

**A COMPARATIVE INVESTIGATION OF SPINAL ANESTHESIA VERSUS
GENERAL ANESTHESIA FOR LAPAROSCOPIC CHOLECYSTECTOMY**

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Abstract

Background: Laparoscopic cholecystectomy (LC) has traditionally been performed under general anesthesia (GA) in our institution. However, various studies have suggested spinal anesthesia (SA) as a viable alternative. This study aimed to assess the efficacy and benefits of conducting laparoscopic cholecystectomy under SA compared to GA.

Methods: N=60 patients with symptomatic cholelithiasis and American Society of Anesthesiologists status I or II were randomly assigned to undergo LC under either S(n=30) or G(n=30). Intraoperative parameters, postoperative pain, complications, recovery, and patient satisfaction were compared between the two groups.

Results: The mean age of the patients was 48 years, with n=6(10%) being male and n=54(10%)90% female. The SA group exhibited more instances of shoulder pain and experienced higher occurrences of bradycardia and hypotension intraoperatively. However, there was no statistically significant difference in the duration of surgery between the two groups. Significantly fewer patients in the S group reported postoperative vomiting and pain at the operative site. Gastrointestinal function returned within 12 hours and recovered earlier in the S group. Moreover, port site infection rates and hospital stay duration were significantly lower in the S group compared to the G group.

Conclusion: Laparoscopic cholecystectomy under spinal anesthesia was found to be both feasible and safe. Therefore, it may be recommended as the preferred anesthesia technique for performing laparoscopic cholecystectomy, especially in hospital settings in developing countries where cost considerations play a significant role.

Keywords: General anesthesia, laparoscopic cholecystectomy, spinal anesthesia

Introduction

Laparoscopic cholecystectomy (LC) has emerged as the preferred surgical approach for treating symptomatic cholelithiasis and has gained widespread recognition [1]. This minimally invasive procedure, facilitated by a laparoscope, eliminates the need for standard incisions, leading to significantly shorter hospital stays and faster recovery compared to traditional open cholecystectomy. Spinal anesthesia (SA) has emerged as a popular alternative to general

anesthesia (GA) for LC. Initially reserved for high-risk patients, SA is now increasingly used for otherwise healthy individuals as well [2]. SA boasts a favorable safety profile, offering several advantages over GA during both intraoperative and postoperative periods. These benefits include reduced postoperative pain, nausea, vomiting, and smoother recovery as patients are awake and alert following the procedure [3]. Additionally, SA avoids specific complications associated with GA, such as cardiac, muscular, and potential cerebral issues. Given these advantages, the role of SA in LC is being explored worldwide to mitigate the risks associated with GA [4]. Therefore, the primary objective of this prospective study was to evaluate whether SA could replace GA as the standard anesthesia technique for LC in clinical practice. Furthermore, the study aimed to assess the efficacy and benefits of performing LC under SA compared to GA.

Material and Methods

This cross-sectional study was conducted in the Department of Anesthesiology, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical Approval was obtained for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language. A total of 60 patients were evenly divided into two groups.

The study included a total of fifty cases with symptomatic cholelithiasis, randomly divided into two groups for comparison. Each group comprised 30 cases with normal coagulation profiles and American Society of Anesthesiologists status I or II, body mass index <30 kg/m², both sexes and ages 16 and above. Laparoscopic cholecystectomy under either spinal anesthesia or general anesthesia was performed, and comparisons were made between the two groups during both intraoperative and postoperative periods. Exclusion criteria encompassed patients with acute cholecystitis, cholangitis, gallstone-induced pancreatitis, gallbladder cancer, portal hypertension, poor cardiac reserve, and a history of previous open upper abdominal surgery. Additionally, patients with contraindications for spinal anesthesia, such as spinal deformity, local lumbar puncture site sepsis, brain space-occupying lesions, and severe hypertension, were not enrolled.

In the spinal anesthesia group, premedication included alprazolam the night before and on the day of surgery, along with intravenous Midazolam. Lumbar puncture was performed at the L3-L4 space, followed by injection of bupivacaine and clonidine into the subarachnoid space. Monitoring included blood pressure, SpO₂, heart rate, and patient anxiety, defined as anxiety leading to the need for conversion to general anesthesia. During surgery, oxygen supplementation was administered as needed. In the general anesthesia group, induction was achieved with Propofol, Fentanyl, and Atracurium, followed by endotracheal intubation and mechanical ventilation. Anesthesia maintenance involved an air-oxygen mixture with Isoflurane. Pneumoperitoneum was established at a pressure of 12 mmHg, and LC was performed using a standard four-trocar technique. Dissection of the gallbladder commenced at the triangle of Calot, with identification and clipping of the cystic duct and artery. Subsequently, gallbladder mobilization from the liver bed occurred, followed by gallbladder removal and placement of a subhepatic drain according to institutional protocol. During the intraoperative period, several parameters were compared between the two groups, including intra-peritoneal CO₂ pressure, gas volume utilized, occurrence of neck/shoulder tip pain, hypotension (defined as a <20% decrease in blood pressure), anxiety levels, instances of stomach distension requiring Ryle's tube aspiration, and the duration of surgery. For surgeries performed under general anesthesia, the duration was measured from intubation to extubation,

while under spinal anesthesia, it was measured from the onset of spinal anesthesia to skin closure. In the postoperative period, various parameters were assessed, including episodes of vomiting, need for pain medication, occurrence of urinary retention, headache, chest complications, muscle pain induced by relaxants, dizziness, port site infection, and overall patient satisfaction measured using the Karnofsky scale. This scale evaluates whether the patient is capable of normal activities and work without special care, able to live at home and care for most personal needs but unable to work or requires hospitalization and assistance for self-care. Patients were followed up for 10 days postoperatively to assess these parameters.

Statistical analysis: All the available data was refined and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 15 in Windows format. All the continuous variables were denoted as mean, standard deviations, and percentages, and categorical variables were denoted as p values, and p values of < 0.05 were considered significant.

Results

Table 1 presents intraoperative parameters compared between patients undergoing cholecystectomy under spinal anesthesia and general anesthesia. *Intraperitoneal Pressure of CO₂:* The mean intraperitoneal pressure of CO₂ during surgery was 15 mmHg in the spinal anesthesia group and 18 mmHg in the general anesthesia group. *Gas Volume Used:* Gas volumes used during surgery were categorized into three ranges: 40-60 liters, 60-80 liters, and 80-100 liters. There were 20 cases in the spinal anesthesia group and 19 cases in the general anesthesia group where 40-60 liters of gas were used. Similarly, for the other two ranges, the distribution of cases was comparable between the two groups.

Neck and Shoulder Tip Pain: During intraoperative and postoperative periods, the occurrence of neck and shoulder tip pain was compared. In the intraoperative period, 18 cases in the spinal anesthesia group reported pain compared to none in the general anesthesia group, showing a statistically significant difference (p=0.001). However, in the postoperative period, only 4 cases in the spinal anesthesia group experienced pain compared to none in the general anesthesia group. *Bradycardia:* Bradycardia occurred in 12 cases in the spinal anesthesia group and 1 case in the general anesthesia group, indicating a significant difference (p = 0.001). *Hypotension:* Hypotension was observed in 4 cases in the spinal anesthesia group and 1 case in the general anesthesia group, but the difference was not statistically significant (p = 0.302). *Anxiety:* Anxiety was reported in 13 cases in the spinal anesthesia group and 1 case in the general anesthesia group, showing a significant difference (p = 0.001). *Duration of Surgery:* The duration of surgery was categorized into three ranges: 40-60 minutes, 60-80 minutes, and 80-100 minutes. There were no significant differences in the duration of surgery between the two groups across all three ranges.

Table 1: Intraoperative parameters in spinal anesthesia and general anesthesia group for cholecystectomy patients

Parameter	Spinal Anesthesia (n=30)	General Anesthesia (n=30)	p-value
Intraperitoneal Pressure of CO ₂ in mm of Hg	15	18	
Gas Volume used (in Liters)			
40 – 60	20	19	0.125
60 – 80	7	8	0.332
80 – 100	3	3	0.152
Neck And Shoulder Tip Pain			
Intraoperative	18	0	0.001
Postoperative	4	0	0.012
Bradycardia	12	1	0.001
Hypotension	4	1	0.302
Anxiety	13	1	0.001
Duration of Surgery (in minutes)			
40-60	20	19	0.236
60-80	8	8	1.000
80-100	2	3	0.995

Table 2: Relationship of post-operative parameters in Spinal anesthesia and general anesthesia group in laparoscopic cholecystectomy

<i>Parameter p-value</i>	<i>Spinal Anesthesia (n=30)</i>	<i>General Anesthesia (n=30)</i>	<i>P value</i>
Post-Operative Vomiting	6	10	0.147
Postoperative Pain	5	6	0.891
Test condition at hours			
4 hours	3	10	0.014
8 hours	8	14	0.062
12 hours	9	18	0.021
24 hours	7	9	0.514
Gut function Return Within 12 hours	12	4	0.002
Urinary Retention	8	5	0.214
Port Site Infection	4	5	1.000
Hospital Stay (in days)			
1	19	4	0.001
2-3	8	22	0.001
4	3	4	0.925

Table 2 illustrates the relationship between postoperative parameters in patients undergoing laparoscopic cholecystectomy under spinal anesthesia and general anesthesia. Post-Operative Vomiting: There were 6 cases of post-operative vomiting in the spinal anesthesia group

compared to 10 cases in the general anesthesia group. However, this difference was not statistically significant ($p = 0.147$). Postoperative Pain: The occurrence of postoperative pain was comparable between the two groups, with 5 cases in the spinal anesthesia group and 6 cases in the general anesthesia group ($p = 0.891$). Test Condition at Hours: The condition of patients at different postoperative time intervals (4, 8, 12, and 24 hours) was compared between the two groups. At 4, 12, and 24 hours post-surgery, there were significant differences in the condition of patients between the two groups ($p = 0.014$, $p = 0.021$, $p = 0.514$, respectively). However, at 8 hours post-surgery, although there was a trend towards significance, the difference was not statistically significant ($p = 0.062$). Gut Function Return Within 12 Hours: Gut function returned within 12 hours in 12 cases in the spinal anesthesia group and 4 cases in the general anesthesia group. This difference was statistically significant ($p = 0.002$), indicating a faster recovery of gut function in the spinal anesthesia group. Urinary Retention: Urinary retention occurred in 8 cases in the spinal anesthesia group and 5 cases in the general anesthesia group, but the difference was not statistically significant ($p = 0.214$). Port Site Infection: There were 4 cases of port site infection in the spinal anesthesia group and 5 cases in the general anesthesia group, with no significant difference between the groups ($p = 1.000$).

Hospital Stay: The duration of hospital stay was categorized into three ranges: 1 day, 2-3 days, and 4 days. There were significant differences in hospital stay between the two groups across all three ranges ($p = 0.001$, $p = 0.001$, $p = 0.925$, respectively). Specifically, more patients in the spinal anesthesia group had a shorter hospital stay of 1 day compared to the general anesthesia group. Conversely, more patients in the general anesthesia group had a hospital stay of 2-3 days compared to the spinal anesthesia group. There was no significant difference in the number of patients staying in the hospital for 4 days between the two groups.

Assessment of Postoperative Satisfaction: Patient satisfaction post-surgery was evaluated using the Karnofsky performance status both at discharge and during follow-up after 10 days. Overall, no distinction was observed, as patients from both groups were capable of resuming their regular activities without exhibiting any signs or symptoms of illness.

Discussion

Laparoscopic cholecystectomy is widely acknowledged as the foremost treatment for symptomatic cholelithiasis, typically administered under general anesthesia. However, this investigation substantiates the safety of conducting laparoscopic cholecystectomy under spinal anesthesia. Shoulder pain associated with laparoscopy, primarily stemming from CO₂ pneumoperitoneum-induced diaphragmatic irritation, is a recognized occurrence. In this study, eighteen patients experienced some degree of shoulder discomfort, with half finding it mild and tolerable, necessitating only Injectable Fentanyl without any need for altering the anesthetic technique. Injectable Ketamine was administered to four patients experiencing severe shoulder tip pain, resulting in their calmness. The incidence of intraoperative shoulder-tip pain (30%) in this study notably exceeded that reported by van Zundert AAJ et al. [5], who observed a 25% incidence of shoulder-tip pain during laparoscopic cholecystectomy under spinal anesthesia. Tzovaras G et al. [6] documented a 43% incidence of intraoperative shoulder tip pain in patients undergoing laparoscopic cholecystectomy under spinal anesthesia, compared to 48% under epidural anesthesia [7]. The higher occurrence of shoulder tip pain in our study may be attributed to the elevated cutoff value of intra-abdominal pressure at 12 mm Hg, combined with minimal tilting of the operating table [8], in contrast to the aforementioned studies where the cutoff value was 10 mm Hg, and the left tilt of the operating table ranged between 15-30 degrees.

The comparatively no incidence of postoperative shoulder tip pain under general anesthesia in our study contrasts with another study [5]. This discrepancy may be attributed to the gentle liver retraction and minimal irrigation performed during the procedure in our study, along with the complete evacuation of residual CO₂ at the surgery's conclusion [9]. Postoperative neck and shoulder tip pain in the spinal anesthesia group was only 12%, possibly due to these aforementioned factors. We opted for low-pressure pneumoperitoneum, with a maximum intra-abdominal pressure of 12 mm Hg, to minimize diaphragmatic irritation, and abdominal, and respiratory discomforts [8]. The use of low-pressure pneumoperitoneum did not compromise surgical space or vision, and all procedures were completed with minimal technical difficulty. The superior muscular relaxation afforded by spinal anesthesia enabled comfortable laparoscopic cholecystectomy, even in obese patients [7]. Anxiety during the intraoperative period under spinal anesthesia is a recognized phenomenon, observed in 13 cases (43.33%) in our study, alleviated by administering Fentanyl and Ketamine. The incidence of anxiety was similar at 44%, in the study by Rajeev Sinha et al. [10], who reported 0.21%, which may be due to the higher cutoff value of intraabdominal pressure of 12 mm Hg in our study, compared to 8 mm Hg in the aforementioned study.

Postoperative nausea and vomiting predominantly afflict patients under general anesthesia due to various anesthetic agents like nitrous oxide, propofol, and isoflurane. In our study, they were observed in 33.33% of cases under general anesthesia and in 20% of cases under spinal anesthesia. This contrasts with the findings of Thune et al. [11], where 50-70% of patients undergoing laparoscopic cholecystectomy under general anesthesia experienced postoperative nausea and vomiting, and with a study by Palachewa et al. [12], where 8.1% of cases under spinal anesthesia suffered from these symptoms. Administration of antiemetics provided relief. Post-operative urinary retention occurred more frequently in cases under spinal anesthesia [13]. Immediate catheterization, with no adverse effects on recovery or discharge times, was necessary in 8 (26.66%) cases under spinal anesthesia and 2 (6.66%) cases under general anesthesia, compared to the incidence of 11.7% reported by Palachewa et al. [12], likely attributed to muscular paralysis.

Chest complications and sore throat, primarily stemming from intubation, were observed in 4 cases under general anesthesia in our study, mainly manifesting as cough with low-grade fever and sore throat. In contrast, no such complaints were noted in cases under spinal anesthesia, consistent with the findings of Casey WF [14], where morbidity was higher in cases under general anesthesia. While cerebral complications can occur under both spinal and general anesthesia, none were observed in our study under either form of anesthesia. Relaxants commonly induce muscle pain and dizziness under general anesthesia; however, no such side effects were observed in cases under general anesthesia in our study. Headache, primarily observed in cases undergoing spinal anesthesia, typically arises from leakage of CSF fluid at the lumbar puncture site. In our study, it occurred in 8 out of 30 cases (26.66%) under spinal anesthesia, compared to Hyderally H's study [15], where the incidence was 14%, mainly postural and relieved by reclining and increasing fluid and salt intake. This difference in incidence in our study may be attributed to the use of a finer spinal needle of 26 gauges.

There was a minimal disparity in port site infection between both groups in our study, with 5 cases (16.66%) under spinal anesthesia and 4 cases (13.33%) under general anesthesia, consistent with the findings of R Sinha et al. [10], where the incidence was the same in both groups. A majority of cases (63.33%) under spinal anesthesia were discharged on the 1st postoperative day, contrasting with only 4 cases (13.33%) under general anesthesia. Similarly, 8 cases (26.66%) under spinal anesthesia and 22 cases (73.33%) under general anesthesia were

discharged on the 2nd to 3rd postoperative day. This differs from the Tzovaras et al. study [6], where 98% of cases under both spinal and general anesthesia were discharged after 24 hours.

At discharge, overall patient and attendant satisfaction, assessed using the Karnofsky performance status questionnaire, was 100%, compared to Tzovaras's study [6], where satisfaction rates were 96% under spinal and 94% under general anesthesia. Patients reported high satisfaction with the anesthetic approach, attributed to effective postoperative pain control, minimal nausea and vomiting, reduced fatigue, and an overall sense of well-being. Patient education and reassurance during the perioperative period likely contributed, as most patients chose to remain awake during surgery. Adequate preoperative explanation regarding the potential need for intravenous analgesics or anxiolytics, or conversion to general anesthesia, is crucial for the success of spinal anesthesia. Preoperative patient information regarding the perioperative care plan aids in coping with surgery, reduces anxiety, and promotes recovery. Furthermore, knowledgeable patients typically require less postoperative analgesia.

Conclusion

In conclusion, this study indicates the adequacy and safety of lumbar spinal anesthesia with hyperbaric Bupivacaine and Clonidine for elective laparoscopic cholecystectomy in healthy patients. Spinal anesthesia offers minimal intraoperative hemodynamic disturbances and effective postoperative pain control, contributing to overall patient satisfaction. With appropriate implementation and refinement, spinal anesthesia has the potential to become the preferred anesthetic technique for elective laparoscopic cholecystectomy.

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