

Spinal anesthesia for laparoscopic cholecystectomy: Thoracic vs. Lumbar Technique

Luiz Eduardo Imbelloni

Doctor of Anesthesiology,
Faculty of Medicine of Botucatu,
UNESP Assistant Professor of
Anesthesiology, School of Medicine-
Nova Esperança
Institute of Regional Anesthesia
Hospital Complex Mangabeira, Brazil

Address for correspondence:

Prof. Luiz Eduardo Imbelloni,
Rua Marieta Steimbach Silva,
106/1001 58043-320,
João Pessoa, PB, Brazil.
E-mail: dr.imbelloni@terra.com.br

ABSTRACT

Aims: In our group, after a study showing that spinal anesthesia is safe when compared with general anesthesia, spinal anesthesia has been the technique of choice for this procedure. This is a prospective study with all patients undergoing LC under spinal anesthesia in our department since 2007. **Settings and Design:** Prospective observational. **Materials and Methods:** From 2007 to 2011, 369 patients with symptoms of cholelithiasis, laparoscopic cholecystectomy were operated under spinal anesthesia with pneumoperitoneum and low pressure CO₂. We compared 15 mg of hyperbaric bupivacaine and lumbar puncture with 10 or 7.5 mg of hyperbaric bupivacaine thoracic puncture, all with 25 µg fentanyl until the sensory level reached T₃. Intraoperative parameters, post-operative pain, complications, recovery, patient satisfaction, and cost were compared between both groups. **Statistical Analysis Used:** Means were compared by ANOVA or Kruskal-Wallis test, the percentages of the Chi-square test or Fisher's exact test when appropriate. Time of motor and sensory block in spinal anesthesia group was compared by paired t test or Mann-Whitney test. Differences were considered significant when $P \leq 0.05$, and for comparisons of mean pain visual scale, we employed the Bonferroni correction applied to be considered significant only with $P \leq 0.0125$. **Results:** All procedures were completed under spinal anesthesia. The use of lidocaine 1% was successful in the prevention of shoulder pain in 329 (89%) patients. There were significant differences in time to reach T₃, obtaining 15 mg > 10 mg = 7.5 mg. There is a positive correlation between the dose and the incidence of hypotension. The lowest doses gave a decrease of 52.2% in the incidence of hypotension. There was a positive correlation between the dose and duration of sensory and motor block. Sensory block was almost twice the motor block at all doses. With low doses, 60% of patients went from table to stretcher. Satisfaction occurred in 99% of patients. **Conclusions:** Laparoscopic cholecystectomy can be performed successfully under spinal anesthesia with low-pressure pneumoperitoneum of CO₂. The use of thoracic puncture and low doses of hyperbaric bupivacaine provided better hemodynamic stability, less hypotension, and shorter duration of sensory and motor blockade than lumbar spinal anesthesia with conventional doses.

Key words: Cholecystectomy, laparoscopic, spinal anesthesia

INTRODUCTION

Spinal and epidural techniques can and should have a place in modern cardiac anesthesia practice and should be further investigated.^[1] Neuraxial anesthesia can be performed with

local anesthetics at different doses and baricity. To obtain high spinal anesthesia, one can use high doses (20-40 mg of bupivacaine) and lumbar puncture^[1,2] or low doses (5 to 10 mg of bupivacaine) and thoracic puncture.^[3-5]

Soon after its introduction, laparoscopic cholecystectomy (LC) was established as the treatment of choice for symptomatic gallstone disease.^[6] The procedure usually requires general anesthesia with tracheal intubation to avoid aspiration and respiratory complications secondary to the induction of pneumoperitoneum. Prospective^[7,8] and retrospective^[9] studies have shown that spinal anesthesia is an excellent option for LC when compared with general anesthesia.

Access this article online	
Quick Response Code:	Website: www.saudija.org
	DOI: 10.4103/1658-354X.140853

The anatomy of the thoracic spinal canal was recently investigated by magnetic resonance imaging (MRI).^[10] In one recent study of 300 patients, it was demonstrated that thoracic puncture was associated with the same incidence of paresthesia as was the lumbar approach, and without neurological sequelae.^[5]

In Brazil, many anesthesiologists perform open cholecystectomy under spinal anesthesia. In our group, after a study showing that spinal anesthesia is safe when compared with general anesthesia, spinal anesthesia has been the technique of choice for this procedure. This is a prospective study with all patients undergoing LC under spinal anesthesia in our department since 2007.

MATERIALS AND METHODS

After the study protocol had been approved by the local Ethics Committee, written informed consent was obtained from 369 patients in a prospective observational study. All patients eligible for LC was offered as the first option to spinal anesthesia. Patients who preferred general anesthesia or had any contraindication to spinal anesthesia were operated under general anesthesia. All patients were also informed about the possibility of conversion to general anesthesia. Both anesthesia and surgery were performed by the same anesthesiologist and surgical team.

Patients did not receive pre-anesthetic medication. All patients were monitored with non-invasive blood pressure, oxygen saturation, and expired CO₂, and all data were recorded at intervals of 5 minutes. An 20G catheter was inserted in the left hand for hydration and administration of drugs. Initially, 500 mL of Ringer's lactate were infused for the administration of cephalosporin 2 g, ranitidine 50 mg, omeprazole 40 mg, dexamethasone 10 mg, ondansetron 8 mg, and metoclopramide 10 mg before the spinal anesthesia. A nasogastric tube was not inserted before induction in neither group.

All patients were given supplemental oxygen via a nasal cannula at a rate of 3 L.min⁻¹. Fentanyl (1 µg.kg⁻¹) and midazolam (1 mg) was given before spinal anesthesia. With the patient in left lateral decubitus or sitting, we performed a puncture of the subarachnoid space through a median or paramedian with a 27G cut needle (B.Braun Melsungen, Germany) without introducer or 27G pencil needle with an introducer (B.Braun Melsungen, Germany). Free flow of CSF confirmed the position of the needle into the subarachnoid space.

All patients received a spinal fentanyl 25 µg (Cristália Chemicals and Pharmaceuticals Ltd.) in 1 mL syringe

before injection of local anesthetic. The patients were divided into 3 groups according to the puncture site and the local anesthetic dose used. Group 1, puncture L₃-L₄ and 15 mg of hyperbaric bupivacaine 0.5% (Cristália Chemicals and Pharmaceuticals Ltd.), Group 2, puncture T₉-T₁₀ and 10 mg of the same solution, and Group 3, puncture T₉-T₁₀ and 7.5 mg of the same solution.

After the spinal injection, the patients were placed in a supine position, and their heads were tilted down 20°-30°. The T₃ dermatome level (tested by pinprick at 1-minute intervals) was targeted for the spinal block.

The standard laparoscopic technique^[8] was used in all patients with one modification, i.e., after visualization of the abdomen using a camera, lidocaine 1% 10 mL was sprayed under the right side of the diaphragm through a 14 needle inserted below the lower border of the tenth rib. If the patient still complained of shoulder pain after spraying with lidocaine would be administered 50 µg of fentanyl. The conversion criteria were: The need to empty the stomach probe, any organ damage, bleeding difficult to control, or if the patient was dissatisfied with spinal anesthesia at any stage of the procedure.

Operative time was recorded, as well as any intra-operative incidents, especially those related to the type of spinal anesthesia, i.e., right shoulder pain, nausea, and discomfort. Hemodynamic effects, necessity for a nasogastric tube, duration of pneumoperitoneum, duration of anesthesia (from puncture to dressing), and necessity to increase intra-abdominal pressure > 8 mmHg were evaluated in all groups. Time for the block to reach the T₃ dermatomal level and time to regression of sensory and motor block were also recorded. At the end of surgery, we evaluated the ability of the patient to move to the stretcher unaided.

Hypotension was defined as a decrease of more than 30% from the baseline systolic arterial blood pressure and treated with IV boluses of 2 mg ethilephrine. Bradycardia was defined as heart rate <50 bpm (beat per minute) and treated with atropine 0.50 mg. The numbers of hypotensive and bradycardic episodes were recorded. Anxiety was treated with midazolam 1 mg and recorded the total dose.

Postoperatively, all patients were given standard intravenous dextrose 5% and IV analgesia of ketoprofen 100 mg every 8 hours and dipyrone 1.5 g every 4 hours. Post-operative pain was assessed in all groups using a visual analog scale at hours 2, 4, 6, and 12 after completion of the procedure. Other post-operative events potentially related to either the surgical or anesthetic procedure, i.e., discomfort, nausea and vomiting, shoulder pain, urinary retention, pruritus,

headache, or other neurologic sequelae, were also recorded. The day after the surgery, patients were fed by mouth in the morning and were discharged 24 hours after the procedure if no complications occurred. All patients were followed up by telephone for 1 week postoperatively, and asked to assess their degree of satisfaction (high, fair, or not at all) with the procedure.

Means were compared by ANOVA or Kruskal-Wallis test, the percentages of the Chi-square test or Fisher's exact test when appropriate. Time of motor and sensory block in spinal anesthesia group was compared by paired t test or Mann-Whitney test. Differences were considered significant when $P \leq 0.05$, and for comparisons of mean pain visual scale, we employed the Bonferroni correction applied to be considered significant only with $P \leq 0.0125$.

RESULTS

Between 2007 and 2011, 369 patients underwent LC at our institution. The patient demographics are shown in Table 1. Conversion to general anesthesia was required in 2 patients by surgical technical problems. Two patients needed to increase abdominal pressure and in the other, the procedure was completed laparoscopically without violation of the present protocol. Of the patients, 31 patients had acute cholecystitis, 102 patients had undergone previous abdominal surgery, and 7 patients were obese. The use of lidocaine 1% was successful in the prevention of shoulder pain in 329 (89%) patients. Rescue intravenous fentanyl was required in 40 patients to control pain in the shoulder.

The characteristics of spinal anesthesia in the type of needle, puncture position, and the needle insertion are shown in Table 2. The observed overall incidence of paresthesia associated with spinal needle insertion was 7%. There is no difference to the puncture site.

Mean time for the block to reach T₃ was 7:17 (1:09) (min:seg) in Group 1, 1:58 (0:25) (min: Seg) in Group 2, and 2:22 (0:52) (min: Seg) in Group 3 with a significant difference. Dually comparing the mean (SD) for blocking access T₃, there was no significant difference between groups 2 and 3 (P -value = 0.081) [Table 3]. There was no significant difference in duration of pneumoperitoneum. Increased CO₂ pressure was required in 2 patients. No patient required nasogastric tube insertion, and no patient had retention of CO₂ or hypoxemia. There was no significant difference between the groups with regard the dose of midazolam, rescue with fentanyl, incidence of nausea and vomiting, and pain in the shoulder [Table 3].

The average administration of Ringer's lactate was 1,171 mL and significant difference between groups (Kruskal-Wallis P -value = 0.0005). On comparing the average dually administration of Ringer's lactate, significant difference was observed between groups 1, 2, and 3 (P -value < 0.001) [Table 3].

None of the patients had cardiopulmonary problems during surgery, except for transient hypotension, which occurred in 24 (32%) patients in Group 1, 6 (20%) patients in Group 2, and 39 (15%) in Group 3. There is a positive correlation between the dose and the incidence of hypotension. There were significant differences between doses. In 69 patients, blood pressure was normalized

Table 1: Characteristics of patients who underwent laparoscopic cholecystectomy and previous surgeries (mean (SD))

Characteristics	15 mg (n = 75)	10 mg (n = 30)	7.5 mg (n = 264)	P-value
Age (years)***	38.8 (11.7)	38.5 (9.7)	41.4 (13.9)	0.6202
Weight (kg)***	68.7 (11.9)	71.3 (11.3)	70.6 (12.9)	0.8468
Height (cm)***	163.5 (7.6)	162.2 (7.0)	163.6 (9.2)	0.0937
ASA: 1/2 **	32/43	17/13	135/129	0.3198
Gender: Male/ Female**	22/53	6/24	62/202	0.4905
Cholecystitis*	7	3	21	0.9063
Previous surgeries*	20	4	78	0.2050

*Fischer's exact test; ASA: American society of anesthesiologists class; **Chi-square test; ***Kruskal-Wallis test

Table 2: Characteristics of spinal anesthesia

Parameters	15 mg (n = 75)	10 mg (n = 30)	7.5 mg (n = 264)	P-value
Needle: Q/W*	75/0	21/9	122/144	<0.0001
Position: LD/SIT*	75/0	17/13	191/73	<0.0001
Insertion: M/PM*	15/60	2/28	192/72	<0.0001
Paresthesia*	6 (8%)	0 (0%)	20 (7.5%)	0.3181

Q: Quincke; LD: Lateral decubitus; SIT: Sitting; W: Whitacre; M: Median; PM: Paramedian *Fischer's exact test

Table 3: Characteristics in all groups in peri-operative period (mean (SD))

Parameters	15 mg (n = 75)	10 mg (n = 30)	7.5 mg (n = 264)	P-value
Time until T ₃ (min)***	7:17 (1:09)	1:58 (0:25)	2:22 (0:52)	<0.0001
Pneumoperitoneum (min)***	37.5 (11.6)	41.7 (10.4)	34.2 (8.31)	0.0561
Shoulder pain*	9 (12%)	2 (6.6%)	22 (8.3%)	0.3822
Nauseas/Vomiting*	1 (1.3%)	0	0	0.6350
Rescue fentanyl*	8 (10.6%)	0	32 (12.1%)	0.2343
Hypotension arterial**	24 (32%)	6 (20%)	39 (15%)	0.0032
Bradycardia*	3 (4%)	1 (3.3%)	7 (2.6%)	0.5851
Table to stretcher*	0	15 (50%)	164 (62%)	<0.0001

*Fischer's exact test; **Chi-square test; ***Kruskal-Wallis test

with only one dose of etilephrine, and the procedure was completed uneventfully. Bradycardia was detected in 11 patients, no significant difference.

Table 4 shows post-operative events, including nausea, vomiting, urinary retention, right shoulder pain, and pruritus. The frequency of shoulder pain was similar in all groups. Five patients complained PDPH. There were no serious complications such epidural hematomas, infection, or permanent nerve injuries in all patients.

The mean duration (SD) of motor block was 02:48 (00:30) (h: Min) with 15 mg of 01:43 (00:13) (h: Min) with 10 mg and 01:12 (00: 18) (h: Min) with 7.5 mg. There was a positive correlation between the dose and duration of motor block (P -value < 0.0001, $Rho = 0.7605$). The mean duration (SD) of sensory block was 04:09 (00:36) (h: Min) with 15 mg, 03:11 (00:23) (h: Min) with 10 mg and 02:44 (00:29) (h: Min) with 7.5 mg. There was a positive correlation between the dose and duration of sensory block (P -value < 0.0001, $Rho = 0.6702$). There was a reduction of 31.91% with 15 mg, with 10 mg of 45.97% and 55.92% with 7.5 mg in the average duration of motor block compared to the sensory block ($P < 0.0001$). Figure 1 shows the average duration of sensory and motor block.

For post-operative pain, there was no significant difference (P -value < 0.0001) between groups during the first 12 hours of assessment [Figure 2] with no significant difference when comparing the groups dually (P -value > 0.051).

All patients in Group 1 (15 mg) recovered 4 hours after the blockade and were ready to be discharged from hospital, while in group 2 (10 mg), all patients recovered 3 hours after the blockade and in group 3 (7.5 mg), all patients recovered 2 hours after the blockade. The

decrease in the dose resulted in a discharged more precocious. However, all patients were kept in hospital overnight to monitor clinical parameters (including heart rate and blood pressure) and any side effects (including nausea, vomiting, and headache) and were discharged the following morning. Three hundred and sixty patients reported high satisfaction, 6 fair satisfaction, and only 3 bad satisfaction, by the prolonged motor blockade of lower limb motor. Three hundred and sixty-seven patients recommend the technique to new surgical procedure without specifying why. In 1 week follow-up, there were no complications.

DISCUSSION

In this study, we demonstrated that the thoracic intrathecal low dose (7.5 and 10 mg) hyperbaric bupivacaine in combination with 25 µg fentanyl provided a reduction in hypotension (50%), a motor block of shorter duration (55%), and ability to move the table for surgery stretcher (60%) than full dose (15 mg) hyperbaric bupivacaine in combination with 25 µg fentanyl and lumbar puncture. Hemodynamic stability was reflected in a minimal need for vasopressor support.

Table 4: Spinal anesthesia-related complication in post-operative period (mean (SD))

Parameters	15 mg (n = 75)	10 mg (n = 30)	7.5 mg (n = 264)	P-value
Shoulder pain*	4 (5.3%)	2 (6.6%)	7 (2.6%)	0.4223
Nauseas /Vomiting*	2 (2.6%)	0	0	1.0000
Prurido*	4 (5.3%)	3 (10%)	6 (2.2%)	0.4340
Urinary retention*	0	0	0	1.0000
Headache*	1 (1.3%)	0	4 (1.5%)	1.0000
Recommended spinal*	74 (98.6%)	30 (100%)	262 (99.2%)	0.4260

*Fischer's exact test

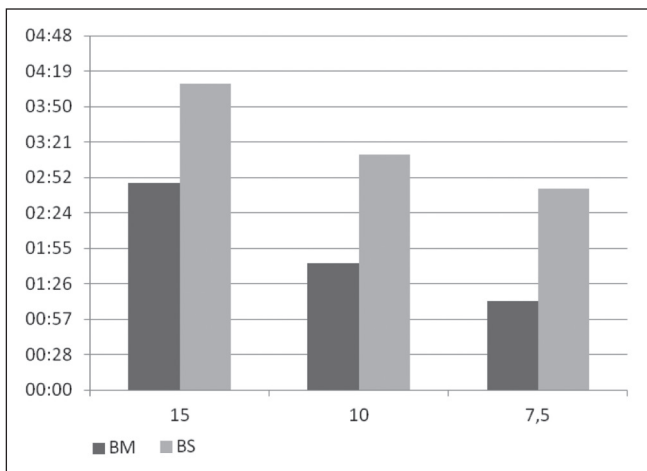


Figure 1: Average duration of sensory and motor block

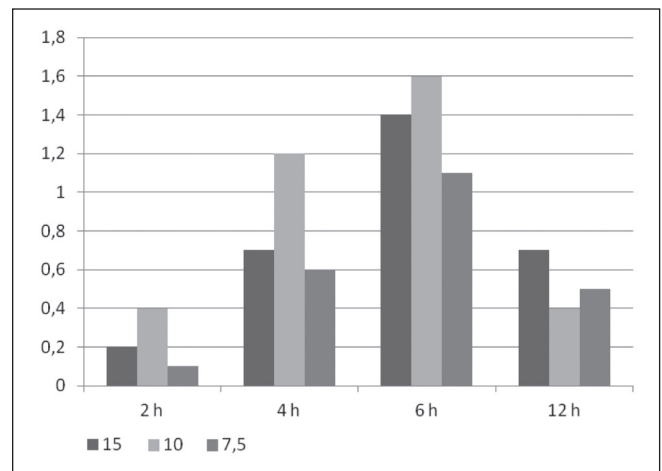


Figure 2: Pain scale for 12 h after surgery

Laparoscopic cholecystectomy (LC) is a minimally invasive procedure, in which the gallbladder is removed; make it the treatment of choice for cholelithiasis. Spinal anesthesia is a less invasive technique and has lower complication and mortality rates compared with general anesthesia.^[7-9] These advantages include the patients' being awake and oriented at the end of the procedure, less post-operative pain, and the ability to ambulate earlier than patients receiving general anesthesia.^[7-9] In 369 patients, the need for sedation with midazolam was low with no need to use other drugs more potent. Some possible problems related to the technique of general anesthesia 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 anesthesia to patients undergoing laparoscopic interventions.^[12] After the initial study comparing general anesthesia with spinal anesthesia,^[8] it was not difficult to prefer spinal anesthesia to avoid the potential problems of general anesthesia. Thus, the anesthetic-surgical team changed the routine to perform the procedure under spinal anesthesia.

The proposed technique of spinal anesthesia for this study did not require any modification in surgical technique, except low-flow insufflation to avoid vagal reflexes and bradycardia. Tolerance of laparoscopy under spinal anesthesia was facilitated by limiting the total volume of CO₂ used for peritoneal insufflation to a maximum of 4 L. The intra-abdominal pressure of 8 mmHg is consistent with that reported previously.^[7-9] We were also impressed by the optimal anterior abdominal wall relaxation of up to the T₃ level and the conscious and receptive patients under spinal anesthesia. There was the need for increased intra-abdominal pressure to 10 mmHg in only 2 patients.

Unlike others authors,^[9] where the discomfort and anxiety were responsible for the conversion to 0.29% of the patients, in this series of 369 patients, no anxiety and / or discomfort during the procedure to justify the conversion. What can be explained by sedation with midazolam has reached the level sensitive T₃ in all patients. Another reason for conversion in 8 patients was incomplete spinal block.^[9] Conversion to general anesthesia due to shoulder pain occurred in 3 of 26 (11.5%) patients,^[13] while in this series of 369 patients, no patient had pain enough for the conversion. This can be explained by spraying the region of the diaphragm with lidocaine. Just as in a previous study, when it was required conversion to general anesthesia in 1 (3.03%) patient due to technical surgical problems,^[8] in this series, it occurred in only 2 (0.5%) patients.

Patients operated under general anesthesia often have an additional problem for inflation of the stomach as a result

of mask ventilation, and this often requires emptying with gastric tube. Some authors^[7] routinely used nasogastric tube with spinal anesthesia, while others do not.^[8,9] In this study, there was no need for any type of probe to empty stomach in all patients. This reinforces the idea that the great responsible for the need of the probe is the anesthesiologist inflates the stomach during ventilation with a mask during the induction and before intubation.

Spinal anesthesia is associated with a risk of severe and prolonged hypotension. In addition to spinal anesthesia-related hypotension, the pneumoperitoneum-induced rise in intra-abdominal pressure could be another cause for the persistence of the hypotension. A retrospective analysis of risk factors and predictors of complications of neuraxial blocks in a teaching hospital found that the incidence of hypotension was 12.6%.^[14] The result of hypotension was 69 (18.6%) patients, similar to 20.05% with the same technique to the same procedure.^[9] When comparing the full dose (15 mg) and lumbar puncture with low doses (10 and 7.5 mg) and thoracic puncture, the incidence of hypotension decreased from 32% to 15.3%, a significant decrease of 52.2%. This decrease can be explained by the decrease in the dose and the thoracic puncture site. Also seems conclusive evidence that the pressure of 8 mmHg does not add to the problem of decreased venous return and persistence of hypotension. The sensory block to T₃ is required to eliminate the discomfort of surgical stimulation of the upper gastrointestinal tract. Although some authors^[15] have mentioned that a high spinal block of up to T₂-T₄ may cause myocardial depression and reduction in venous return, compounding the adverse effects of pneumoperitoneum, this was never substantiated in our series of 369 patients.

The main debatable point, however, seems to be the status of respiratory parameters during laparoscopic surgery. In this context, it can be stated that a spontaneous physiologic respiration during spinal anesthesia would always be better than assisted ventilation in general anesthesia. The potentiality of intubation and ventilation-related problems, including an increase in the mechanical ventilation to achieve an adequate ventilation pressure, exists during general anesthesia as compared to spinal anesthesia.^[12] In addition, pulmonary function takes 24 hours to return to normal after laparoscopic surgery is performed under GA.^[16] It was shown that there is a greater increase in PaCO₂ after CO₂ pneumoperitoneum when the patient under general anesthesia was compared with the spontaneous breathing.^[17] Similarly, an increase in forced ventilation capacity during general anesthesia.^[18] SpO₂ (pulse oximetry) and P_{ET}CO₂ (pickup of CO₂ in the nose) remained within normal limits during the procedure confirming that spinal anesthesia can be safe even without

tracheal intubation. Retention of CO₂ and hypoxemia were not observed in all patients during the procedure.

Spinal fentanyl is often combined with local anesthetics to prolong the sensory block in spinal anesthesia. Recently, it was proposed to understand the physiology for spinal anesthesia, explaining that the use of hyperbaric solutions and placement in the supine position and cefalodecive, there is a predominance of sensory roots block (posterior) at the expense of motor roots (anterior).^[19] The use of this concept and the necessity to reach sensory block till T₃ have established a difference and advantage of the mean duration of the analgesia of 4:11 h with 15 mg, to 3:11 with 10 mg and to 2:44 h with 7.5 mg against 2:48 hours with 15 mg, 1:43 hour with 10 mg, and 1:12 hour with 7.5 mg for the motor block. Comparing the full dose against the low doses, it was found a decrease of 55% in the duration of motor blockade and 41% in the duration of analgesia. Using this concept and the proper use of hyperbaric anesthetic confirm that residual analgesia remains for a much longer time than the motor block.

In a study comparing spinal anesthesia with general anesthesia, pain score was significantly lower in the first 6 hours with spinal anesthesia.^[8] Patients who received spinal anesthesia required less injectable and oral doses of analgesics (61.57%) compared with 91.45% under general anesthesia.^[9] In this study, the patients had pain scores less than 3 in the first 24 hours, and intravenous and oral analgesics were administered with a fixed time. A specific advantage of spinal anesthesia seems to be the decrease in the requirements of post-operative analgesia. This benefit of prolonged analgesia after spinal anesthesia has also been reported in other studies.^[4,7-9,20,21]

At the beginning of the advent of LC, most surgeons used high pressures; however, one should use the lowest abdominal pressure allowing adequate exposure of the operative field, instead of using a high pressure routine. We chose a low pressure of up to 8 mmHg to reduce diaphragmatic irritation, and it was necessary to increase the pressure of the pneumoperitoneum in only 2 patients. Spinal anesthesia for LC offers sensory block, motor and sympathetic enough to avoid the use of muscle relaxant, which is usually required when using general anesthesia.

Post-operative nausea and vomiting is particularly troublesome, and anti-emetics may be required in as many as 50% patients^[22] and can delay discharge from the hospital.^[23] In other studies of spinal anesthesia for CL, nausea and vomiting were not a problem either during surgery and in the immediate post-operative.^[7-9,13,24] Therefore, the low incidence of nausea and vomiting seems to be related to the spinal anesthesia.^[13]

In two other studies, the need for bladder catheterization was between 0.41%^[9] and 11.7%.^[25] This incidence of urinary retention is explainable by the prolongation of motor blockade of spinal anesthesia. Urinary retention is not observed in our series, which may be explained by the end of the motor block in about 2 hours. There was no need for bladder catheterization in any patient. Using needle 24 and 25G, postural headache was seen in 5.9% of patients and persisted for an average of 2.6 days and responded to lying posture and increased intake of fluids and salt.^[9] In this study, post-operative postural headache was seen in 1.3% of patients with a 27G needle (cutting tip and pencil tip). The satisfaction with the technique has not occurred in only 3 patients.

Paresthesia can occur with any spinal technique and peripheral blocks. A study of 300 patients undergoing thoracic spinal puncture reported a 6.6% incidence of paresthesia without neurological sequelae,^[5] almost half the incidence (12%) with lumbar puncture.^[11] In this study, with lumbar and thoracic puncture, the incidence was similar to that obtained with 300 patients.

Our study demonstrated a reduction in the duration of motor block in relation to sensory block. The patient regained movement around 1:34 h, allowing the patient can walk immediately after surgery. The low-dose and thoracic puncture strategies may thus have an advantage in ambulatory patients because of the earlier recovery of motor and sensory function.

This study showed that spinal anesthesia is technically feasible and safe for LC. The use of thoracic puncture and low doses of hyperbaric bupivacaine in combination with fentanyl provided better hemodynamic stability, less hypotension, and shorter duration of sensory and motor blockade than lumbar spinal anesthesia with conventional doses.

REFERENCES

1. Kowaleswski R, Seal D, Tang T, Prusinkiewicz C, Ha D. Neuraxial anesthesia for cardiac surgery: Thoracic epidural and high spinal anesthesia — why is it different? *HSR Proc Intensive Care Cardiovasc Anesth* 2011;3:25-8.
2. Lee TW, Grocott HP, Schwinn D, Jacobsohn E. High spinal anesthesia for cardiac surgery. Effects on b-adrenergic receptor function, stress response, and hemodynamics. *Anesthesiology* 2003;98:499-510.
3. Van Zundert AA, Stultiens G, Jakimowicz JJ, van den Borne BE, van der Ham WG, Wildsmith JA. Segmental spinal anesthesia for cholecystectomy in a patient with severe lung disease. *Br J Anaesth* 2006;96:464-6.
4. Van Zundert AA, Stultiens G, Jakimowicz JJ, Peek D, van der Ham WG, Korsten HH, *et al.* Laparoscopic cholecystectomy under segmental thoracic spinal anesthesia: A feasibility study. *Br J Anaesth* 2007;98:682-6.

5. Imbelloni LE, Pitombo PF, Ganem EM. The Incidence of paresthesia and neurologic complications after lower spinal thoracic puncture with cut needle compared to pencil point needle. Study in 300 Patients. *J Anesth Clin Res* 2010;1:106.
6. Soper NJ, Stockman PT, Dunnegan DL, Ashley SW. Laparoscopic cholecystectomy: The new "gold standard"? *Arch Surg* 1992;127:917-21.
7. Tzoravaras G, Fafoulakis F, Pratsas K, Georgopoulou S, Stamatiou G, Hatzitheofilou C. Laparoscopic cholecystectomy under spinal anesthesia. A pilot study. *Surg Endosc* 2006;20:580-2.
8. Imbelloni LE, Fornasari M, Fialho JC, Sant'Anna R, Cordeiro J. General anesthesia versus spinal anesthesia for laparoscopic cholecystectomy. *Rev Bras Anesthesiol* 2010;60:217-27.
9. Sinha R, Gurwara AK, Gupta MS. Laparoscopic cholecystectomy under spinal: A study of 3492 patients. *J Laparoscosc Adv Surg Tech A* 2009;19:323-7.
10. Imbelloni LE, Quirici MB, Ferraz-Filho JR, Cordeiro JA, Ganem EM. The anatomy of the thoracic spinal canal investigated with magnetic resonance imaging. *Anesth Analg* 2010;110:1494-5.
11. Hopkinson JM, Samaan AK, Russel IF, Birks RJ, Patrick MR. A comparative multicentre trial of spinal needles for Caesarean section. *Anesthesia* 1997;52:1005-11.
12. Pursani KG, Bazza Y, Calleja M, Mughai MM. Laparoscopic cholecystectomy under epidural anesthesia in patient with chronic respiratory disease. *Surg Endosc* 1998;12:1082-4.
13. Yuksek YN, Akat AZ, Gozalan U, Daglar G, Pala Y, Canturk M, *et al.* Laparoscopic cholecystectomy under spinal anesthesia. *Am J Surg* 2008;195:533-6.
14. Pereira ID, Grando MM, Vianna PT, Braz JR, Castiglia YM, Vane LA, *et al.* Retrospective analysis of risk factors and predictors of intraoperative complications in neuroaxial blocks at Faculdade de Medicina de Botucatu-UNESP. *Rev Bras Anesthesiol* 2011;61:568-81.
15. Chui PT, Gin T, Oh TE. Anesthesia for laparoscopic general surgery. Review. *Anaesth Intensive Care* 1993;21:163-71.
16. Putensen-Himmer G, Putensen CH, Lammer H, Haisjack IM. Comparison of postoperative lung function in patient undergoing laparotomy or laparoscopy for cholecystectomy. *Am Rev Resp Dis* 1992;145:A156.
17. Nishio I, Noguchi J, Konishi M, Ochiai R, Takeda J, Fukushima K. The effects of anesthetic techniques and insufflating gases on ventilation during laparoscopy. *Masui* 1993;42:862-6.
18. Rademaker BM, Ringers J, Odoom JA, de Wit LT, Kalkman CJ, Oosting J. Pulmonary function and stress response after laparoscopic cholecystectomy: Comparison with subcostal incision and influence of thoracic epidural analgesia. *Anesth Analg* 1992;75:381-5.
19. Gouveia MA, Imbelloni LE. Understanding spinal anesthesia (Letter to Editor). *Acta Anaesthesiol Scand* 2006;50:260.
20. Gramatica L Jr, Brasesco OE, Mercado Luna A, Matinassi V, Panebianco G, Labaque F, *et al.* Laparoscopic cholecystectomy performed under regional anesthesia in patients with chronic obstructive pulmonary disease. *Surg Endosc* 2002;16:472-5.
21. Pursani KG, Bazza Y, Calleja M, Mughai MM. Laparoscopic cholecystectomy under epidural anesthesia in patient with chronic respiratory disease. *Surg Endosc* 1998;12:1082-4.
22. Nathanson LK, Shimi S, Cuschieri A. Laparoscopic cholecystectomy: The Dundee technique. *Br J Surg* 1991;78:155-9.
23. Fielding GA. Laparoscopic cholecystectomy. *Aust N Z J Surg* 1992;62:181-7.
24. Hamad MA, Ibrahim El-Khattary OA. Laparoscopic cholecystectomy under spinal anesthesia with nitrous oxide pneumoperitoneum: A feasibility study. *Surg Endosc* 2004;17:1426-8.
25. Palachewa K, Chau-In W, Naewthong P, Uppan K, Kamhom R. Complications of spinal anesthesia at Tinagarind Hospital. *Thai J Anesth* 2001;27:7-12.

How to cite this article: Imbelloni LE. Spinal anesthesia for laparoscopic cholecystectomy: Thoracic vs. Lumbar Technique. *Saudi J Anaesth* 2014;8:477-83.

Source of Support: Nil, **Conflict of Interest:** None declared.

Author Help: Online submission of the manuscripts

Articles can be submitted online from <http://www.journalonweb.com>. For online submission, the articles should be prepared in two files (first page file and article file). Images should be submitted separately.

1) **First Page File:**

Prepare the title page, covering letter, acknowledgement etc. using a word processor program. All information related to your identity should be included here. Use text/rtf/doc/pdf files. Do not zip the files.

2) **Article File:**

The main text of the article, beginning with the Abstract to References (including tables) should be in this file. Do not include any information (such as acknowledgement, your names in page headers etc.) in this file. Use text/rtf/doc/pdf files. Do not zip the files. Limit the file size to 1024 kb. Do not incorporate images in the file. If file size is large, graphs can be submitted separately as images, without their being incorporated in the article file. This will reduce the size of the file.

3) **Images:**

Submit good quality color images. Each image should be less than **4096 kb (4 MB)** in size. The size of the image can be reduced by decreasing the actual height and width of the images (keep up to about 6 inches and up to about 1800 x 1200 pixels). JPEG is the most suitable file format. The image quality should be good enough to judge the scientific value of the image. For the purpose of printing, always retain a good quality, high resolution image. This high resolution image should be sent to the editorial office at the time of sending a revised article.

4) **Legends:**

Legends for the figures/images should be included at the end of the article file.