Original Research Article

Role of Spinal Anesthesia in Laparoscopic Cholecystectomy: A Comparative Study in a North Indian Hospital

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Abstract

Background: Laparoscopic Cholecystectomy (LC) has become the procedure of choice for gallbladder removal surgeries. It is a surgical procedure, conventionally performed under general anesthesia (GA). There are multiple studies which have found spinal anesthesia as a safe alternative.
Aim: We have conducted this study to compare outcomes of spinal anesthesia and general anesthesia (as the gold standard) in patients undergoing elective laparoscopic cholecystectomy.
Materials and methods: Sixty patients of ASA (American Society of Anesthesiology) class I or II undergoing laparoscopic cholecystectomy with low-tension pneumoperitoneum were divided into two groups having 30 patients each. Group I received conventional general anesthesia with endotracheal intubation and mechanical ventilation and group II received spinal anesthesia using hyperbaric bupivacaine 15 mg and fentanyl 25 µg. Post-operative pain and complications were compared between the 2 groups.
Results: All the procedures were completed by the allocated method of anesthesia, as there were no conversions from spinal to general anesthesia. Pain was significantly lower at 2, 4, and 6 hours after the procedure for the spinal anesthesia group compared with those who received general anesthesia. The cost of the spinal anesthesia was significantly lower than that of the general anesthesia. There was

no significant difference found between the 2 groups in terms of complications, hospital stay, recovery, or degree of satisfaction at follow-up.

Conclusion: Spinal anesthesia is adequate, safe, and cost effective for laparoscopic cholecystectomy with low pressure pneumoperitoneum in otherwise healthy patients and offers better postoperative pain control than general anesthesia without limiting recovery.

Key words

Laparoscopic cholecystectomy, Laparoscopy, General anesthesia, Spinal anesthesia, VAS score.

Introduction

Conventionally, laparoscopic cholecystectomy (LC) is performed under general anesthesia (GA) to avoid aspiration, abdominal discomfort and hypercarbia secondary to induction of CO_2 pneumoperitoneum. However, in the past, as an alternative to GA, regional anesthesia techniques have been used for performing LC. Spinal anesthesia (SA), which is a type of regional anesthesia, is a commonly used anesthetics technique with a great safety profile [1]. The advantage of using spinal anesthesia includes analgesia and muscle relaxation while allowing complete preservation of consciousness and quick post-operative recovery. Moreover, it avoids the potential complications of general anesthesia [2]. LC has now become a popular alternative to open cholecystectomy and is regarded as a cost-effective technique for symptomatic cholelithiasis management. As compared with general anesthesia, spinal anesthesia has some advantages, including the patient being awake and oriented at the end of the procedure, less postoperative pain, and less incidence of post-operative nausea and vomiting [3]. A controlled randomized study was designed to compare spinal anesthesia versus the gold standard general anesthesia as anesthetic techniques for patients scheduled for elective laparoscopic cholecystectomy.

Materials and methods

The study was conducted from 2015 to 2017 in the Department of Anesthesiology, PBM hospital, Bikaner (Rajasthan), India after getting approvals from Institutional Ethics Committee. Sixty patients aged between 18 to 70 years, both male and female, belonging to ASA I or II grades, undergoing laparoscopic cholecystectomy surgery were included in the study. They were randomized into 2 groups of 30 patients each and an effort was made that the groups did not significantly differ with respect to parameters such as age, weight and height. Consecutive newly diagnosed cases of cholelithiasis who reported to the department of surgery and who were aged between 18 and 70 years and who met the criteria of American Society of Anesthesiologists (ASA) physical status I or II were enrolled in the study. Patients with chronic obstructive pulmonary disease, acute inflammatory process such as cholecystitis, pancreatitis or cholangitis, suspected/confirmed common bile duct stones and a history of cardiac disease were excluded. Furthermore, anxiety prone patients and patients in whom spinal anesthesia was contraindicated were excluded. Standard monitoring was applied with non-invasive BP, HR, PR, SpO_2. One intravenous canula was inserted into the patient's dorsum of hand and IV fluid was started. Pre-anesthetic medication was standardized for all patients. Each patient received Midazolam 1 mg IV, Ranitidine 50 mg IV and Metoclopramide 10 mg IV. Pre-anesthetic values of heart rate, mean arterial pressure, respiratory rate and pulse oximetry were recorded. Patients were assigned into 2 groups of 30 each, group I being spinal anesthesia (SA) group and group II being the general anesthesia (GA) group. In the spinal anesthesia group, the subarachnoid space puncture was performed between the L_3-L_4 apophyses and 3 to 3.4 ml of hyperbaric 0.5% bupivacaine plus Fentanyl 25 mcg was injected. As soon as sensory block level reached at T4 dermatome; surgical procedure was initiated. In

the General Anesthesia group, anesthesia was induced with Fentanyl 2 mcg/kg, Propofol 2.5 mg/kg and Succinylcholine 2 mg/kg. Laryngoscopy and intubation were done with appropriate sized endotracheal tubes. Maintenance of anesthesia was done with O_2, N_2O, Sevoflurane and Vecuronium. Residual neuromuscular blockage was antagonized with 2.5 mg of neostigmine and 0.4 mg of glycopyrrolate at the end of the surgery. Laparoscopic cholecystectomy was done as per the standard four-port technique. Certain salient features of the technique that were practiced for both the groups included:

(i) After the second trocar, the sub-diaphragmatic surface of the liver was bathed with 30 ml of a solution containing 10 ml each of 2% Lignocaine and 0.5% Bupivacaine dissolved in 10 ml of saline.
(ii) The pneumoperitoneum was maintained with CO2 at 8-10 mmHg.
(iii) Nasogastric tube was not introduced routinely. It was done if decompression of stomach was desired.
(iv) After gall bladder had been extracted, the gall bladder fossa was bathed with 20 ml of solution containing 5 ml each of 2% Lignocaine and 0.5% Bupivacaine dissolved in 10 ml of saline.

Patient anxiety, bleeding which could not be controlled by routine maneuvers, pain which was not relieved by addition of Inj. Fentanyl 100 µg were the criteria established for the conversion of anesthesia from SA to GA procedure. Continuous monitoring of hemodynamic parameters (Pulse, BP, SPO_2) was maintained for all patients in both the groups with non-invasive multi-parameter monitor. Patients in SA group were asked about presence of any intra-operative events such as pain in the right shoulder, anxiety, headache, nausea, vomiting, and abdominal discomfort. Patients were shifted to post anesthesia care unit and subsequently to general ward post-surgery. Patients were maintained on IV fluids post-surgery as per standard line of care. Thereafter, operating surgeon along with the anesthesiologist evaluated the patient for pain, nausea, and vomiting, consciousness level and vital parameters including oxygen saturation. Post-operative pain was evaluated, in both groups, using the Visual Analogue Scale (VAS) at 0, 2, 6, 12, 18 and 24 hours post-surgery. VAS is a 10 cm horizontal line labelled as no pain at one end and worst pain imaginable on the other end. Patient was asked to mark on the line depending on the severity of pain as below.

0	**No Pain**
1-3	**Mild Pain**
4-6	**Moderate Pain**
7-10	**Severe pain**

The other post-operative events related to the surgery or anesthesia recorded was discomfort, nausea, vomiting, shoulder pain, and urinary retention. Headache or any other neurologic complaints were also recorded. Patients were routinely discharged, unless some complication warranted further stay. The study data was analyzed statistically by using Z test and χ^2 test.

Results

In the SA group, the mean age of study population was 42.66±4.36 years whereas in GA group it was observed to be 38.76±3.34 years. SA group had mean weight of 55.83±10.63 kg as compared to GA patients with 58.86±11.93 kg mean weight. Out of 30 patients undergoing surgery under SA, 12 (40.0%) were males and 18 (60.0%) were females whereas among patients undergoing surgery under GA, 16(53.33%) were males and 14 (46.67%) were females (**Table - 1**).

Between both groups, when changes in pulse readings, SBP, DBP, MAP were observed intra-operatively, at 10, 15, 20, 25, 30 & 45 minutes respectively, the mean pulse among patients in SA group statistically significantly differed from that of patients of GA group (p value<0.05). In the SA group, the event occurrence was higher as compared to GA group in terms of hypotension, bradycardia and right shoulder pain (**Table - 2**). Though when $\chi 2$ test was applied to assess statistical difference between occurrence of these

events between 2 groups, it was observed to be statistically insignificant. (p>0.05). There was no significant difference statistically proved in pulse rate at any point of time post operatively, (p>>0.05). while SBP, DBP & MAP changes were highly significant at baseline, 2 hours, 6 hours and 12 hours postoperatively.

Table - 1: Baseline Data.

Parameters	**SA Group (N_1=30)**	**GA Group (N_2=30)**
Age (years)	42.66±4.36	38.76±3.34
Weight (kgs)	55.83±10.63	58.86±11.93
Pulse (bpm)	82.13±10.40	82.06±8.45
Hb (g/dl)	11.49±1.70	11.52±1.47
BT (min.)	2.20±0.34	2.21±0.42
CT (min.)	3.69±0.45	3.43±0.41
Urea (mg/dl)	30.70±10.19	27.75±4.94
S. Creatinine (mg/dl)	0.97±0.22	0.87±0.18
FBS (mg/dl)	87.02±8.71	91.09±10.29
Sebrasez Test Score	24.06±2.89	23.23±2.28

Table - 2: Comparison of Hypotension, Bradycardia & Shoulder Event Occurrence between Patients Undergoing Laparoscopic Cholecystectomy under SA vs GA.

Event occurrence	**SA Group (N_1=30)**		**GA Group (N_2=30)**	
	No.	**%**	**No.**	**%**
Hypotension	7	36.84	2	66.67
Bradycardia	2	10.53	1	33.33
Right shoulder pain	10	52.63	0	00.00
Total	**19**	**100.00**	**3**	**100.00**

Table - 3: Comparison 0f Post-Operative VAS Score Between Patients Undergoing Laparoscopic Cholecystectomy Under SA vs GA.

Time Points	**SA Group (N_1=30)**	**GA Group (N_2=30)**	**P value**
T0 (0 min post-op)	1.0±0.4	6.1±1.1	0.0001*
T2 (2 hr post-op)	2.0±0.6	5.5±0.8	0.04*
T6 (6hr post-op)	2.8±0.4	5.4±0.67	0.0023*
T12 (12 hr post-op)	2.4±0.3	5.1±0.3	0.03*
T18 (18hr post-op)	2.0±0.5	4.2±0.86	0.01*
T24 (24hr post-op)	1.0±0.2	4.0±0.65	0.002*

The VAS score showed lower mean values in SA group when compared with GA group. Also the differences between the mean VAS score in 2 groups at different post-operative time points was found to be statistically significant to highly significant (p<0.05 to p<0.001) (**Table – 3, Figure - 1**).

Out of 30 patients undergoing surgery under SA, 9 (30.0%) observed one or the other complications whereas among 30 patients undergoing surgery under GA, 14 (46.67%) experienced one or the other complications which is higher than the first group. In SA group, most common complication occurring was urinary retention followed by postural headache and back pain respectively. In GA group most common complications were post-operative nausea, vomiting followed by sore throat and urinary retention respectively.Also, when $\chi 2$ test was

applied to assess statistical difference between occurrence of complication between 2 groups, it was observed to be statistically significant ($p<<0.05$) (**Table – 4, Figure - 2**).

Figure - 1: Post operative VAS score between patients undergoing SA vs. GA.

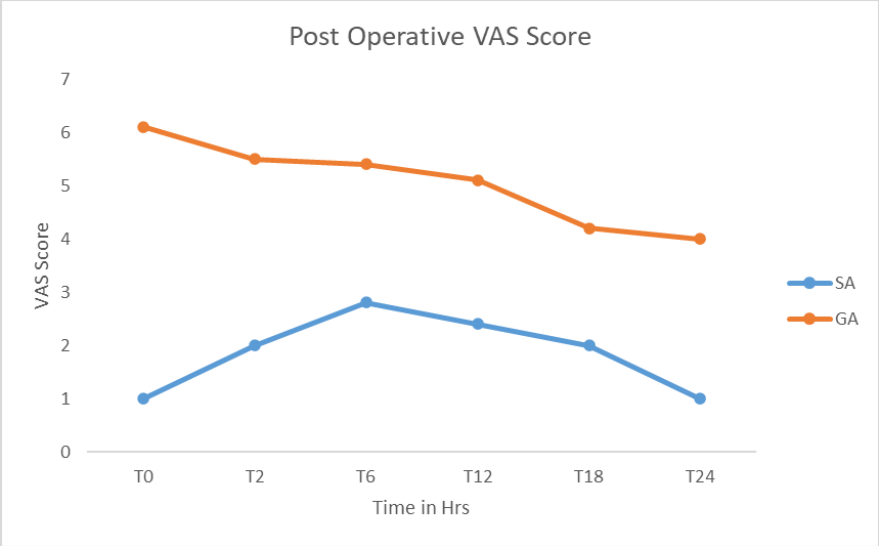
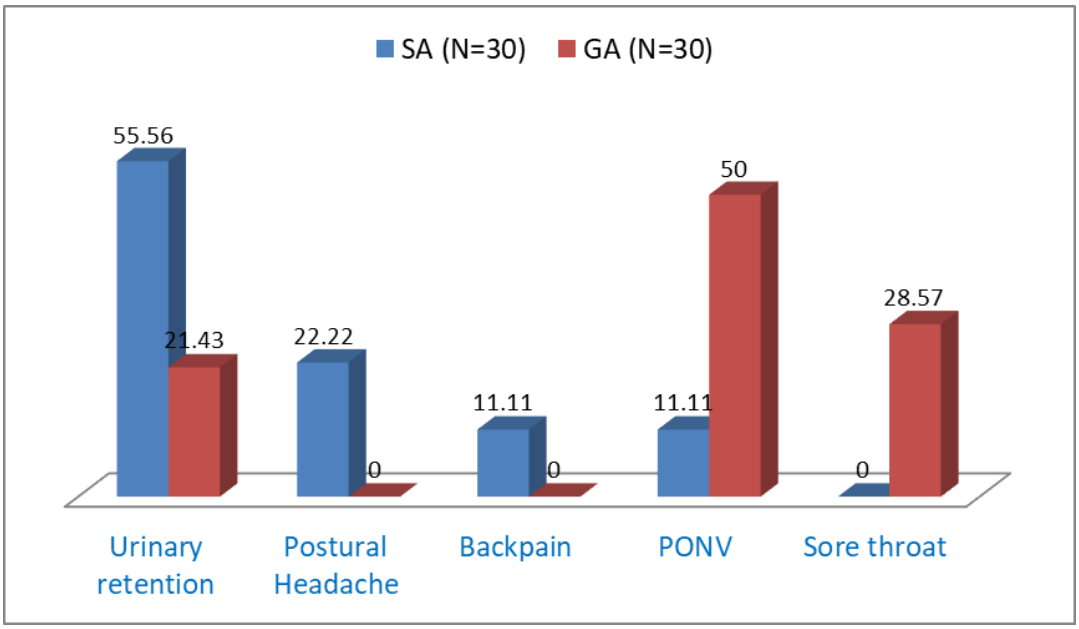


Table - 4: Comparison of Complications between Patients Undergoing Laparoscopic Cholecystectomy under SA vs GA.

Complications	**SA Group**		**GA Group**	
	No.	**%**	**No.**	**%**
Urinary retention	5	55.56	3	21.43
Postural headache	2	22.22	0	00.00
Back pain	1	11.11	0	00.00
Post-operative nausea vomiting	1	11.11	7	50.00
Sore throat	0	00.00	4	28.57
Total	**9**	**100.00**	**14**	**100.00**

Figure - 2: Incidence of Post-operative complications occurrence in SA vs. GA groups.



Discussion

Laparoscopic cholecystectomy is a procedure that is usually performed under general anesthesia with tracheal intubation to escape aspiration and respiratory complications secondary to the pneumoperitoneum induction. Of late, it has been demonstrated that laparoscopic cholecystectomy can be performed successfully under spinal anesthesia also. In our study, bradycardia was observed in 2 patients in the SA group and in 1 patient in the GA group and was managed with IV atropine. When effects of anesthesia mode on systolic blood pressure were compared, statistically significant differences were observed between both the groups ($p<0.05$), except for baseline observation ($p>0.05$). When DBP was compared between the two groups, except baseline DBP, difference between mean DBP was observed to be statistically highly significant ($p<0.01$). When MAP was compared between the 2 groups, except baseline values, the MAP changes with respect to different time points were found to be statistically highly significant ($p<<0.05$). Hypotension was encountered in 7 (23.3%) patients in the SA group and in two patients (7%) in the GA group. Hypotension was managed with I.V. Ephedrine 6 mg in 4 patients and with Ephedrine 12 mg in 3 patients. Hypotension is due to the effect of reduced venous return, peripheral vasodilatation due to SA and as a consequent to the increased intra-abdominal pressure and the reverse Trendelenburg position. In our study, it was observed that there is more hemodynamic stability in SA group as compared to GA group. This correlates with the study conducted by Yuksek YN, et al. who reported that none of the patients had cardiopulmonary problems other than transient hypotension during surgery [4]. Similar observations were noted in the study conducted by Ellakany M, who observed that systolic and diastolic blood pressure demonstrated significant reduction in the early-operative period in the SA group versus the GA group. Throughout the time of measurements during surgery and immediate postoperative period, the heart rate demonstrated significant decrease in SA group when compared to GA. Hypotension and bradycardia were encountered in 8 patients (40%) and they were given ephedrine and atropine, respectively [5]. Referred pain to right shoulder is a well described phenomena and is thought to occur due to irritation of sub-diaphragmatic surface by the CO_2 pneumoperitoneum. The incidence of the same in our study was 10 cases (33.3%). All these cases were managed with Intravenous fentanyl, reassurance to the patient, massage of the right shoulder, and by keeping the intra-abdominal pressure below 12 mm Hg, avoiding excessive tilting of table and thereby minimizing diaphragmatic irritation. We attribute this low incidence of referred shoulder pain to the liberal use of local anesthetic agents (Lignocaine plus Bupivacaine) to bathe the subdiaphragmatic surface immediately post creating pneumoperitoneum. This was also helped by the fact that we used low pressure pneumoperitoneum (<10 mmHg) during the surgical procedure. While standard LC entails a pneumoperitoneum at 12–16 mmHg, pneumoperitoneum pressure below 10 mmHg has been shown to be associated with lesser abdominal/shoulder pain. The reported incidence for intra-operative right-shoulder pain requiring i.v. fentanyl administration in previous studies ranged from 13 to 55.2%. Xian Xue Wang reported in their meta-analysis that patients in spinal anesthesia groups have lower visual analogue scale score 24 hours postoperatively [6]. Tiwari S. observed in their study that pain was less in the SA group in the immediate operative period (up to 12 hours) but was similar to the other group at the time of discharge [7]. Kalaivani V. reported that in their study none of the patients in the SA group had immediate postoperative pain at the operated site. Only two (8%) patients had pain score of 4 at the operative site within eight hours requiring rescue analgesics. Our study correlates well with these studies which have demonstrated less values of VAS post spinal anesthesia as compared to general anesthesia [8]. It was observed in our study that among patients undergoing surgery under SA, 9 (30.0%) experienced complications

whereas among patients undergoing surgery under GA, 14 (46.67%) experienced complications which is higher than the first group. In the SA group, the most common complication that occurred was urinary retention followed by postural headache, post-operative nausea and vomiting (PONV) and back pain respectively. In the GA group, the most common complications observed were post-operative nausea, vomiting followed by sore throat and urinary retention. Bessa, et al. reported in their study that 22.2% of the GA group had PONV compared to only 6.9% of patients in the SA group. Postoperative urinary retention requiring catheterization was observed in two patients in the SA group. This was known to be related to regional anesthesia with rates of up to 20% in some series [9]. Tiwari S, et al. found that the post-operative recovery of patients was normal in all the patients of both the groups. It showed that SA is related to lower frequency of serious peri-operative morbidities and an improved outcome when compared to GA. In their series the incidence of post-operative events which required intervention was 21% in GA group compared to 11% in the SA group [7]. Mehta, et al. found that the postoperative complications like nausea, vomiting and dizziness were more common with general anesthesia owing to the intubation of trachea and intravenous drugs usage [10].

Conclusion

In conclusion, the study demonstrated that spinal anesthesia is an adequate and safe technique for LC with low pressure pneumoperitoneum in otherwise healthy patients. Thus, it offers better postoperative pain control than general anesthesia without limiting recovery.

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