

Original Research Article

## Spinal anesthesia versus general anesthesia in laparoscopic cholecystectomy: a comparative study

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**Abstract:** Laparoscopic cholecystectomy (LC) is conventionally performed under general anesthesia (GA) in our institution. There are multiple studies which have found spinal anesthesia as a safe alternative. The study aimed to evaluate efficacy and advantages of performing laparoscopic cholecystectomy under spinal anesthesia (SA) in comparison to general anesthesia (GA). Fifty patients with symptomatic cholelithiasis and American Society of Anesthesiologists status I or II were randomly allocated to have LC under spinal (n = 25) or general (n = 25) anesthesia. Intra-operative vitals, postoperative pain, complications, recovery, and patient's satisfaction were compared between the 2 groups. Mean age of the patients was 48 years. Out of the total study participants 10% were males and 90% were females. In the SA group more patients complained of shoulder pain and also there were more incidences of bradycardia and hypotension during intra-operative period in SA group. There was no statistically significant difference in operating time between the two groups. Significantly fewer patients had post-operative vomiting and pain at operated site in the SA group. Gut function returned within 12 hours, restored early in SA group. Port site infection and hospital stay (in days) were also significantly less in SA group as compared to GA group. Laparoscopic cholecystectomy done under spinal anesthesia is feasible and safe. It can be recommended to be the anesthesia technique of choice for conducting laparoscopic cholecystectomy in hospital setups in developing countries where cost factor is a major factor.

**Keywords:** General anesthesia, laparoscopic cholecystectomy, spinal anesthesia

### INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the surgical treatment of symptomatic cholelithiasis and has gained worldwide acceptance [1]. By using a laparoscope, standard incision is avoided. So, this minimally invasive procedure requires significantly shorter hospital stay and there occurs quicker convalescence as compared with the classical open cholecystectomy [2].

Spinal anesthesia (SA) is a commonly used anesthetic technique for performing LC as an alternative to GA [3]. Initially it was reported only for cases who were high risk candidates for general anesthesia, more recently it has been used as a routine technique for otherwise healthy patients also [4].

Spinal anesthesia (SA) technique has a very good safety profile. Laparoscopic surgery done under spinal anesthesia has several advantages over that done

under general anesthesia in intra operative and post-operative periods like reduced post-operative pain, nausea, vomiting and smooth post anesthesia recovery period, as the patient is awake and oriented at the end of procedure. Also the complications specific to general anesthesia like cardiac, myogenic and possible cerebral complications do not occur in spinal anesthesia. To avoid these complications, role of spinal anesthesia in laparoscopic cholecystectomy is being evaluated world over [5-8].

The aim of this prospective study was to assess if spinal anesthesia instead of general anesthesia can be used as a routine in clinical practice and also to evaluate the efficacy and advantages of conducting LC under SA in comparison to GA.

### MATERIALS AND METHODS

The present study was conducted at Indira Gandhi Medical College, Shimla from January 2009 to

January 2011 in the Department of Surgery in collaboration with Department of Anesthesia. The study was approved by the Institutional Ethics Committee. A written informed consent was obtained from all the patients who had agreed to participate in the study. A detailed explanation of the procedure and risks involved was given.

The study comprised of total fifty cases presenting with symptomatic cholelithiasis. 25 cases each with normal coagulation profile & American Society of Anesthesiologist status I & II with body mass index  $<30\text{Kg/m}^2$ , belonging to both sexes & in age group of 16 & above were randomly divided in to two groups and enrolled for the study. Laparoscopic cholecystectomy, using CO<sub>2</sub> pneumoperitoneum, was performed under spinal anesthesia in one group & general anesthesia in other group and comparison of these groups was done during intraoperative & post-operative period.

The patients with acute cholecystitis, cholangitis, gallstone induced pancreatitis, gallbladder cancer, portal hypertension, patients with poor cardiac reserve and history of previous open surgery in the upper abdomen were excluded from the study. The patients with contraindication for spinal anesthesia i.e. spinal deformity, local sepsis at site of lumbar puncture, space occupying lesion of brain and severe hypertension were also not enrolled in the study.

#### **Technique of Spinal Anesthesia and General Anesthesia:**

In spinal anesthesia group, premedication was done with alprazolam 0.5mg at 10 pm previous night and 0.25 mg at 6 am on the day of surgery. Preloading was done with Colloid (6% Hydroxyethyl starch) 450ml and patients were pre medicated with 0.05 to 0.07 mg/kg of Midazolam intravenously. Lumbar puncture was done using 26 G needle in L3—L4 space and free flow of cerebrospinal fluid was observed. 3.5ml of 0.5% bupivacaine heavy + Clonidine 75mcg was injected into subarachnoid space and head down tilt of 10 to 15 degrees was kept for 3 to 5 minutes. The segmental level was achieved up to T4-T5 for enabling introduction of the epigastric port. The patient was monitored for blood pressure, SpO<sub>2</sub>, heart rate and patient anxiety. Patient anxiety has been defined as anxiety that resulted in inability to complete the procedure under spinal anesthesia and requiring conversion to general anesthesia. During surgery, oxygen supplementation was optional and was administered through a ventimask, at the rate of 3-5L/minute, only in patients with SpO<sub>2</sub> below 90%.

In the GA group, after pre-oxygenation, induction was done with Propofol (2mg/kg), Fentanyl (2mcg/kg,) and Atracurium (0.5mg/kg).An appropriate

size endotracheal tube was inserted after 3minutes of ventilation. Maintenance of anesthesia was done with air oxygen mixture enriched with Isoflurane (0.6-1.5%) and controlled mechanical ventilation. The patients were then placed in the supine, reverse Trendelenburg position with the arms fully abducted and a right up lateral tilt was given. A minimal possible tilt to facilitate exposure of the gallbladder of the patient was used (i.e. minimal use of both reverse Trendelenburg positioning and right shoulder elevation).

Pneumoperitoneum was set at a pressure of 12mmHg; initial insufflation of carbon dioxide (CO<sub>2</sub>) was done at a low flow rate (2L/min) and gradually increased to 5L/min. A standard four-trocar technique of LC was followed. Open technique was used for the placement of the umbilical port for the creation of pneumoperitoneum. A zero-degree optical scope was used for the surgery. Dissection of the gallbladder was started at the triangle of Calot with the identification and clipping of both the cystic duct and artery. Mobilization of the gallbladder from the liver bed started at the triangle of Calot. Following removal of the gallbladder, a sub hepatic drain was placed, as per our institutional practice.

During intraoperative period, various parameters were compared in the two groups such as intra peritoneal pressure of CO<sub>2</sub>, volume of gas used, neck/shoulder tip pain, hypotension ( $<20\%$  fall), anxiety, stomach distension requiring Ryle's tube aspiration & duration of surgery. In case of general anesthesia, duration of surgery was taken as the time from intubation to extubation. In case of spinal anesthesia duration of surgery was measured from the start of effect of spinal anesthesia to skin closure.

During post-operative period, parameters compared were vomiting, pain requiring medication, urinary retention, headache, chest complications, relaxant induced muscle pain, dizziness, port site infection and lastly the overall satisfaction of the patient under both methods of anesthesia using Karnofsky scale. This included whether patient was able to carry out normal activity & work with no special care needed or unable to work but able to live at home & care for most personal needs or unable to care for self & require hospitalization. Patient was followed up to 10 days post operatively.

#### **STATISTICAL ANALYSIS**

The data was analyzed using Epi Info software. Descriptive frequency and percentage were determined for the groups studied. Statistical analysis of the data was done using the chi— square test. A p-value of  $<0.05$  was taken as significant.

**Observations**

The present study comprised of total of 50 cases presenting with symptomatic cholelithiasis.

**Age and Sex Distribution:**

The age of the patients ranged from 16 to 80 years with a mean of 48 years. In general anesthesia group range was 24 to 80 years with the mean age of 52 years whereas in Spinal anesthesia group the age ranged from 16 to 58 years with a mean of 37 years. The total numbers of males and females in the present study were 5(10%) and 45(90%) respectively. In general anesthesia group, the total numbers of males were 4(6%) and females were 21(84%). In spinal anesthesia group, there were one (4%) male and 24(96%) females.

**Intra-operative period**

**Intraoperative Pressure:**

Pneumoperitoneum was created by closed technique in which CO<sub>2</sub> was insufflated into peritoneal

cavity through veress needle. Peritoneal pressure was kept at 12 mm of Hg in case of spinal anesthesia and 15 mm of Hg in case of general anesthesia.

**Gas Volume Used:**

In both the groups CO<sub>2</sub> consumed was comparable and there was no statistical difference in both the groups.( Table 1) CO<sub>2</sub> volume consumed during laparoscopic cholecystectomy does not depend upon type of anesthesia given. It depends upon the intra—operative findings and on time spent for calot’s triangle’s dissection.

The patients undergoing spinal anesthesia had significantly higher incidence of shoulder pain as compared to patients on general anesthesia. (p<0.001)Low incidence of post-operative shoulder tip pain was found in case of both spinal and general anesthesia 3 out of 25and 4 out of 25 respectively (Table1).

**Table 1: Intraoperative parameters in spinal anesthesia and general anesthesia group**

Parameter	Spinal Anesthesia (n=25)	General Anesthesia (n=25)	p-value
<b>Intraoperative Pressure of CO<sub>2</sub> in mm of Hg</b>	12	15	
<b>Gas Volume used (in Liters)</b>			
40 – 60	18	16	0.8
60 – 80	5	6	1.0
80 – 100	2	3	1.0
<b>Neck And Shoulder Tip Pain</b>			
Intraoperative	16	0	0.001
Postoperative	3	4	
<b>Bradycardia</b>	11	0	0.001
<b>Hypotension</b>	4	1	0.3
<b>Anxiety</b>	11	0	0.001
<b>Duration of Surgery (in minutes)</b>			
40-60	18	16	0.8
60-80	5	6	1.0
80-100	2	3	1.0

In cases performed under spinal anesthesia anxiety was a known entity. Despite the use of sedatives in the form of ketamine and pentazocine, it was found in 11 out of 25 cases but conversion to general anesthesia was not required. The patients who underwent spinal anesthesia had significantly higher incidence of bradycardia and anxiety as compared to patients on general anesthesia. (p<.001)Hypotension developed in 4 out of 25 cases under spinal anesthesia and in one case under general anesthesia (Table 1).

**Duration of Surgery:**

There was no statistically significant difference in operating time between the two groups. However the time from application of total anesthesia to wheeling the patient out of operating room actually decreased

appreciably when the patient was operated under spinal anesthesia because intubation and extubation time of general anesthesia was saved. Though the time was consumed to wait for the effect of spinal anesthesia to come.

**Post-Operative Period:-**

The incidence of post operating nausea and vomiting was higher in cases performed under general anesthesia as compared to those who underwent spinal anesthesia. Postoperative pain was assessed by visual analogue score at 4, 8, 12, 24 hours duration. Post-operative pain was significantly lower in spinal anesthesia group. (Table 2) Analgesic requirement was less in cases performed under spinal anesthesia as compared to those under general anesthesia. Gut

function returned significantly early in cases performed under spinal anesthesia ( $p < 0.005$ ).

Catheterization was required in 8 out of the 25 cases performed under spinal anesthesia and 2 out of the 25 cases performed under general anesthesia. Post-operative urinary retention was found more in cases performed under spinal anesthesia. Chest complications and sore throat was seen in 3 cases and 4 cases respectively performed under GA which might be due

to intubation and absorption atelectasis. There was no statistically significant difference in port site infection performed under both form of anesthesia (Table 2). 15 Cases performed under spinal anesthesia were discharged on first postoperative day and 21 cases performed under general anesthesia were discharged on 2<sup>nd</sup> to 3<sup>rd</sup> post operative day. Patients who underwent GA had statistically higher hospital stay as compared to patients who underwent SA. ( $p < .001$ )

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

Parameter	Spinal Anesthesia (n=25)	General Anesthesia (n=25)	p-value
<b>Post-Operative Vomiting</b>	4	9	0.196
<b>Postoperative Pain</b>			
<b>Test condition at hours</b>			
4 hours	1	8	0.023
8 hours	5	12	0.072
12 hours	7	16	0.022
24 hours	4	7	0.496
<b>Gut function Return Within 12 hours</b>	10	1	0.005
<b>Urinary Retention</b>	8	2	0.074
<b>Port Site Infection</b>	2	3	1.000
<b>Hospital Stay (in days)</b>			
1	15	2	0.001
2-3	8	21	0.001
4	2	2	1.000

#### Post-Operative Satisfaction:

Post-operative satisfaction of patient was assessed by Karnofsky performance status at discharge and on follow up after 10 days. Overall there was no difference as patients in both groups were able to carry their normal activity without any signs and symptoms of disease.

#### DISCUSSION

Laparoscopic cholecystectomy is considered the gold standard for treatment of symptomatic cholelithiasis. The laparoscopic cholecystectomy is classically performed under general anesthesia. This study confirms that it is possible to carry out laparoscopic cholecystectomy safely under spinal anesthesia.

Laparoscopy-related referred right shoulder pain, principally attributed to diaphragmatic irritation from CO<sub>2</sub> pneumoperitoneum is a well-known phenomenon [9]. Sixteen patients in the present study experienced some degree of shoulder pain. Importantly, it was mild and tolerable in half of the cases and required only Injectable Fentanyl and it did not necessitate conversion of anesthetic technique. Four patients who reported severe shoulder tip pain received injectable Ketamine and remained calm afterwards. The incidence of intraoperative shoulder tip pain (64%) in

the present study was much higher as compared with the work done by van Zundert AAJ *et al.*; [11] who reported 25% incidence of shoulder—tip pain during laparoscopic cholecystectomy under Spinal anesthesia. Tzovaras G *et al.*; [12] reported that 43% of patients who underwent laparoscopic cholecystectomy under spinal anesthesia suffered intraoperative shoulder tip pain as compared to 48% under epidural anaesthesia [13]. The higher incidence of shoulder tip pain in patients in the present study could be attributed to higher cutoff value of intra—abdominal pressure at 12 mm Hg combined with the minimal tilting of operating table [10] when compared to the above mentioned studies where the cut off value of intra-abdominal pressure was 10 mm of Hg and the left tilt of operating table was between 15-30 degrees.

Low incidence of postoperative shoulder tip pain under general anesthesia in the present study (16%) contrasts to another study [11]. Probably it is because in the present study gentle liver retraction and minimal irrigation was done during the procedure and complete evacuation of residual CO<sub>2</sub> was done at the end of surgery [14]. Postoperative neck and shoulder tip pain in the group performed under spinal anesthesia was only 12% again probably because of the above mentioned reasons.

We choose a low pressure pneumoperitoneum at a maximum of 12 mm Hg of intra-abdominal pressure. Low pressure minimizes diaphragmatic irritation as well as abdominal and respiratory discomforts [9, 10]. The use of low—pressure pneumoperitoneum did not imperil the adequacy of surgical space and vision and subsequently all the procedures were completed with minimal technical difficulty. Because of better muscular relaxation offered by Spinal anesthesia laparoscopic cholecystectomy under was performed comfortably even in obese patients also [13].

Anxiety during intraoperative period under Spinal anesthesia is a known entity and was seen in 11 cases (44%) and was overcome after giving injection Fentanyl and Ketamine. Incidence of anxiety was much higher 44% as compared to work done by Rajeev Sinha *et al.*; [15] who reported 0.21% probably because of higher cut off value of intraabdominal pressure of 12mm of Hg as compared to above study where cut off value was 8mm of Hg.

Hemodynamic effects of CO<sub>2</sub> pneumoperitoneum during spinal anesthesia were mainly hypotension and bradycardia. Four patients (16%) in the present study suffered from intraoperative hypotension as compared to study done by Palachewa *et al.*; [16] who reported 15.7% incidence. The low incidence of hypotension could be attributed to preloading with colloid (6% hydroxyethyl starch 450ml) fluid therapy, low intra—abdominal pressure, minimal operating table tilts and absence of any cardiovascular disease in the patients [17]. Hypotension occurring in the patient was easily overcome with injection mephenteramine, and it did not essentially affect the planned procedure.

Bradycardia was also seen in cases under spinal Anesthesia as a consequence of decreased sympathetic flow and decreased venous return and was overcome by giving atropine. In the present study it was seen in 11 (44%) cases as compared to study by Gautam *et al.*; [18] where incidence was nil ,probably none of patient in above mentioned study facilitate unopposed vagal reflex.

General anesthesia patients unlike spinal Anesthesia frequently have an additional problem of stomach distension as result of mask ventilation .This often require Ryle s tube aspiration In the present study it was seen in only 2 (8%) cases as compared to study by Rajeev Sinha *et al.*; [15] where incidence was 0.7%. In our study, 20% cases performed under spinal anesthesia and 48% cases performed under general anesthesia required injectable analgesic. After the completion of 12 hours pain was seen in 16% cases under Spinal anesthesia and 28% cases performed under

general anesthesia as compared to study by Tzouvaras *et al.*; [12] where incidence was 2% in cases performed under spinal anesthesia and 25% in cases performed under general anesthesia. Lesser requirement of postoperative analgesia in cases performed under spinal anesthesia was because of prolonged analgesia provided by combination of bupivacaine and clonidine.

Gut function return in form of early passage of flatus and bowel sound positive on auscultation was found in 10 (40%) cases done under spinal anesthesia as compared to one case done under General anesthesia which was comparable to study by Rajeev Sinha *et al.*; [15].

Postoperative nausea and vomiting is complication mainly seen in patient under general anesthesia as a result of various anesthetic agents such as nitrous oxide, propofol, isoflurane etc. In the present study it was seen in 36% of cases under general anesthesia and in 16% of cases performed under spinal anesthesia. Compared to study by Thune *et al*<sup>19</sup> where 50-70 % of patients following laparoscopic cholecystectomy under general anesthesia have been reported to suffer from post-operative nausea and vomiting [10] and in a study performed by Palachewa *et al.*; [16] 8.1% cases performed under spinal anesthesia suffered from nausea and vomiting. Nausea and vomiting were relieved after giving antiemetic.

Post-operative urinary retention developed in cases performed under spinal anesthesia [20]. Instant catheterization was required with no adverse effect on the patient's recovery as well as discharge times. It was seen in 8 (32%) cases performed under spinal anesthesia and 2 (8%) cases performed under general anesthesia compared to study by Palachewa *et al.*; [16] where incidence was 11.7% in cases performed under spinal anesthesia is probably as a result of muscular paralysis.

Chest complications and sore throat are mainly seen in cases under general anesthesia as a side effect of intubation. In the present study it was seen in 4 cases and mainly manifested as cough with low grade fever and sore throat in comparison no such complaint seen in cases done under spinal anesthesia which was comparable to study by Casey WF [21] where morbidity is higher in cases performed under general anesthesia.

Cerebral complications are known complications seen both under spinal and general anesthesia but in the present study no such complication was seen under both form of anesthesia. Relaxants induce muscle pain and dizziness and this side effect is seen in cases under general anaesthesia. In the present study no such side effect was observed in cases performed under general anesthesia.

Headache is a side effect seen mainly in cases performed under spinal anesthesia and develops as a result of leakage of CSF fluid from lumbar puncture site. In the present study it was seen in 6 out of 25 (24%) cases performed under spinal anesthesia as compared to study by Hyderally H [22] where incidence was 14% which was mainly postural and was relieved after making patient lying down and increased intake of fluid and salt. The present study was seen probably because of use of finer spinal needle of 26 gauges.

In the present study there was not much difference in port site infection in both groups. It was seen in 2 cases performed under Spinal 2(8%) anesthesia and in 3(12 %) cases performed under general anesthesia and was comparable to study by Rajeev Sinha *et al.*; [15] where incidence was same in both groups.

Most cases (60%) performed under spinal anesthesia were discharged on 1<sup>st</sup> postoperative day as compared to only 2 (8%) cases performed under general anesthesia. 8 (32%) cases performed under spinal and 21(84%) cases performed under general anesthesia were discharged on 2<sup>nd</sup> to 3<sup>rd</sup> postoperative day as compared to study by Tzovaras [12] where 98% of cases each performed under spinal and general anesthesia were discharged after 24 hours.

At discharge, overall satisfaction of patient and attendant was done on the basis of karnofsky performance status questionnaire. After 10 days the score was found to be 100 % compared to study by Tzovaras [12] where overall satisfaction was 96% under Spinal and 94% under general anesthesia. At the time of discharge, all patients reported being highly satisfied with the anesthetic approach which is attributable to a good postoperative pain control, minimal nausea & vomiting, less fatigue and a good feeling of well-being. In addition, these patients were constantly educated and reassured perioperatively; patient motivation and willingness had probably also contributed as most of the patients had chosen to be awake during their surgery. Adequate explanation to the patient regarding possible requirements of intravenous analgesics and anxiolytic or conversion to general anesthesia is vital for the success of spinal anesthesia. Preoperative patient information regarding the per operative care plan aids in coping with surgery, reduces anxiety and enhances recovery; in addition, the knowledgeable patient requires less analgesia postoperatively.

## CONCLUSION

This study provides an indication regarding adequacy and safety of lumbar Spinal anesthesia with hyperbaric Bupivacaine and Clonidine for conducting elective laparoscopic cholecystectomy in otherwise

healthy patients. Additionally, it appears that spinal anesthesia provides minimal intraoperative hemodynamic perturbations and is valuable in postoperative pain control. Early return of gut function and reduced incidence of postoperative nausea and vomiting, lesser hospital stay as compared to general anesthesia seen under spinal anesthesia add to overall patient's satisfaction. From these conclusions, it becomes clear that with proper application and with suitable improvements, spinal anesthesia has got the potential to emerge as the novel gold standard anesthetic technique for elective laparoscopic cholecystectomy.

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