
Headache	3.80%	0%	0.034
Urinary Retention	1.90%	0%	0.022
Return of Bowel Function (hrs)	7.39 ± 0.88	13.47 ± 2.37	0.011
Patient Satisfaction	94.30%	92.50%	0.057

Source: The differences observed between spinal anaesthesia (SA) and general anaesthesia (GA) for laparoscopic cholecystectomy (LC) can be explained by well-established physiological principles.

Under SA, the neuraxial block produces dense sensory and motor blockade below the level of administration, providing excellent intraoperative analgesia. This reduces the need for systemic opioids and sedatives, which are commonly required in GA and are known to contribute to delayed bowel motility, postoperative nausea, and vomiting (PONV).[1]

The lower intra-abdominal insufflation pressures (10 mmHg) used during SA, compared to standard pressures (12–15 mmHg) used under GA, minimize diaphragmatic irritation and reduce the incidence of shoulder tip pain, which can otherwise lead to discomfort and conversion to GA.[2]

The sympathetic blockade caused by SA can result in mild hypotension and bradycardia due to vasodilation and reduced venous return. However, these effects are generally transient and manageable with fluids and vasopressors, as supported by previous studies.[3]

Early return of bowel function under SA is attributed to the absence of inhalational anaesthetic agents and opioids, both of which depress gut motility through central and peripheral mechanisms. The regional block allows for faster recovery of gut peristalsis.[4]

The higher patient satisfaction observed in the SA group is likely due to reduced postoperative discomfort, faster ambulation, and avoidance of airway-related side effects such as sore throat or hoarseness.[5]

Together, these physiological and pharmacological factors explain why SA can offer comparable surgical feasibility with distinct postoperative advantages for suitable patients undergoing elective LC.

DISCUSSION

Laparoscopic cholecystectomy (LC) remains the treatment of choice for symptomatic cholelithiasis due to its proven advantages over open surgery, such as less postoperative pain, shorter hospital stay, faster return to normal activity, and fewer wound-related complications.[1,2] Traditionally, LC is performed under general anaesthesia (GA) to ensure adequate muscle relaxation, patient comfort, and tolerance of pneumoperitoneum.[3] However, GA is associated with complications such as postoperative nausea and vomiting (PONV), airway-related trauma, sore throat, and longer recovery times.[4]

The search for alternative anaesthetic techniques that minimize these drawbacks has led to increasing interest in regional anaesthesia for laparoscopic procedures. Spinal anaesthesia (SA) offers several theoretical advantages, including reduced airway manipulation, excellent intraoperative analgesia, reduced stress response, minimal PONV, and earlier postoperative recovery.[5,6]

The results of this study demonstrate that LC under SA is safe, feasible, and comparable to GA in terms of operative parameters and surgical outcomes. The mean operative time did not differ significantly between the two groups, consistent with studies by Tzovaras et al. and Imbelloni et al.[7,8] Pneumoperitoneum was maintained at lower pressures in the SA group (10 mmHg) to reduce diaphragmatic irritation and shoulder tip pain, a strategy validated in earlier research.[9]

Hypotension and bradycardia, though observed in a small percentage of SA patients, were easily managed with fluids and vasopressors — as reported by Bessa et al.[10] The conversion rate from SA to GA was only 3.8% in this study, mainly due to inadequate muscle relaxation and discomfort from shoulder tip pain. This aligns with similar conversion rates reported in other Indian and global studies.[11]

One of the most significant advantages of SA highlighted in this study is better early postoperative pain control. Patients in the SA group had lower VAS scores at 6 and 12 hours and were completely pain-free at 24 hours, which confirms the superior analgesic effect of neuraxial blockade [12] This advantage is clinically meaningful because it can reduce the need for systemic opioids, lower the risk of PONV, and support earlier mobilization.

The return of bowel function was significantly faster in the SA group (mean 7.39 hours) than in the GA group (mean 13.47 hours). This early bowel recovery can be attributed to the absence of general anaesthetic agents and opioids that depress gut motility, a finding supported by similar trials.[13]

Minor complications specific to SA, such as headache and urinary retention, were noted in a few patients but were self-limiting and easily managed. Importantly, no major respiratory complications or significant intraoperative bleeding were reported in either group, which confirms the safety of the technique under appropriate patient selection.

Patient satisfaction was high in both groups, slightly higher in the SA group, underlining that patients tolerated SA well when given proper counselling and intraoperative sedation if needed.

These findings strengthen the case for SA as an alternative to GA for LC in suitable patients, particularly in resource-limited settings where cost savings and shorter hospital stays are desirable.[14]

While GA remains the standard for complex or prolonged laparoscopic procedures, SA can be safely used in straightforward elective LC cases in experienced hands.

This study's results align with international evidence suggesting that SA is an effective and safe technique for LC when careful patient selection, anaesthetic technique, and intraoperative management are ensured.[15]

CONCLUSION

This prospective randomized study demonstrates that spinal anaesthesia (SA) is a safe, feasible, and cost-effective alternative to general anaesthesia (GA) for elective laparoscopic cholecystectomy (LC) in well-selected patients. The findings show that LC performed under SA offers comparable operative conditions and surgical outcomes to GA, with the added benefits of significantly lower early postoperative pain scores, earlier return of bowel function, and reduced incidence of postoperative nausea and vomiting. Minor intraoperative hemodynamic changes such as hypotension and bradycardia were observed but were easily managed with standard measures.

Although the conversion rate from SA to GA was minimal, it highlights the need for careful patient selection, appropriate anaesthesia technique, and good intraoperative monitoring to ensure patient safety and comfort. Importantly, no major complications were reported, and patient satisfaction remained high, supporting the acceptability of SA for LC.

Based on these results, SA can be considered a viable routine anaesthetic technique for elective LC, particularly in resource-limited settings where minimizing costs, avoiding airway manipulation, and ensuring faster recovery are important goals. Future larger multicentric studies could further validate these findings and help establish clear guidelines for wider adoption of SA in minimally invasive gallbladder surgery.

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