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Laparoscopic cholecystectomy with thoracic epidural anesthesia and low-pressure pneumoperitoneum in patients with chronic obstructive pulmonary disease: A retrospective study

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ABSTRACT

Introduction: General anesthesia-related side effects are more common in the presence of chronic obstructive pulmonary disease (COPD). Regional anesthesia techniques should be considered in these patients to reduce the risks. In this study, we aimed to retrospectively review our experience of laparoscopic cholecystectomy with thoracic epidural anesthesia, which we carried out in the COPD group.

Materials and Methods: A total of 34 patients who underwent laparoscopic cholecystectomy operation under thoracic epidural anesthesia in our general surgery clinic between 2014 and 2018 were enrolled in this study. All patients had COPD with American Society of Anesthesiologist (ASA) III-IV.

Results: All patients were successfully operated with low CO_2 pneumoperitoneum (10 mmHg) under thoracic epidural anesthesia. Of all patients, 21 (61.8%) of them were male, and 13 (38.2%) of them were female with a mean age of 64 years (range: 52–76). Thirty-one (91.2%) of the patients had ASA III and 3 (8.8%) of them had ASA IV status. Analgesic was needed in 13 (38.2%) patients at the 6th hour and three (8.8%) patients at the 12th hour, while no analgesic was needed in any patients at the 24th hour. The most common complaint in the perioperative period was right shoulder pain by 35.2% (n=12). In addition, nausea occurred in 29.4% (n=10) of the patients; abdominal discomfort, or pain was noted in nine (26.5%) patients. In the per-op period, three (8.8%) patients developed hypotension and two patients (5.9%) bradycardia. In the post-op period, any complain was not observed in 14 (41.2%) patients, while 11 (32.5%) patients had nausea/vomiting, shoulder pain in four (11.8%), and abdominal discomfort was seen in four (11.8%). When pre- and post-op respiratory function tests were compared, no adverse effect was seen due to thoracic epidural anesthesia.

Conclusion: COPD patients who are at a high risk of general anesthesia can be operated under regional anesthesia without experiencing respiratory system complications and with less post-op pain.

Keywords: Chronic obstructive pulmonary disease; epidural anesthesia; laparoscopic cholecystectomy; low-pressure pneumoperitoneum.

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Introduction

General anesthesia is generally preferred in laparoscopic cholecystectomy operation, although series with spinal or thoracic epidural anesthesia have been reported in recent years.[1–3]

General anesthesia shows a negative effect on respiratory function especially by decreasing mucociliary activity. In addition, mechanical ventilation and upper abdominal surgery are also the factors that negatively influence respiratory functions.[4] Therefore, epidural anesthesia can be preferred particularly in ASA III-IV patients with restricted respiartory functions. With epidural anesthesia, both mucociliary activity is protected and lower post-op pain positively affect respiratory functions.[4–6]

In this study, we retrospectively reviewed our results of laparoscopic cholecystectomy that we performed under epidural anesthesia in ASA III-IV patients with restricted respiratory functions due to COPD.

Materials and Methods

In this study, 34 COPD patients who underwent laparoscopic cholecystectomy under epidural anesthesia in the Altinbas University Bahcelievler Medicalpark Hospital between 2014 and 2018 were retrospectively evaluated.

Patients demographic data, ASA scores, concomitant diseases, peri- and post-operative complications, pain levels evaluated with the visual analogue scale at the post-op 6th, 12th and 24th hours, pre- and post-op respiratory function test outcomes, and satisfaction levels before discharge evaluated with Likert scoring were screened from the hospital records and retrospectively examined.

ASA III and ASA IV patients who had restricted respiratory functions due to COPD, and who underwent laparoscopic cholecystectomy under thoracic epidural anesthesia were included in the study. ASA I-II patients were excluded from the study. Patients were informed about the possible complications of epidural anesthesia such as shoulder pain, hypotension, bradycardia, abdominal pain and aboıut that the operation could be converted to general anesthesia. All patients underwent respiratory function test 1 day before and 1 day after surgery. No any premedication was administered except for 15 mL/kg intravenous isotonic solution given 30 minutes before epidural anesthesia in order to prevent hypotension.

Routine monitorization was performed in all patients with ECG, arterial blood pressure, heart rate, respiratory rate and peripheral oxygen saturation, and 4 l/min oxygen was given with a face mask during the operation. Decreased systolic blood pressure under 90 mmHg was considered as hypotension and intervened with 10 mg ephedrine. Decreased heart rate under 40 bpm was evaluated as bradycardia, and these patients were administered 0.5 mg i.v. atropine. Additional midazolam was administered in patients with intraoperative severe shoulder pain for a deeper sedation.

Patients were operated by the same surgical team with standard four-trocar method by providing low-pressure (10 mmHg) pneumoperitoneum. Time between the first incision and the last suture was evaluated as the operational time. Post-op cardiopulmonary stable patients were discharged.

Epidural Anesthesia Technique

After necessary asepsis and local anesthesia were provided in sitting or left lateral decubitus position, the epidural space was accessed from thoracic T10-T11-T12 space with negative pressure method using a 18 gauge Tuohy needle, and the epidural catheter was inserted 3–4 cm upwards. 5 mL 2% Lidocaine was given as test dose. 12 mL 2% Lidocaine, 50 µgr fentanyl and 3 mL 0.5% bupivacaine were then diluted to 24 mL. 12 mL of this solution was administered and additionally 3 mg i.v. midazolam was given for sedation.

The operation was started after detection of sensorial block was obtained at T4-T5 dermatoma level with pinprick test.

Statistical Analysis

Descriptive statistics were presented using mean and standard deviation, median (and minimum-maximum). The normality of continuous variables were investigated by Shapiro-Wilk's test. For comparison of two dependent normally distributed groups Paired Samples t test was used. Statistical analysis was performed using the MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Results

Laparoscopic cholecystectomy operation was successfully performed under epidural anesthesia in 34 patients with chronic obstructive pulmonary disease. None of the patients required general anesthesia or open surgery.

All of our patients had a history of admission to hospital occasionally due to biliary colic with 4 (11.7%) of them was hospitalized and received medical therapy at least once with the diagnosis of acute cholecystitis. In addition, ERCP was applied to 3 (8.8%) patients due to mechanical jaundice and stone extirpation was performed.

Of all patients 21 (61.8%) were male and 13 (38.2%) were female with a mean age of 64 (range: 52–76). Of these patients, 31 (91.2%) were operated with ASA III and 3 (8.8%) with ASA IV score. Twenty five patients (73.5%) had one or more comorbidities other than COPD. Twelve patients (35.2%) had hypertension, 11 (32.4%) coronary artery disease, 8 (23.5%) diabetes mellitus, 2 (5.9%) patients heart failure and 1 (2.9%) renal failure without in need of dialysis.

The mean operational time was 39.68±5.32 minutes and the mean time to discharge was 1.29±0.48 days.

Patients demographic data, comorbidities, ASA scores, mean operational time and length of hospital stay are summarized in Table 1.

Table 1. Distributions of parametres

	n	%
Gender		
Male	21	61.8
Female	13	38.2
ASA		
3	31	91.2
4	3	8.8
Concomitant diseases		
COPD	34	100
Hypertension	12	35.3
Diabetes	8	23.5
CAD	11	32.4
Heart insuffciency	2	5.9
CKD	1	2.9
	Mean±SD	**Med. (Min-Max)**
Age (year)	64.06±6.26	64.5 (52–76)
Operation time (min)	39.68±5.32	39.5 (29–54)
Hospitalization duration (day)	1.29±0.48	1 (1–3)

ASA: American society of anesthesiologist; COPD: Chronic obstructive pulmonary diseas; CAD: Coronary arter diseas; CKD: Chronic kidney deficiency; SD:Standard deviation.

The most common complaints of the patients in the perioperative period was right shoulder pain by 35.2% (n=12). While 5 of these patients benefited from the massege to the right shoulder, additional sedation dose was administered in 7 more severe patients and 4 (11.7%) patients who developed anxiety. In addition, nausea occurred in 29.4% (n=10) of the patients and 8 mg i.v. ondansetron was applied for sedation. Complaint of abdominal discomfort or pain was noted in 9 (26.5%) patients. Three (8.8%) patients whose systolic blood pressure dropped under 90 mmHg in the per-op period were first given isotonic infusion, and 10 mg ephedrine was administered since the infusion failed. Bradycardia developed in 2 (5.9%) patients was improved with the administration of 0.5 mg i.v. atropine (Table 2).

No complaint was observed in 14 (41.2%) patients in the postoperative period. Eleven (32.5%) patients had the complaint of nausea/vomiting, shoulder pain persisted in 4 (11.8%) patients, and sensation of abdominal pain or discomfort was seen in 4 (11.8%) patients (Table 3). Respiratory tests were performed 1 day before and 24 hours after the operation in order to evaluate respiratory functions. Peripheral oxygen saturation was monitored during the surgery (Table 4). When pre- and post-op respiratory function tests were compared, no adverse effect was seen due to the surgery or thoracic epidural anesthesia. Statistically increased post-op peripheral oxygen saturation in the patients had no clinical significance (Table 5)... Analgesic was administered from the catheter when VAS score

Table 2. Per-op adverse event

	n	%
Abdominal discomfort/pain	9	26.5
Anxiety	4	11.8
Nausea	10	29.4
Bradycardia	2	5.9
Hipotension	3	8.8
Shoulder pain	12	35.3

Table 3. Post-op adverse event

	n	%
None	14	41.2
Nausea/vomiting	11	32.5
Shoulder pain	4	11.8
Abdominal discomfort/pain	4	11.8

Table 4. Respiratory function tests

	Pre-op		Per-op		Post-op	
	Mean±SD	Med. (Min-Max)	Mean±SD	Med. (Min-Max)	Mean±SD	Med. (Min-Max)
FVC (L)	1.98±0.07	1.98 (1.81–2.1)	–	–	1.98±0.07	1.97 (1.8–2.1)
FEV_1 (L)	1.04±0.1	1.04 (0.89–1.2)	–	–	1.05±0.09	1.04 (0.88–1.21)
FEV_1/FVC X100 (%)	52.46±3.43	52.8 (46.8–58.5)	–	–	52.65±3.59	52.55 (45.8–59)
sPO_2	85.32±2.78	85 (80–91)	91.24±2.03	92 (87–94)	85.76±2.89	86.5 (81–92)

FVC: Forced vital capacity; FEV_1: forced expiratory volüme,first second; sPO_2: Peripheral oxygen saturation; SD: Standard deviation.

Table 5. Comparison of pre-op and post-op respiratory functions

	Pre-op	Post-op	p
	Mean+SD Med. (Min-Max)	Mean+SD Med. (Min-Max)	
FVC (L)	1.98±0.07 1.98 (1.81–2.1)	1.98±0.07 1.97 (1.8–2.1)	0.604
FEV_1 (L)	1.04±0.1 1.04 (0.89–1.2)	1.05±0.09 1.04 (0.88–1.21)	0.271
FEV_1/FVC X100 (%)	52.46±3.43 52.8 (46.8–58.5)	52.65±3.59 52.55 (45.8–59)	0.277
sPO_2	85.32±2.78 85 (80–91)	85.76±2.89 86.5 (81–92)	0.034

FVC: Forced vital capacity; FEV_1: Forced expiratory volume, first second; sPO_2: Peripheral oxygen saturation, SD: Standard deviation. Paired Samples t-test. There is statistically significant difference between pre and post measurements in terms of sPO_2 (Wilcoxon $p<0.05$). The average of post-op was found higher than prop measurements.

Table 6. Postoperatif pain score (VAS)

	Mean±SD	Med. (Min-Max)
Post-op pain (VAS)		
6. hour	3.21±0.81	3 (2–5)
12. hour	2.35±0.88	2 (1-4)
24. hour	1.97±0.9	2 (0–3)

VAS: Visual Analogue Scale; SD: Standard deviation.

Table 7. Patient satisfaction score

Likert score	n	%
1 Extremely not satisfied	0	0
2 Not satisfied	0	0
3 Undecided	7	20.6
4 Satisfied	19	55.9
5 Very satisfied	8	23.5
Total	34	100

was ≥4. While analgesic was needed in 13 (38.2%) patients at the 6th and 3 (8.8%) patients at the 12th hour, none of the patients had a VAS score ≥4 at the 24th hour (Table 6).

According to the patient satisfaction rates measured before discharge with Likert scale; 8 (23.5%) were extremely satisfied, 19 (55.8%) were satisfied, while 7 (20%) patients reported nor satisfaction neither dissatisfaction. None of the patients reported dissatisfaction (Table 7).

Discussion

Many studies have reported that laparoscopic cholecystectomy can be safely performed under thoracic epidural, spinal or combined epidural/spinal ansethesia.[1,2,7,8]

General anesthesia and carbon dioxide pneumoperitoneum have negative effects such as decreased mucociliary activity in the respiratory tracts and development of hypercarbia due to the absorption of carbon dioxide especially in laparoscopic upper abdominal surgeries.[9]

This results in a higher risk for performing laparoscopic surgery under general anesthesia in COPD patients.

Lung functional residual capacity decreases due to diaphragm elevation in laparoscopic surgeries with increased inrta-abdominal pressure. Ventilation-perfusion compliance is impaired, pawing the way for hypoxemia.

Patients with normal respiratory functions before surgery can overcome the effects of this increased intra-abdominal pressure without experiencing hypoxia, but this may lead to convertion to open surgery in patients with chronic lung disease.[10]

Another side effect of pneumoperitoneum with CO_2 is respiratory acidosis and arrhythmia triggered by it. Mechanic ventilation performed with general anesthesia largely prevents this problem, but spontaneous breathing of the patients remains insufficient to remove increased PCO_2 in epidural anesthesia. This problem can be reduced by giving O_2 to the patients during the surgery.[11,12]

In our study, we applied nasal oxygen at a rate of 4 l/min during surgery. However, 2 (5.9%) patients developed bradycardia, which was improved by appropriate medication.

Previous studies have found significantly higher post-op PCO_2 level compared to pre-op PCO_2 level in patients undergoing laparoscopic cholecystectomy under general anesthesia.[13,14]

Bayrak et al.[6] found that while there was no significant difference between COPD patients who underwent laparoscopic cholecystectomy under general or spinal anesthesia in terms of PCO_2 at the pre-op 5th and 20th minutes, PCO_2 values at the post-op 5th and 20th minutes were lower with spinal anesthesia.

In our study, when pre-op and post-op respiratory tests and peripheral oxygen saturation were compared, it was found that thoracic epidural anesthesia had no negative effect on respiratory functions of the patients. However, we believe that the use of arterial blood gas parameters that were not used in the current study will be helpful.

Epidural anesthesia enables performing the surgery without disrupting mucociliary activity, and moreover it reduce respiratory difficulty because of the decreased postoperative pain.[5,6,15]

In our study, analgesic was needed in 13 (38.2%) patients at the 6th hour, 3 (8.8%) patients had a VAS score requiring analgesics. None of our patients required analgesics at the 24th hour.

Despite these positive effects of regional anesthesia, it has the possibility of failure to provide sufficient anesthesia, leading to conversion to general anesthesia. In addition, several side effects such as nausea/vomiting, headache, and urinary retention. Conversation to general anesthesia was not needed in any of our patients. The most common symptom that we encountered in the postoperative period was nausea/vomiting in 11 (32.5%) patients.

One of the most commonly seen problems in laparoscopic surgeries under regional anesthesia is right shoulder pain, which possibly occurs with the irritant effect of CO_2. In the literature, shoulder pain requiring additional analgesia has been reported between 10% and 55%.[1,5,6,16] Consistently with the literature, in our study 12 (35.3) patients developed shoulder pain, with 7 (20.6%) of them required analgesics.

Massage application to the right shoulder is effective in pain relief of patients who developed shoulder pain, as in our study. Pursnani et al.[17] reported that gentle elevation of the liver and less irrigarion reduce shoulder pain. Many studies have reported that working with low pneumoperitoneum prressure and short operation time are the factors reducing the incidence of shoulder pain.[8,17–21]

Disclosures

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