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Research Article

Comparative study between general and thoracic spinal anesthesia for laparoscopic cholecystectomy

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KEYWORDS

Spinal;
General;
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Abstract *Background:* Laparoscopic cholecystectomy is usually done under general anesthesia, but many patients with major medical problems sometimes cannot tolerate such anesthesia, and thoracic spinal anesthesia may be beneficial in such patients. A comparative study between two groups of patients submitted to laparoscopic cholecystectomy using either general anesthesia or segmental thoracic spinal anesthesia.

Patients and methods: Forty patients classified according to American Society of Anesthesiology (ASA) as class I or II undergoing laparoscopic cholecystectomy, divided into two groups, 20 patients each. Group G received conventional general anesthesia with endotracheal intubation and mechanical ventilation, and group S received a segmental (T10-11 injection) thoracic spinal anesthesia (through combined spinal epidural) using 1 ml of plain bupivacaine 0.5% (5 mg) in addition to 25 μg fentanyl. In group S, drugs to manage patient anxiety or hemodynamic perturbations (bradycardia or hypotension) were given when needed. Intraoperative monitoring, postoperative pain, complications, recovery time, and patient satisfaction at follow-up were compared between the two groups.

Results: As regards the thoracic spinal group, spinal anesthetic was performed easily in all 20 patients, although two complained of paresthesia, which responded to slight needle withdrawal; the block was effective for surgery in all 20 patients, and five experienced some discomfort, which was readily treated with small doses of fentanyl, but none required conversion to general anesthesia; five patients required midazolam for anxiety, eight patients required ephedrine and atropine for

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hypotension and bradycardia, and recovery was uneventful and without sequelae.

Aim: The aim of this study is to compare discharge time, patient, and surgeon satisfaction between two groups of healthy patients submitted to laparoscopic cholecystectomy under general and segmental thoracic spinal anesthesia.

Conclusion: Patients received segmental thoracic spinal anesthesia had shorter discharge time and better satisfaction. Surgeon satisfaction was higher in general anesthesia group. Segmental thoracic spinal anesthesia can be used successfully and effectively for laparoscopic cholecystectomy in healthy patients by experienced anesthetists.

1. Introduction

Jonnesco [1] described the use of general spinal anesthesia for surgeries in the skull, head, neck, and the thorax. The punctures were performed between the 1st and the 2nd thoracic vertebrae, which resulted in good analgesia for the head, neck, and upper limbs. He performed puncture between the 12th thoracic vertebra and the 1st lumbar vertebra, and this resulted in anesthesia for the lower half of the body. Frumin et al. [2] proposed the use of segmental spinal block using low thoracic puncture. van Zundert [3] proposed segmental spinal block for laparoscopic cholecystectomy in patient with severe obstructive lung disease using a low thoracic puncture (T10) for combined spinal–epidural block. Then, they performed a feasibility study of segmental spinal anesthesia in healthy patients submitted to laparoscopic cholecystectomy [4].

Laparoscopic cholecystectomy was first introduced by Phillipe Mouret in 1987 and is now generally performed by many surgeons [5,6]. Unlike previous open surgery, this procedure requires only very little incisions and has benefits such as less pain and shorter hospital stay due to less tissue damage and swift return to everyday life due to fast recovery [7]. However, considerable difficulties in anesthetic management could be encountered since wide hemodynamic fluctuation may develop due to pneumoperitoneum and position changes.

Pneumoperitoneum induces systemic effects due to the absorption of CO_2, and in venous return due to the increase in intra-abdominal pressure [8]. Initially, absorption of CO_2 increases its elimination in the expired air, in the arterial, and venous blood [8,9]. This carboxemia induces metabolic and respiratory acidosis decreasing arterial and mixed venous pH and arterial PO_2 [9]. Absorption of CO_2 affects negatively the respiratory function, which is not observed with inert gases such as helium and argon [10]. Minute ventilation, peak inspiratory pressure, pulmonary vascular resistance, alveolar concentration of CO_2, calculated physiological short circuit, central venous pressure, diastolic and systolic blood pressure, systemic vascular resistance, and cardiac index are all increased [8].

In recent years, advanced laparoscopic surgery has targeted older and high risk patients for general anesthesia; in these patients, regional anesthesia offers several advantages with improved patient satisfaction [11–15]. Thus, the aim of this study is to compare discharge time, patient, and surgeon satisfaction between two groups of healthy patients submitted to laparoscopic cholecystectomy under general and segmental thoracic spinal anesthesia.

2. Methods

After approval from the medical ethical committee and obtaining an informed consent from 40 patients at the medical research institute, Alexandria university, those patients were chosen with inclusion criteria of ASA physical status classification groups I or II and ages 20–70 years, and exclusion criteria of body mass index above 35 kg/m^2, acute cholecystitis, pancreatitis or cholangitis, previous open surgery in the upper abdomen, contraindication for pneumoperitoneum and the presence of any condition contra-indicating elective surgery or spinal anesthesia. A study to determine the size of the study groups was not undertaken, and the small number of patients is a limiting factor in this study. After informed and verbal consent, patients were randomized by sealed envelopes to receive either general (group G) or segmental thoracic spinal anesthesia (group S). Numbered and sealed envelopes were placed in the operating room and only opened at the patients' arrival there. Patients' preoperative evaluation and preparation were standardized. All patients, who were in spinal anesthesia group, were informed about spinal anesthesia in detail that any anxiety, discomfort, or pain during surgery would be dealt with intravenous medication. The patients were also informed about the probability of conversion to general anesthesia, if needed. At the night before surgery, all patients received 150 mg ranitidine and 10 mg metoclopramide orally. Both anesthesia and surgery were performed in all cases by the same anesthetic and surgical team. On patients' arrival in the operating room, after establishing noninvasive monitoring (electrocardiogram, arterial blood pressure, and pulse oximetry), 500–1000 ml of Ringer acetate solution was commenced intravenously. All patients were intravenously administered 1 mg of midazolam hydrochloride, 1 mg of granisetron hydrochloride, and 8 mg dexamethasone before the induction of anesthesia. The nasogastric tube was inserted only on surgeon's demand to decompress the stomach and avoid vomiting and aspiration; this is especially useful for the thoracic spinal group.

After obtaining baseline vital signs, oxygen at 5 l/min was commenced through a face mask. Patients randomized to thoracic spinal anesthesia were positioned at the sitting position and under full aseptic technique, and a combined spinal epidural (CSE) block system was placed at the 10th thoracic interspace using 16 gauge Tuohy needle and a paramedian approach. The epidural space was identified using the "loss of resistance" to air method. A 27 gauge pencil point spinal needle inserted through the Tuohy needle until the resistance of the dura mater was felt. The advancement of the spinal needle was very slow and cautious, the dura was then pierced, and

once flow of clear CSF began, 1 ml of plain bupivacaine 0.5%, i.e., 5 mg in addition to 25 mcg fentanyl was injected. Hemodynamic parameters were recorded every 2 min for 10 min then every 5 min thereafter. Sensory loss was confirmed by pinprick determining its upper and lower level. Motor block was confirmed by using modified Bromage scale: 0, able to lift extended legs; 1, just able to flex knees, full ankle movement; 2, no knee movement, some ankle movement; 3, complete paralysis. Sensory and motor block were recorded just before the start of surgery and after the completion of surgery. Surgeon was allowed to start his incision once the block considered adequate (T4–T12 sensory block). Intravenous drugs were given to control patient anxiety, hypotension and bradycardia (i.e., 1 mg midazolam increments for anxiety, 5 mg increments of ephedrine for hypotension, or half milligram atropine for bradycardia).

In patients randomized to receive general anesthesia, anesthesia was induced with propofol (2–3 mg/kg), fentanyl citrate (2 μg/kg), and atracurium besylate (0.5 mg/kg). Balanced anesthesia was continued with sevoflurane, 1–2%, and propofol (2 mg/kg/h). After intubation of the trachea, the lungs were ventilated with 50% oxygen in air using a semiclosed circle system. Ventilation was controlled with a tidal volume of 6–8 ml/kg, and the ventilatory rate was adjusted to maintain a $PaCO_2$ value of 35–40 mmHg. Residual neuromuscular block was antagonized with 2.5 mg of neostigmine and 1 mg of atropine sulfate at the end of surgery.

All patients were monitored by electrocardiogram, heart rate, arterial blood pressure, respiratory rate, and pulse oximetry and were recorded at 5-min intervals. Laparoscopic cholecystectomy was performed by using the same technical principles for both groups, with the standard 4-trocar technique. Pneumoperitoneum was established by using the open technique with carbon dioxide at a maximum intra-abdominal pressure of 10 mmHg, instead of the usual 14 mmHg. To minimize the incidence of shoulder pain, 50 ml lidocaine 0.5% was spreaded under the right diaphragmatic coupula using a cannula after insufflation. Another modification of the technique was the minimal—if any—tilting of the operating table, i.e., head up and left tilt to minimize diaphragmatic irritation.

Operative time in both groups as well as any intraoperative adverse effects like bradycardia, hypotension, nausea, vomiting, headache, and abdominal discomfort were recorded in group S. Drug consumption and fluid intake were also recorded.

Discharge time, patient, and surgeon satisfaction were recorded by an observer using an objective scale for recovery assessment and a verbal rating scale for satisfaction (1/5 very dissatisfied, 2/5 dissatisfied, 3/5 neutral, 4/5 satisfied, and 5/5 very satisfied).

Patients who received thoracic spinal anesthesia (group S) who requested sedation were given an intraoperative increment of IV midazolam 1–2 mg. All patients in both groups received 30 mg IV ketorolac intraoperatively.

All patients were transferred to the postanesthesia care unit (PACU). Discharge time was recorded as the time from admission to PACU until the patient met all discharge criteria from it. These included mental alertness, stable vital signs, absence of nausea, control of pain, ability to ambulate, and (for regional techniques) voiding. Side effects measured were the incidence of hypotension, bradycardia, nausea, vomiting, headache, abdominal pain severe enough to require IV narcotics, urine retention and pruritis during PACU stay.

Postoperatively, all patients were given standard intravenous fluids (1 l of Ringer acetate solution and 1 l of dextrose 5%, for the next 24 h) and intravenous analgesia (75 mg of diclofenac IM every 12 h, 500 mg of acetaminophen every 6 h, and supplementary opioids on demand).

Postoperative pain was assessed at relaxed conditions by using the visual analog scale at the completion of surgery, 4, 8, 12, and 24 h after the completion of the procedure.

Other postoperative events related either to surgical or (especially) anesthetic procedure, such as abdominal discomfort, nausea, vomiting, shoulder pain, urine retention, pruritus, headache, and other neurologic sequelae, were also recorded. The patients were fed orally the morning after the operation and discharged 24 h after the procedure, unless complications had occurred.

3. Statistical analysis

Statistical analysis was performed with analysis of variance, standard deviation (x2) and Mann–Whitney *U* test. For data analysis, discharge time was considered the primary outcome variable, with a difference considered significant at the *P* less than 0.05 level. The secondary variable was the patient and surgeon satisfaction, and the two variables were estimated by an observer using an objective scale for recovery assessment and a verbal rating scale for satisfaction. These were compared by analysis of variance for the two groups and confirmed with Wilcoxon's nonparametric test. The frequency of side effects among the groups was compared by x2 analysis with Fisher's exact test, 0.05 level with 80% power.

4. Results

Forty elective cholecystectomy patients (Table 1) were recruited in 6 months, the segmental CSE technique being successful in all patients of group S. The two groups were comparable with respect to gender, age, weight, height, body mass index, ASA classification, preoperative oxygen saturation, and preoperative respiratory rate (Table 1).

In both groups, all procedures were completed laparoscopically, and there were no surgical conversions. In the thoracic spinal group (group S), all procedures were completed under thoracic spinal anesthesia, and there were no anesthetic or surgical conversions. In group G, the operative time ranged from 38 to 102 min, with a mean of 68.6 ± 16.6, while in group S, the operative time ranged from 39 to 95 min, with a mean of 67.3 ± 16.3. This difference in the mean operative time between both studied groups was statistically insignificant.

In the thoracic spinal anesthesia group, during insertion of the spinal needle, two patients experienced paresthesia (one in the leg and the other in the thigh), and this episode was too brief to identify the precise dermatomal distribution, so immediate withdrawal of the stylet of the needle with good effect. No problems experienced during injection of the anesthetic solution. An effective sensory block [range: upper T2–T3; lower L1–L3] developed within 15 min in all patients. Modest amounts of lower limb motor block developed before the start of surgery in about half the patients (Table 2).

Table 1 Personal characteristics of the studied cases of both groups.

Personal characteristics	Thoracic spinal anesthesia (n = 20)		General anesthesia (n = 20)		Significance
	No.	%	No.	%	
Gender					
Male	8	40.0	7	35.0	$X^2 = 0.107$
Female	12	60.0	13	65.0	$P = 0.744$
Age (years)					
Range	21–70		20–69		$t = 0.402$
Mean ± SD	45.9 ± 13.6		44.3 ± 13.2		$P = 0.69$
Weight (kg)					
Range	68–106		62–114		$t = 0.034$
Mean ± SD	85.6 ± 12.6		85.8 ± 15.2		$P = 0.973$
Height (cm)					
Range	164–178		159–180		$t = 0.544$
Mean ± SD	169.4 ± 4.2		168.5 ± 5.6		$P = 0.59$
Body mass index (kg/m^2)					
Range	24.0–35.0		24.0–35.0		$t = 1.99$
Mean ± SD	29.8 ± 4.1		30.0 ± 3.9		$P = 0.843$

X^2: Chi-square test, t: t-test, ^{FE}P: Fisher's exact test, Z: Mann–Whitney test, * significant at $P \leqslant 0.05$.

Table 2 Characteristics of thoracic spinal anesthesia among the studied cases (n = 20).

Paresthesia from spinal needle		Time to full block regression (min)	
Absent	18 (90%)	Range	140–183
Present	2 (10%)	Mean ± SD	160.9 ± 111.4
Upper level sensory block before surgery		Lower level sensory block before surgery	
T2	12 (60%)	L1	7 (35%)
T3	8 (40%)	L2	8 (40%)
		L3	5 (25%)
Upper level sensory block after surgery		Lower level sensory block after surgery	
T3	9 (45%)	T12	15 (75%)
T4	7 (35%)	L1	5 (25%)
T5	4 (20%)		
Bromage grade before surgery		Bromage grade after surgery	
1	11 (55%)	0	12 (60%)
2	9 (45%)	1	8 (40%)

The intra-operative cardiovascular changes in the thoracic spinal group were significant when compared with the general anesthesia group, hypotension, and bradycardia were encountered in 8 patients (40%), and they were given ephedrine and atropine, respectively. Five patients (25%) described some abdominal discomfort and 2 patients (10%) had intraoperative headache late in the procedure, all responded to modest doses of fentanyl. Five patients (25%) received increments of midazolam 1–2 mg for anxiety and 2 patients (10%) described some mild itching not requiring treatment. Three patients (15%) experienced intraoperative nausea and vomiting (Table 3).

No patient showed overt evidence of respiratory depression, oxygen saturation being 97–98% throughout. The intra-operative respiratory rate showed significant increase in the thoracic spinal group when compared with the general anesthesia group. The mean time to full block regression was 160.9 min.

As regards the intra-operative fluids, thoracic spinal group patients were given a mean of 2425 ml fluids which was significantly greater than patients of the general anesthesia group (1225 ml) (Table 3).

The systolic and diastolic blood pressure showed significant decrease in the early-operative and postoperative period in group S, when compared to group G. The heart rate showed significant decrease in group S when compared to group G throughout the time of measurements during surgery and immediate postoperative period.

PACU complications (hypotension, bradycardia, nausea, vomiting, headache, abdominal pain severe enough to require IV narcotics, urine retention and pruritus) showed insignificant difference between both groups except for abdominal pain and urine retention. Fourteen patients (70%) in group G required PACU opioid administration, while in group S, 2 patients (10%) only, this difference in consumption of opioid analgesics between both groups was statistically significant. Six patients (30%) in group G developed PACU urine retention, while none in group S, this difference between groups was statistically significant.

The mean discharge time from PACU in group S was 81 min, which was significantly less than in group G (111.9 min).

Table 3 Intra-operative data among the studied cases of both groups.

Intra-operative data	Thoracic spinal anesthesia (n = 20)		General anesthesia (n = 20)		Significance
	No.	%	No.	%	
Use of medications					
Midazolam					
Yes	5	25.0	0	0.0	$^{FE}P = 0.047^{*}$
Ephedrine					
Yes	8	40.0	0	0.0	$^{FE}P = 0.003^{*}$
Atropine					
Yes	8	40.0	0	0.0	$^{FE}P = 0.003^{*}$
Crystalloids/colloids(ml)					
Range	1500–3000		1000–2000		$t = 9.651$
Mean ± SD	2425.0 ± 466.7		1225.0 ± 302.4		$P < 0.0001^{*}$
Intra-operative side effects					
Nausea and vomiting					
Yes	3	15.0	0	0.0	$^{FE}P = 0.231$
Headache					
Yes	2	10.0	0	0.0	$^{FE}P = 0.487$
Abdominal pain					
Yes	5	25.0	0	0.0	$^{FE}P = 0.047^{*}$
Unaided ambulation at the end of procedure					
Yes	16	80.0	0	0.0	$X^2 = 26.67$ $P < 0.0001^{*}$

X^2: Chi-square test, t: t-test. ^{FE}P: Fisher's exact test.
* Significant at $P \leqslant 0.05$.

Table 4 Postoperative VAS, patient and surgeon satisfaction among both studied groups.

Postoperative VAS	Thoracic spinal anesthesia (n = 20)	General anesthesia (n = 20)	Significance
After 4 h			
Range	0–4	0–6	$t = 2.406$
Mean ± SD	1.2 ± 1.2	2.3 ± 1.6	$P = 0.021^{*}$
After 8 h			
Range	0–5	0–6	$t = 3.507$
Mean ± SD	1.6 ± 1.4	3.4 ± 1.9	$P = 0.001^{*}$
After 12 h			
Range	0–5	0–6	$t = 5.126$
Mean ± SD	1.6 ± 1.4	3.8 ± 1.3	$P = 0.0001^{*}$
After 24 h			
Range	0–2	0–5	$Z = 3.148$
Mean ± SD	0.8 ± 0.7	2.3 ± 1.5	$P = 0.002^{*}$
Patient satisfaction			
Range	2–5	2–5	$t = 2.532$
Mean ± SD	3.6 ± 0.9	2.9 ± 0.9	$P = 0.016^{*}$
Surgeon satisfaction			
Range	2–4	3–5	$t = 4.321$
Mean ± SD	3	4.1	$P = 0.001^{*}$

t: t-test, Z: Mann–Whitney test.
* Significant at $P \leqslant 0.05$.

The mean postoperative visual analog score (VAS) at 4, 8, 12, and 24 h was significantly less in thoracic spinal group patients, when compared with general anesthesia group patients (Table 4).

Postoperatively, there were minor degrees of abdominal pain, shoulder pain, or itching in small numbers of patients, all readily treatable with standard oral medication, but no nausea or vomiting. Patients of group S gave a mean satisfaction score of 3.6, which was significantly more than patients of group G, whose satisfaction score was 2.9. Surgeon satisfaction score of 3 for group S was significantly lower than in group G, whose score was 4.1 (Table 4).

5. Discussion

Regional anesthesia for laparoscopic cholecystectomy reduces the surgical stress response. In regional anesthesia, there is no airway instrumentation and there is low incidence of deep vein thrombosis [13]. Despite that, regional anesthesia carries the possibility of inadequate ventilation due to extensive thoracic nerve block. The main inspiratory muscle, diaphragm, will be unaffected because it is innervated from cervical level, and expiration is normally a passive phenomenon. However, forceful expiration and coughing will be affected because they are generated primarily by the muscles of the anterior abdominal wall which are innervated by the thoracic nerves [16,17].

Use of relatively large dose of local anesthetics can produce disastrous effects in patients with obstructive airway disease, which depends on active expiration in maintaining lung ventilation. Thus, the degree of nerve block and muscle weakness should be minimized by using adequate dose of local anesthetics. Another concern is careful control of the pneumoperitoneal pressure during surgery to ensure adequate diaphragmatic excursion. Because pneumoperitoneum by CO_2 insufflation can stimulate vagal nerve and cause bradycardia, CO_2 must be insufflated slowly, and the maximum intra-abdominal pressure should be lowered than 14 mmHg. The negative effects of the pneumoperitoneum with CO_2 on the respiratory function have been widely investigated [18]. Usually, CO_2 is used for safety due to its high water solubility and its high capacity of exchange in the lungs. The concentration of CO_2 can be easily monitored by capnography and controlled by ventilation [19].

SpO_2 and $P_{ET}CO_2$ remained within normal limits (no hypoxemia or retention of CO_2) during the procedure, confirming that thoracic spinal anesthesia can be safe for laparoscopic cholecystectomy in patients without associated respiratory depression as the respiratory control mechanism is still intact and allows patients to adjust their minute ventilation [20]. It seems that regional anesthesia may be alternative method to general anesthesia for laparoscopic cholecystectomy in patients with cardiopulmonary disease when low intra-abdominal pressure and less degree of patient tilt during surgical procedure is used [21]. van Zundert et al. stated that segmental spinal anesthesia can be used safely for patient with impaired organ function [3]. Lau et al. also quoted that laparoscopic hernia can be performed successfully under spinal anesthesia [22]. Yi et al. used segmental spinal anesthesia in a patient with previous right pneumonectomy and moderate obstructive and restrictive pattern (was found on pulmonary function tests) and hypokinesia of apical anterior and septal segments (was seen on echocardiography), epidural catheter was inserted at 10th thoracic intervertebral space, and segmental spinal anesthesia was performed at L2–L3 intervertebral space with 5 mg of hyperbaric bupivacaine 0.5% and 20 μg of fentanyl. A segmental sensory block, extending from T3 through L2 dermatomes, was obtained. Surgery was performed smoothly and uneventfully [23].

The combined spinal epidural (CSE) technique was performed at the low thoracic level without any great difficulty. Lumbar puncture is usually performed at L3–L4, where the 2nd to 5th sacral nerve roots are present in the dural sac. Considering that the lower nerves are of higher origin and that the lumbar nerves come from a thoracic level, it is easy to understand why the thoracic puncture provides lumbar paresthesia (L1–S4). Two patients did experience some paresthesia during initial insertion of the spinal needle, these symptoms responded to needle withdrawal and did not lead to any postoperative sequelae. Paresthesia can occur with any technique of spinal anesthesia, but are of potentially greater significance when the needle is inserted above the termination of the spinal cord. Use, as here, of a CSE system which limits the length of needle which can project beyond the tip of the epidural needle should minimize the risk of contact with neural tissue, however, the occurrence of paresthesia in two patients implied that this could be significant. Imbelloni et al. [24] observed a 6.6% incidence of paresthesia during low thoracic spinal needle placement without any permanent neurologic deficit. In their study, they compared frequencies of paresthesia for the cut point needle (4.67%) and pencil point needle (8.67%) for low thoracic spinal anesthesia, and it was not found that the pencil point needle caused paresthesia more frequently than cut needle during the procedure. Eliciting paresthesia during spinal needle insertion indicates that the tip of the needle is adjacent to spinal nerve roots, or, potentially, the spinal cord. Needle size and shape may influence the incidence of paresthesia and other complications during spinal procedures.

It is possible that the low dose of bupivacaine used was a factor which minimized the degree of thoracic motor block in group S. The generally minor and transient degree of lower limb motor block was more likely to have been due to minimal physical spread of solution to the lumbosacral nerve roots.

Cardiovascular changes between groups were significant, but easily controlled, where 40% of patients in group S received ephedrine and atropine for hypotension and bradycardia. Critchley et al. reported 29% increase in mean arterial pressure after gas insufflation under general anesthesia [25]. van Zundert et al. [4] have provided preliminary evidence that segmental spinal anesthesia can be an effective anesthetic technique for routine laparoscopic surgery; in a group of 20 healthy patients, side effects were minimal, and patient satisfaction scores were high, although cardiovascular changes might be greater in older patients and those with intercurrent disease. Gupta et al. [26] during their study about thoracic epidural anesthesia for elective laparoscopic cholecystectomy found that hemodynamic changes were minimal.

This study confirmed the superiority of spinal anesthesia in the control of pain in the immediate postoperative period when compared to general anesthesia, besides having a lower cost. Spinal anesthesia is associated not only to low mortality indices, but also a lower incidence of severe complications such as deep venous thrombosis, pulmonary embolism, pneumonia, respiratory depression, myocardial infarction, and renal failure when compared to general anesthesia [27]. In another series, spinal anesthesia was associated with a lower incidence of postoperative complaints and treatments as well as shorter observation time when compared to general anesthesia [28]. Consequently, laparoscopic cholecystectomy under spinal anesthesia should be an appropriate method. In conclusion, this small study has provided preliminary evidence that patients received segmental thoracic spinal anesthesia had shorter discharge time and better satisfaction when compared to patients received general anesthesia, surgeon satisfaction was higher for general anesthesia group than thoracic spinal anesthesia group, and thoracic spinal anesthesia can be used successfully and effectively for laparoscopic cholecystectomy in healthy patients by experienced anesthetists.

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