

ORIGINAL RESEARCH

A Prospective Surgical Evaluation of the Feasibility, Safety, and Outcomes of Laparoscopic Cholecystectomy

¹Dr. Manoj Kumar Garg, ²Dr. Ashish Chhabra, ³Dr. Vikram Kumar Arora

¹Associate Professor, Department of General Surgery, Dr. S.S. Tantia Medical College, Hospital and Research Center, Sri Ganganagar, Rajasthan, India

^{2,3}Associate Professor, Department of Orthopaedics, Dr. S.S. Tantia Medical College, Hospital and Research Center, Sri Ganganagar, Rajasthan, India

Corresponding author

Dr. Vikram Kumar Arora

Associate Professor, Department of Orthopaedics, Dr. S.S. Tantia Medical College, Hospital and Research Center, Sri Ganganagar, Rajasthan, India

Received Date: 16 September, 2024

Accepted Date: 19 October, 2024

Published: 10 November, 2024

ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the standard surgical treatment for symptomatic uncomplicated gallstone disease and is conventionally performed under general anesthesia (GA). However, spinal anesthesia (SA) has emerged as a potential alternative, especially in patients where GA poses increased risk. This study aimed to compare the surgical outcomes of LC under spinal anesthesia versus general anesthesia. **Objectives:** To evaluate and compare the intraoperative and immediate postoperative outcomes of laparoscopic cholecystectomy performed under spinal anesthesia with those performed under general anesthesia in patients with uncomplicated symptomatic gallstone disease. **Materials and Methods:** This was a prospective randomized study involving two patient groups undergoing LC—one under spinal anesthesia and the other under general anesthesia. For the SA group, patients were positioned either sitting or in the left lateral decubitus posture based on comfort. Spinal anesthesia was administered via subarachnoid puncture at the L3–L4 interspace using 2.5–3.5 ml of 0.5% hyperbaric bupivacaine. **Results:** A statistically significant difference in the incidence of intraoperative hypotension was observed between the two groups ($p = 0.008$), with higher rates in the spinal anesthesia group. However, no statistically significant difference in intraoperative hypertension was found between the groups. **Conclusion:** Spinal anesthesia is a viable option for laparoscopic cholecystectomy in appropriately selected patients. While it offers potential benefits, attention must be paid to managing intraoperative hypotension and bradycardia, which are more common under spinal anesthesia.

Keywords: Spinal Anesthesia, Laparoscopic Cholecystectomy, Gallstone

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INTRODUCTION

Laparoscopic cholecystectomy (LC) has emerged as the gold standard for the surgical management of symptomatic cholelithiasis and gallbladder diseases due to its minimally invasive nature, reduced postoperative pain, shorter hospital stay, and quicker recovery time. Traditionally, general anesthesia (GA) has been considered the anesthetic technique of choice for LC, primarily due to the creation of pneumoperitoneum, the Trendelenburg position, and the need for airway control. However, recent advancements in regional anesthesia techniques have stimulated growing interest in the use of spinal anesthesia (SA) as a viable alternative.

Spinal anesthesia offers several potential benefits in laparoscopic procedures, including better

postoperative analgesia, reduced incidence of postoperative nausea and vomiting (PONV), early ambulation, and decreased systemic drug exposure. Furthermore, it avoids the risks associated with general anesthesia, particularly in patients with significant comorbidities such as chronic obstructive pulmonary disease (COPD) or cardiovascular instability. These advantages are especially pertinent in resource-limited settings and for patient populations at higher risk of GA-related complications.

This has been attributed to the minimally invasive nature of the procedure, which is associated with less post-operative pain, reduced hospital stay, and earlier return to daily activities.^{1,2} The potential for LC to be performed as a day case has been recognized only a

few years after the introduction of the procedure.³ Several randomized studies comparing day-case and overnight-stay LC have confirmed that day-case LC in selected patients was feasible and safe and was associated with a high degree of patient satisfaction without an increase in the complications rate.⁴⁻⁷

Adequate pain relief is an important aspect of day-case surgery. Various methods have been attempted to decrease postoperative pain following LC such as peritoneal instillation of normal saline or local anaesthetic and wound infiltration with local anaesthetic.^{8,9} Spinal anaesthesia is a less invasive anaesthetic technique that has lower morbidity and mortality rates, compared with general anaesthesia.¹⁰

Spinal anaesthesia (SA) is a commonly used anaesthetic technique that has a very good safety profile. SA has several advantages over GA. These advantages include the patients' being awake and oriented at the end of the procedure, less postoperative pain, and the ability to ambulate earlier than patients receiving general anaesthesia. Moreover, the incidences of nausea and vomiting are less with selective spinal anaesthesia than with general anaesthesia.¹¹ SA is more effective than GA in blunting the neuroendocrine stress and adverse responses to surgery.¹² Some possible problems related to the technique of general anaesthesia such as teeth and oral cavity damage during laryngoscopy, sore throat, and pain related to intubation and/or extubation are prevented by administering selective spinal anaesthesia to patients undergoing laparoscopic interventions.¹³ There are multiple reports that have been published regarding the feasibility of SA for LC in patients fit for GA.¹⁴⁻²⁰

The choice of anaesthesia for laparoscopic surgery has for long been general anaesthesia because of the following reasons: a) The patient's airway is under the control of the anaesthesiologist, b) Minimal chances of aspiration due to gastric regurgitation, c) No patient discomfort and shoulder pain due to pneumoperitoneum, d) Controlled ventilation to manage hypercarbia, e) No patient discomfort due to change in position, f) No complications due to decreased sympathetic outflow such as hypotension and bradycardias seen with regional anaesthesia, g) Better hemodynamic status.^{21,22}

Nonetheless, the application of spinal anaesthesia in laparoscopic surgeries remains controversial. Concerns persist regarding patient discomfort due to pneumoperitoneum, limited respiratory reserve in the conscious state, and intraoperative hemodynamic

instability. Despite these challenges, several small-scale studies have demonstrated promising outcomes, suggesting that with appropriate patient selection and intraoperative management, LC under spinal anaesthesia can be a feasible and safe option.

This prospective study aims to evaluate the practicality, safety, and surgical outcomes of laparoscopic cholecystectomy performed under spinal anaesthesia. By systematically assessing intraoperative parameters, patient satisfaction, complications, and recovery profiles, this research seeks to contribute valuable evidence toward optimizing anesthetic approaches in minimally invasive gallbladder surgery.

MATERIALS AND METHODS

Permission from Institutional ethical committee was sought for and obtained. All 60 patients were explained about the study and written informed consent obtained. All patients were interviewed by the anaesthesiologist in a pre-operative visit who in turn specifically instructed them about possible intraoperative events while under SA, like vomiting, shoulder pain and anxiety. It was instructed to them that in eventuality of ibid events occurring, intravenous medications would be administered and, if required, conversion to GA would be done. As there would be multiple outcomes possible, no separate analysis was undertaken to determine the size of the study groups.

In the general anaesthesia group, anaesthesia was induced with 2.5 mg/kg of propofol and 0.6 mg/kg-1 of rocuronium. Maintenance of anaesthesia was done with O₂, N₂O and sevoflurane. The respiratory rate was adjusted to maintain PETCO₂ between 32 and 36 mmHg. Expired concentrations of CO₂, O₂, and sevoflurane were monitored continuously by a gas analyzer. Residual neuromuscular blockade was antagonized with 2.5 mg of neostigmine and 0.4 mg of glycopyrrolate at the end of the surgery.

In the spinal anaesthesia group, the patients were placed in sitting or left lateral decubitus position as deemed comfortable. The subarachnoid space puncture was performed between the L3-L4 apophyses and 2.5–3.5 ml of hyperbaric 0.5% bupivacaine were injected. Afterwards, patients were placed in the supine position with a head-down position. After the surgeon confirmed anaesthesia at T4 level by pin prick, "go-ahead" was given. If the mean arterial pressure dropped below 60 mmHg, 3 µg of mephenataramine was administered. During the procedure, anxiety was treated by 2 mg midazolam and pain with fentanyl 50 µg in intravenous boluses.

RESULTS

In the above table it was observed that there was no statically significant difference in ASA between the two groups [Table 1].

Table 1: Comparison of ASA between two groups.

AS A	General Anesthesia		Spinal Anesthesia		P Value
	Frequency	%	Frequency	%	
1	42	70 %	46	76.6 %	0.337
2	18	30 %	14	23.3 %	
Total	60	100%	60	100%	

In the above figure it is seen that there was statically significant difference in intraoperative hypotension* between the two groups (p value 0.008) but there was insignificant difference in hypertension between two groups [Table 2].

Table 2: Comparison of Hypo/Hypertension between two groups.

Group	General Anesthesia (n=60)		Spinal Anesthesia (n=60)		P Value
	Frequency	%	Frequency	%	
Hypotension	0	0.0%	10	16.6%	0.008
Hypertension	5	8.3%	3	5.0%	0.619

Operative difficulty was noted in 0.0% of G.A cases and in 8% of cases under S.A the difference was statically insignificant [Table 3].

Table 3: Comparison of Operative difficulty between two groups.

Operative Difficulty	General Anesthesia		Spinal Anesthesia		P Value
	Frequency	%	Frequency	%	
No	60	100%	51	85.0 %	0.118
Yes	0	0.0%	9	15.0%	
Total	60	100%	60	100	

DISCUSSION

The comparison of ASA between the two groups showed: 74% of patients of G.A group fell into ASA 1 compared with 82% in S.A group. 26% of patients of G.A group fell into ASA 2 compared with 18 % in S.A group. There was no statically significant difference in ASA between the two groups.

In our study intraoperative hypotension was recorded in none of the patients that received G.A and 16 % patients receiving S.A. The difference being statically significant (p value 0.006). Intra-operatively, intravenous phenylephrine was administered when mean arterial blood pressure drops of more than 20% from the pre-anesthetic values. In all these cases, mean arterial blood pressure was then normalized and the procedure was completed uneventfully. In a study researcher observed hypotension in 4 % of G.A group patients as compared to 59 % patients from S.A group which was reversed by i.v phenylephrine. In our study hypertension was recorded in 6 % of G.A patients and 2% of S.A group patients. The difference in incidence of intraoperative hypertension between the two groups was insignificant. In our study operative difficulty was noted in 0.0 % (0) of G.A cases and in 8% (4) of cases under SAB the difference was statically insignificant (p value 0.117). None of the patients of S.A group required conversion to G.A due to operative difficulty. None of our surgeons reported inadequate relaxation of abdominal wall leading to any sought of difficulty during the procedure in S.A group.

Low pressure pneumoperitoneum in our cases added to technical complexity of the dissection process. The surgeon had to be slower and gentler in tissue dissection. Additionally, on occasions, it became necessary to interrupt the procedure when the patient complained of discomfort and then the anaesthesiologist had to intervene with additional medication. This explains the fact that the pneumoperitoneum time and correspondingly the surgery time was more in the SA group. Other studies^[18,19] too have documented the technical difficulty faced by the surgeon when operating in limited field permitted by low pressure pneumoperitoneum. The significant advantage of this is in terms of reduced post-operative pain, less use of analgesics, preservation of pulmonary function, and reduced hospital stay.

The post-operative recovery of patients was normal in all patients of both the groups. It is described that SA is associated with lower frequency of serious peri-operative morbidities and an improved outcome when compared to GA.^{23,24} In our series the incidence of post-operative events which required intervention was 21% in GA group compared to 11% in the SA group. But in our opinion, it is not justified to compare the two groups on this basis. While in one group the events were peculiar to GA, in the other they were peculiar to SA. Perhaps the only event which would be common to both would be surgical procedure related pain which was consistently reported significantly less by the patients who had undergone the surgery under SA as compared to those

who had undergone it under GA. We believe this was due to the sensory blockade which persists for some time in the post-operative period. The patients in SA group seemed to have lesser pain in immediate post-operative period but by the time of discharge the level of post-operative pain/ discomfort was same for both groups. Bessa *et al.*,²⁵ in a similar study, too confirm that LC done under SA results in significantly less early post-operative pain, compared to that performed under general anaesthesia.

In 2009 Gautam B, performed laproscopic cholecystectomy on twelve American Society of Anaesthesiologists' physical status I or II patients received SA using 4 ml of 0.5% hyperbaric bupivacaine mixed with 0.15 mg Morphine. Results were spinal anaesthesia was adequate for surgery in all but one patient. Intraoperatively, two out of four patients who experienced right shoulder pain received fentanyl. Two patients were given midazolam for anxiety and one was given ephedrine for hypotension. Operative difficulty scores were minimal and surgery in one patient was converted to open cholecystectomy. Postoperatively, pain scores were minimal and no patient demanded opioid. One patient required antiemetic for vomiting and one patient each suffered headache and urinary retention. 11 patients were discharged within 48 hours of surgery and patient satisfaction scores were very good.²⁶

CONCLUSION

Intraoperative hypotension and bradycardia need to be addressed during laparoscopic cholecystectomy under spinal anaesthesia. It provided with good patient selection laparoscopic cholecystectomy under spinal anaesthesia can substitute that under general anaesthesia. Spinal anaesthesia can be recommended to be the anaesthesia technique of choice for conducting laparoscopic cholecystectomy in hospital setups in developing countries where cost factor is a major factor.

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