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Original Article

Laparoscopic Cholecystectomy Under Combined Spinal/Epidural Anesthesia: A Retrospective Analysis of 112 Cases in Terms of Per- and Postoperative Outcomes

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Abstract

Introduction: Laparoscopic cholecystectomy (LC) is the gold standard for the treatment of benign gall bladder diseases. The use of spinal (SA), epidural (EA), and combined spinal epidural anesthesia (CSEA) has increased in recent years.

Methods: A total of 112 patients who underwent elective LC under CSEA for gall stones or polyps were retrospectively analyzed. Low-pressure CO_2 pneumoperitoneum was used, and standard LC was performed. Patient demographics, ASA scores, comorbidities, surgery, anesthesia, and total time were recorded. Intraoperative complications (hypotension, bradycardia, hypoxemia, nausea/vomiting, right shoulder pain, anxiety or abdominal discomfort, and/or pain) were recorded. Postoperative shoulder pain, postdural puncture headache (PDPH), nausea/vomiting, urinary retention, anxiety, and abdominal discomfort and/or pain were also recorded.

Results: LC was successful in all patients, except one. Seventy patients had VAS0=0, 40 (35.7%) had VAS0 <1, and two (1.8%) had VAS0 ≤2. The patient satisfaction score was 4 or 5 for 84.8% of patients. There was intraoperative abdominal discomfort, shoulder pain, and anxiety in 26 (23.2%), 13 (11.6%), and eight (7.1%) patients, respectively. Two patients (1.8%) developed intraoperative hypotension. Postoperatively, shoulder pain, urinary retention, nausea and vomiting, and PDPH were observed in 10 (8.9%), six (5.4%), four (3.6%), and four (3.6%) patients, respectively.

Discussion and Conclusion: LC under CSEA with low-pressure CO_2 pneumoperitoneum is feasible and safe.

Keywords: Anesthesia; laparoscopic cholecystectomy; pain.

Laparoscopic cholecystectomy (LC) is currently the gold standard for treating patients with cholelithiasis and gall bladder polyps [1,2]. It has advantages, such as shorter hospital stay, faster return to daily routine, and lower intra- and postoperative morbidity and mortality than in open surgery [3,4,5].

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Although general anesthesia (GA) has been traditionally used in LC, the use of spinal (SA), epidural (EA), and combined spinal epidural anesthesia (CSEA) has increased in recent years [6,7,8]. Regional anesthesia has advantages, such as smaller surgical incision, lesser shoulder pain, lesser nausea and vomiting, and lower neuroendocrine response in the postoperative period than those in GA [6,9]. Rodgers et al. [10] reported in their meta-analysis that the application of neuraxial techniques resulted in a reduced mortality rate. In addition, the number of patients with venous thromboembolism and myocardial infarction has decreased when using neuraxial techniques.

Despite these advantages, an anesthesiologist must overcome problems pertaining to pneumoperitoneum and spinal anesthesia-related per- and postoperative complications and provision of sufficient neural block for surgical procedures [6,7,8,9]. There are few studies on LC under CSEA; CSEA in LC has not been analyzed as much as SA aor EA [9,12,13]. We analyzed per- and postoperative side effects and patient satisfaction in 112 patients who underwent LC under CSEA.

Materials and Methods

This retrospective study was conducted in general surgery clinics. Ethics committee approval was obtained, and the study was conducted in accordance with the Declaration of Helsinki. We obtained written informed consent from the patients. Data from 112 patients who underwent elective LC under CSEA for gall stones or polyps were retrospectively analyzed. Patients with contraindications for SA or pneumoperitoneum, spinal deformity, cooperation difficulty, or psychiatric illness; those younger than 18 years of age; and those who were pregnant did not undergo surgery with CSEA. The anesthesia procedure and LC were performed by the same anesthesiologist and surgeon, respectively, for all the patients. All patients were preoperatively informed about the side effects, such as shoulder pain, abdominal discomfort, and anxiety, which might develop during the procedure, and that they could be treated by additional intravenous medication. If this did not result in adequate pain relief, conversion to GA was considered an option. Preoperative medication was not administered to any of the patients. To prevent hypotension, 10 ml/kg Ringer's lactate was intravenously administered 20 min before the start of the CSEA procedure. A standardized CSEA technique was used in all patients, which included the following: a) patient in a sitting position; b) use of needle-through-needle CSEA technique with an 18-G Tuohy needle at the L3–L4 interspace, loss-of-resistance to saline technique, and 26-G pencil point spinal needle (Perifix®, Braun, USA); c) subarachnoid injection of 15 mg hyperbaric bupivacaine for over 30 s to which 10 µg of fentanyl was added via the long spinal needle; and d) insertion of the epidural catheter to a depth of 3–4 cm in cranial direction. EA was performed by administering 20 ml of a mixture of 10 ml bupivacaine (0.5%; 50 mg), 5 ml lidocaine (2%), 1 ml fentanyl, and 4 ml isotonic saline solutions through the epidural catheter into the epidural space. The patients were positioned in the 15° Trendelenburg position. The repeated pin-prick test at 1-min intervals was used to check the sensorial block level, and when the block reached the T4 dermatome level, the surgery was initiated. An insufficient level of anesthesia, failure to cope with intraoperative complaints, or patient's choice was the criteria for conversion to GA. Low-pressure (10 mm Hg) CO_2 pneumoperitoneum was used, and a standard four-trocar LC was performed.

Electrocardiography (ECG), noninvasive arterial blood pressure (NIBP), heart rate (HR), respiratory rate (RR), and peripheral oxygen saturation (SpO_2) were continuously monitored for all patients. Patient demographics, ASA scores, comorbidities, surgery time (the time between skin incision and end of skin closure), anesthesia time (the time between spinal entry and achieving anesthesia level), and total time (the time between spinal needle entry and end of skin closure) were recorded. Additionally, pneumoperitoneum or CSEA-related peroperative complications, such as hypotension (decrease in mean arterial pressure by ≥30% or decrease in systolic arterial pressure to <90 mm Hg), bradycardia (HR <50 bpm), hypoxemia (SpO_2 <90%), nausea/vomiting, right shoulder pain, anxiety, or abdominal discomfort and/or pain were recorded. Shoulder pain, PDPH, nausea/vomiting, urinary retention, anxiety, and abdominal discomfort and/or pain were recorded during the postoperative period. Intravenous fluid replacement with 1 L of Ringer's lactate and 1 L of isotonic saline was performed during the first 24 h following surgery. On postoperative days 3 and 7, the patients were evaluated for surgical complications (choledochal injury, hemorrhage, and vascular injury). A visual analog scale (VAS) was used to evaluate postoperative pain (0, no pain to 10, severe pain), and data were recorded at 2, 4, 6, 12, and 24 h. Additionally, a five-parameter Likert scale was used to evaluate patient satisfaction before discharge (1, dissatisfied to 5, very satisfied).

The Statistical Package for Social Sciences, version 16.0 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis of study results. Data are presented as the mean±SD or number and percentage of patients.

Table 1. Patient characteristics and procedures (n=112)

Age (year)	51±15
Gender (n) M/F	35/77
Weight (kg)	81±14
Height (cm)	165±8
BMI (kg/m^2)	29.9±4.7
ASA I/II/III (n)	57/42/13
MSB (T_2/T_3/T_4) (n)	13/91/8
Gallbladder disease (n)	
Stone	95 (84.8%)
Polyp	17 (15.2%)
Co-existing disease	38 (33.9%)
Diabetes mellitus	23 (20.5%)
Hypertension	28 (25%)
COPD	10 (8.9%)
Others	2 (1.8%)
Drain (+) (n)	14 (12.5%)
Anesthesia time (min)	28±3
Surgery time (min)	32±6
Total procedure time (min)	64±7

Data are presented as the mean±SD, number of patients (%), and median (min–max). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. ASA, American Society of Anesthesiologists; MSB, maximal sensorial block height (dermatomal level); COPD, chronic obstructive pulmonary disease.

Results

This retrospective study analyzed data from 112 patients (35 males, 77 females) who underwent LC under CSEA for gall stones or polyps between December 2014 and 2015. All patients underwent minimally invasive surgery under CSEA, without having the need to convert to open surgery or GA. A subhepatic drain tube was placed in 14 patients because of minimal blood leakage in the liver bed, and the drain was removed on postoperative day 1 in all patients. All patients were discharged from the hospital within 36 h, and no surgical complications were observed on postoperative days 3 and 7. Patient demographics, ASA scores, maximum level of blockage, surgical diagnosis, drain tube use, comorbidity, and procedure duration are summarized in Table 1.

Sixty-nine patients (61.6%) who underwent surgery had no untoward effects or pain, although side effects were intraoperatively observed in 43 patients (38.39%). These patients experienced abdominal discomfort (n=26, 23.2%), shoulder pain (n=13, 11.6%), or anxiety (n=8, 7.1%), which were subsequently reduced by administering 1–2 µg/kg of fentanyl or 0.015–0.030 mg/kg of midazolam. Two patients (1.8%) developed intraoperative hypotension resulting from SA. Patients with hypotension were treated with 250 mL of isotonic saline infused over a 5-min period. Intravenous administration of 5 mg ephedrine was performed in patients who were not responsive to saline treatment or whose systolic arterial pressure decreased <90 mmHg. None of the patients experienced bradycardia, nausea/vomiting, or respiratory distress (Table 2).

Table 2. Intraoperative adverse events (n=112)

Adverse event	n (%)
Abdominal discomfort/pain	26 (23.2%)
Shoulder pain	13 (11.6%)
Anxiety	8 (7.1%)
Hypotension	2 (1.8%)
Bradycardia	0 (0%)
Respiratory discomfort	0 (0%)
Nausea/vomiting	0 (0%)

Table 3. Postoperative adverse events (n=112)

Adverse event	n (%)
Shoulder pain	10 (8.9%)
Urinary retention	6 (5.4%)
Headache	4 (3.6%)
Nausea/vomiting	4 (3.6%)

Table 4. Postoperative pain evaluation

Measurement Time	VAS
VAS0	0.39±0.53
VAS2	1.08±0.54
VAS4	1.62±0.59
VAS6	4.06±0.62
VAS12	1.19±0.48
VAS24	0.51±0.50

VAS, Visual analog scale.

The side effects seen in the first 24 h after surgery are shown in Table 3. Ten patients (8.9%) reported mild shoulder pain which resolved within few hours without treatment. Urinary retention and postoperative nausea and vomiting (PONV) were treated with urinary catheterization and intravenous administration of 8 mg ondansetron, respectively. Furthermore, 1 L of isotonic bolus fluid and tramadol (50 mg in 100 ml isotonic saline solution infused over 30 min) were administered for PDPH (headache started in four patients 5 h after surgery). All these side effects were easily resolved, and they did not result in increased hospital stay duration.

Postoperative VAS scores are presented in Table 4. of the

112 patients, 70 (62.5%) reported no pain immediately after the surgery (VAS0=0). The pain levels were recorded as VAS0 <1 in 40 (35.7%) and VAS0 ≤2 in two (1.8%) patients.

If postoperative VAS score was ≥3, analgesia was provided by infusing 50 mg of tramadol in 100 ml of isotonic saline solution for 30 min. When VAS scores at 6 h were ≥3, analgesic treatment was administered to the patients. After this time point, none of the patients needed analgesics. The patient satisfaction points were 4 and 5 in 84.8% of the patients.

Table 5. Patient satisfaction

Likert point	n (%)
1	0 (0)
2	2 (1.8)
3	15 (13.4)
4	67 (59.8)
5	28 (25)

Discussion

LC under CSEA was successfully performed in this study. The preferred anesthesia for LC to date has been GA because of the risk of aspiration, increased CO_2 load, and shoulder pain associated with RA [8]. However, RA has advantages such as an awake and oriented patient, less postoperative pain, and less nausea and vomiting, along with the exclusion of GA-related problems, such as mouth and teeth injury, sore throat, and stomach insufflations [14]. Successful RA for laparoscopic procedures requires a neural block of at least ≥T6 [15].

LC with neuroaxial blockage at level T4 was successful, and we believe that this level can also provide improved comfort when performing LC. Imbelloni et al. also reported that a sensorial block of level T3 is sufficient for LC. A combination of fentanyl with local anesthetics prolongs sensory block in SA. The use of hyperbaric solutions and supine and Trendelenburg positions are thought to promote sensory block more than anterior motor roots [16]. We observed the advantage of this technique in our study.

CSEA has the advantage of extending the neuroaxial block without causing respiratory depression and prolonged postoperative analgesia [17]. Respiratory depression was reported to be more common with hydrophilic opioids (i.e., morphine) than with lipophilic opioids (i.e., fentanyl), which rapidly and strongly bind to their receptors and do not tend to progress superiorly [8]. Using fentanyl, we did not observe respiratory depression in any patient. Paralysis of the expiratory muscles was not seen, thus indicating no respiratory discomfort, as observed in the literature for CSEA [8,17].

Additionally, although itching is a side effect seen in opioid administration, we did not encounter this side effect in our study [8].

Peroperative abdominal discomfort and right shoulder pain resulting from pneumoperitoneum are well-known side effects in LC under SA or EA [7,14,16,17,20,21,22] due to irritation of the diaphragm by the pneumoperitoneum [18]. The incidence of shoulder pain was 4%–55% [8,11,17,19,21,22].

The use of fentanyl, nitrous oxide, slow and gentle surgical manipulation, nasogastric decompression, irrigation of the diaphragm with 2% lidocaine solution, phrenic nerve block, NSAIDs, and pneumoperitoneum evacuation in Trendelenburg position have been proposed to overcome this problem [7,14,20,23]. Intractable shoulder pain might necessitate conversion to GA [7,17].

Shoulder pain incidence in our study was 11.6% and lower than the mean value reported in most previous studies, which might have resulted due to the combination of EA and low-pressure pneumoperitoneum [7,17,19,20]. All patients responded well to fentanyl and/or midazolam, and conversion to GA was not required in any patient, which is consistent with the results of Imbelloni et al. who reported that their patients had no conversion caused by abdominal discomfort and shoulder pain. They explained that this success was related to midazolam sedation reaching the T3 level [16]. We managed these symptoms by administering midazolam and/or fentanyl.

After surgery, the incidence of shoulder pain decreased to 8.9%; this incidence was between 30%–50% in GA, suggesting that CSEA was superior than GA in preventing postoperative shoulder pain [18]. We believe that EA provides parasymphatetic sensory block of the diaphragm, unlike GA in which all the patients complain of postoperative pain. Thus, CSEA has better results in terms of postoperative pain.

Anxiety resulted due to pain and discomfort, and was managed well by fentanyl/midazolam administration. Mehta et al. [17] reported conversion to GA in one patient because of anxiety and shoulder pain in ASA I and II patients who had a BMI of <30%. In this study, anxiety improved in six patients (20%). In our study, anxiety developed in eight patients (7.1%). Our study also showed that LC under CSEA was a safe method in patients who had ASA III and BMI >30. Hypotension is a common problem, and its incidence is as high as 36% in patients who undergo SA and CSEA with pneumoperitoneum [15,18,24]. This hypotension is also be-

cause of pneumoperitoneum-related increased intraabdominal pressure, which decreases venous return.

A pneumoperitoneum pressure of 12 mm Hg was reported to result in a decrease in arterial blood pressure and HR in 3% of the patients who underwent cholecystectomy [24]. Lee at al. reported hypotension in eight of 12 patients and significant bradycardia in two who underwent LC under EA only at 10-mmHg pneumoperitoneum [25].

We used a 10-mmHg pneumoperitoneum and observed hypotension in 1.8% of our patients. Mehta et al. [17] who also used a <10-mm Hg pneumoperitoneum and CSEA with T2–T4 block reported hypotension in 11 patients (36%) who responded to a single dose of 6-mg mephenteramine and bolus fluids. This lower incidence (1.8%) in our patients may be because of the combination of EA and SA, in contrast to Mehta et al. who used EA for postoperative pain management only, along with good fluid resuscitation before the anesthesia procedure, effective fluid replacement throughout the surgery, and use of low-pressure pneumoperitoneum. Although Mehta et al. used only thoracic epidural catheter to administer 2 ml levobupivacaine (0.5%)+25 µg fentanyl, we administered both SA and EA using 15 mg hyperbaric bupivacaine+10 µg fentanyl and 20 ml of a mixture of 10 ml bupivacaine (0.5%; 50 mg)+5 ml lidocaine (2%)+1 ml fentanyl between the L3–L4 interspinal space, respectively. We think that hypotension incidence in the study of Mehta et al. was due to a higher dose of drug to provide both motor and sensorial block. We increased the epidural blockage level under control. We provided motor block using SA and sensorial block using EA. However, Mehta et al. used high-dose EA to achieve both motor and sensorial blocks.

Obese or ASA III patients are particularly prone to respiratory problems. EA was reported to be safe for LC in patients with respiratory problems, and even 80-year-old patients with severe lung problems were reported to undergo LC under EA [22,25]. However, Lee et al. [24] reported respiratory distress in one of 12 (8.3%) patients who were administered EA. Mehta et al. [12] successfully performed LC under CSEA in a patient with dilated cardiomyopathy. We also observed that CSEA was safe in ASA III and obese patients with hypotension and bradycardia, and it was superior to SA alone and similar to EA alone [8,17,24]. None of our patients developed peroperative respiratory discomfort. In our study, 32 patients had a BMI of >30 in whom CSEA was administered in the same manner. As motor block and parasypmhatetic sensorial block of the diaphragm were achieved, no additional medication was needed. If SA-only or EA-only anesthesia is used, peroperative fentanyl administration in SA or high-dose drug administration in EA is needed to provide motor and sensorial blocks.

Although peroperative nausea and vomiting for SA is a problem reported in other studies, none of our patients developed such symptoms during surgery [11]. Their incidence was between zero and 7.3% in some reports on EA [7,21,24]. Singh et al. [8] and Mehta et al. [17] reported their incidences as 2% and 0% for CSEA, respectively.

Postoperative urinary retention is a complication in SA and EA, although Imbelloni et al. reported its incidence as 0% for SA [14,16,21,25,27]. Singh et al. reported its incidence as 10%, but Mehta at al. reported as 0% for CSEA [8,17]. Postoperative urinary retention incidence was 5.4% in our study, which was consistent with those in other studies and which necessitated urinary catheterization [8,14,17,25].

PONV is common in GA and less common in SA and EA [3,8,14,21,25,27]. We observed PONV in four patients (3.6%), and the percentage was slightly higher than in LC under EA or CSEA [8,17,25]. However, PONV ratio was variable for EA in other studies [17,25]. Our results were also better than those of SA reported in a meta-analysis by Wang at al. [27].

PDPH incidence in our series was 3.6% (4 patients), which was higher than that in other studies for CSEA, which was 0% [8,17]. Singh et al. [8] related this to the type of spinal needle used and type of drug (plain bupivacaine) administered into the epidural space, which reduced the pressure gradient between the subarachnoid and epidural spaces, thus preventing a CSF leak. Singh et al. [8] used a 26-G pencil point needle, whereas we used a 26-G pencil point spinal needle (Perifix®).

Postoperative VAS scores were low because of CSEA within 4 h. After the effect of CSEA was resolved, they peaked at 6 h postoperatively; at 12 and 24 h, the pain was mild. VAS scores at 2, 4, 8, and 24 h were significantly reduced in LC under SA compared with GA [27]. Kalaivani et al. [28] reported postoperative VAS 0, 1, and 2 scores as 0, and the scores increased at 4 h; VAS 8 and 24 scores were between 3.5 and 4. Tzovaras showed that the mean pain scores for LC under SA at 4, 8, and 24 h were 1.5, 1, and 1, respectively [20]. Mehta et al. [17] reported for CSEA that none of the patients needed opioid analgesics postoperatively.

Our VAS scores correlated well with those in SA studies; they were low during the first 4–6 h after surgery because of the effect of SA. VAS scores within the first 24 h were also lower because of the combined effect of SA and EA [8,17].

Most patients (98.2%) reported good satisfaction points (most gave 4 points), and the satisfaction rate, including 3

points or more, was 98.2%, which was consistent with the results of Mehta et al. [17] who reported 100% satisfaction rate for CSEA. None of our patients gave a score of<2 (Table 5).

None of our patients experienced any abdominal muscle relaxation issue, similar to studies by Singh et al. [17] and Mehta et al. [8]. Singh et al. explained this as a widespread block caused by combined anesthesia and cephalad spread of intrathecal drug resulting from the epidural drug volume [8]. Mehta et al. [17] suggested that this good muscle relaxation was related to SA. However, they excluded patients with ASA III and BMI >30 to prevent technical difficulties. We also successfully performed LC in these patients without any technical difficulties. Mehta et al. analyzed only patients with BMI<30, without performing a subgroup comparison. In LC performed using 10-mm Hg pressure, there was no problem in the GA and EA groups in terms of surgical dissection and field formation. Surgeons were satisfied with the anesthesia technique.

The duration from the beginning of the anesthesia procedure to achieving a good anesthesia level was 28±3 min, which was longer than that in Mehta et al. Our mean surgery time was 32±6 min, which was consistent with that of Mehta et al. and better than that of Singh et al. for CSEA [8,17]. Our total procedure time was acceptable and better than that reported in other studies [8,28] (Table 1).

The strength of this study is that it is one of the few reports on LC under CSEA. However, a limitation was that it did not include emergency patient cases, and LC under GA was not compared.

Another limitation of this study was that only elective patients were included, whereas pregnant patients were excluded. Furthermore, we did not perform intergroup comparisons, including SA and EA. Further studies on emergency and pregnant patients are required.

Conclusion

We showed that CSEA was an efficient and feasible anesthetic method for LC even in ASA III and obese patients and in those with comorbidities. Although sensorial block level above T6 was reported as being sufficient for LC under SA or EA, the optimal block level has not yet been determined. In this study, we obtained a sensorial block level of T4 without any serious side effects related to CSEA.

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