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Original Article

Experience of Laparoscopic Cholecystectomy Under Thoracic Epidural Anaesthesia: Retrospective Analysis of 96 Patients

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Abstract

Objective: Although the traditional anaesthesia method for laparoscopic cholecystectomy has been general anaesthesia, regional anaesthesia techniques are also successfully used today. In this paper, we aimed to report our experiences with thoracic epidural anaesthesia, including complications, postoperative analgesia, technical difficulties and side effects.

Methods: Between December 2009 and November 2012, 90 patients undergoing laparoscopic cholecystectomy were retrospectively analysed. Demographic data, American Society of Anesthesiologists (ASA) scores, comorbidities, duration of operations, medications and doses used for sedation were reviewed.

Results: The gender distribution of patients were recorded as 15 males (15%) and 81 females (85%). The patients had an average age of 46.74±13.28, an average height of 162.50±5.57 cm and a mean weight of 73.57±12.48 kg. ASA classifications were distributed as follows: ASA I: 63 (65%) patients, ASA II 28 (29%) patients and ASA III: 5 patients. We recorded 3 patients with chronic obstructive pulmonary disease (COPD), 14 patients with diabetes mellitus (DM) and 22 patients with hypertension who got their diagnosis in the perioperative visit. During the operation, three patients had bradycardia (heart rate 50 min^{-1}), and atropine was applied. Ephedrine and fluid resuscitation had been applied to 3 patients for the treatment of intraoperative hypotension. Midazolam, ketamine hydrochloride and propofol were administered to patients for sedation during the operations. Thoracic epidural anaesthesia was performed at the level of T7 -9 intervertebral space with the patients in the sitting position. Patients were given oxygen by a face mask at a rate of 3-4 L min^{-1}. The pneumoperitoneum was created by giving carbon dioxide at the standard pressure of 12 mmHg into the abdominal cavity in all patients. If needed, postoperative analgesia was provided by epidural local anaesthetic administration.

Conclusion: Thoracic epidural anaesthesia can be applied as an alternative to general anaesthesia for laparoscopic cholecystectomy.

Key Words: Laparoscopic cholecystectomy, thoracic epidural anaesthesia, pneumoperitoneum

Introduction

The traditional anaesthetic technique used in laparoscopic cholecystectomy surgeries is the application of general anaesthesia. Today, regional anaesthesia techniques (spinal anaesthesia, thoracic epidural anaesthesia) are also successfully used in laparoscopic cholecystectomy operations (1, 2). Both techniques have advantages and disadvantages. General anaesthesia allows controlled ventilation and provides sufficient muscle relaxation. On the other hand, regional anaesthesia is known to decrease surgical stress, postoperative mortality and morbidity (3, 4). In literature, there are no morbidity and mortality studies comparing general anaesthesia and regional anaesthesia in patients undergoing laparoscopic cholecystectomy surgery; however, some studies comparing nausea, vomiting, postoperative analgesia, shoulder pain and duration of hospitalization are available (5, 6). In laparoscopic surgeries, preoperative epidural analgesia not only provides efficient postoperative analgesia but also has a positive effect on cardiac output and cardiac index (7). It has been reported that the addition of spinal anaesthesia to general anaesthesia has led to a reduced response of neuroendocrine stress (8). Spinal anaesthesia and thoracic epidural anaesthesia have advantages and disadvantages over each other. Spinal cord injury is one of the complications about which anaesthetists mostly worry during the administration of thoracic epidural anaesthesia (9).

In laparoscopic cholecystectomy surgeries, cardiopulmonary changes can be observed depending on pneumoperitoneum that is created (10). Moreover, if regional anaesthesia has been performed in patients with pneumoperitoneum, the patient can suffer from shoulder pain due to diaphragmatic irritation during and after operation. Intraoperative deep sedation can be required for removing this pain. Respiratory depression and aspiration of gastric contents should be taken into

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consideration while applying deep sedation, particularly for patients with inadequate respiratory reserve [such as obese, advanced-aged and chronic obstructive pulmonary disease (COPD) patients].

In this retrospective study, we aimed to present our thoracic epidural anaesthesia experience, postoperative analgesia applications, technical difficulties and side effects and complications that occurred in 96 patients having undergone laparoscopic cholecystectomy surgery.

Methods

After obtaining the permission of the institutional review board, 96 patients, who were in the age range of 18-80 years and who had undergone laparoscopic cholecystectomy surgery between November 1009 and November 2012, were evaluated retrospectively. Demographic data of patients, their American Society of Anaesthesiologists (ASA) scores, comorbidities, bradycardia and hypotension developed during operation and sedative drugs and their doses were reviewed on the patient files. Furthermore, the intervertebral space through which thoracic epidural anaesthesia intervention had been performed, the type of local anaesthetic used for epidural anaesthesia, the length of operation and local anaesthetic agents administered through epidural catheter after operation were examined.

The patients who had been younger than 18 years and older than 80 years, whose operation had started as laparoscopic but switched to open surgery due to any reason, whose pneumoperitoneum pressure had been above 12 mmHg and who had been taken into postoperative intensive care unit because of intraoperative surgical complication were excluded from the study.

Statistical analysis

Statistical Package for the Social Sciences 18.0 (SPSS Inc., Chicago, IL, USA) for Windows was used for statistical analysis. Demographic data and operation length were evaluated as mean±standard deviation and comorbidities were calculated as a percentage (%) (Table 1). The drugs used for sedation were evaluated as mean±standard deviation (Table 2). Paired Student t-test was employed for within-group comparison of parametric values (hypertension, heart rate). The value of $p<0.05$ was accepted to be statistically significant.

Results

Demographic data, comorbidities and operation length of 96 patients included in the study are presented in Table 1. Standard patient monitorization was performed for all patients, and thoracic epidural intervention was subsequently performed in sitting position. After providing necessary asepsis and local anaesthesia for the patients, 16 gauge (G) Tuohy needle was inserted through the thoracal (T) 7-9 intervertebral space, using loss of resistance, to a depth of 3-10 cm in the epidural space and epidural catheter was inserted to a depth of 7-14 cm in the space. When no cerebrospinal fluid or blood leak was observed in negative aspiration, test dose was obtained from epidural catheter by adding 3 mL 2% lidocaine 15 µg epinephrine. In all patients, following the test dose, 50 µg fentanyl, 83 mL 4% sodium bicarbonate and 42 µg epinephrine (1 mL) were added to 12 mL 2% lidocaine and diluted to 24 mL and then 12 mL of this solution was administered in the epidural space. Operation was initiated after reaching adequate sensorial block onset. Additional intraoperative dose of local anaesthetic was required in one patient. Midazolam, ketamine hydrochloride and propofol were used for providing sedation. A standardized drug usage protocol was not used and different procedures were applied for sedation. Sedation depth was determined according to the Ramsay Sedation Scale (11) (Table 3). Sedation was provided in a way that sedation score was 2 or 3 for the patients without shoulder pain and 4 or 5 for the patients with shoulder pain. The drugs used for sedation, the mean doses and the number of patients are presented in Table 3.

After sedation, the patients were given O_2 at a rate of 3-4 L min^{-1} by a facial mask. No patients required intubation because of respiratory depression or pain during or after epidural

Table 1. Demographic data, comorbidities and operation duration of patients

Age (year)	46.74±13.28
Height (cm)	162.50±5.57
Weight (kg)	73.57±12.48
Gender (M/F)	15/81
ASA I/II/III	63/28/5
Body Mass Index (kg m^{-2})	
30-35 (Stage 1 Obese)	16 (17%)
35-40 (Stage 2 Obese)	4 (4%)
≥40 (Stage 3 Obese)	2 (2%)
COPD	3 (3%)
DM	14 (14%)
HT	22 (23%)
Duration of operation	

ASA: Risk classification of American Society of Anaesthesiologists; COPD: chronic obstructive pulmonary disease; DM: diabetes mellitus; HT: hypertension; mean±standard deviation and percentage value (%)

Table 2. Sedative drugs and their mean doses and the number of patients

Drugs	**Mean drug dose**
Midazolam (mg)	2.2±0.82
Propofol (mg)	95±68.59
Ketamine (mg)	54.2±20.07
Total number of patients	96

Drug doses are given as mean±standard deviation

anaesthesia. All patients were applied the standard pressure of 12 mmHg CO_2 for creating pneumoperitoneum. The mean duration of operation was found to be 46.31 min. In the case of postoperative pain, local anaesthesia was administered through epidural catheter. To prepare a local anaesthetic solution, 20 mg 2% lidocaine hydrochloride, 15 mg 0.5% bupivacaine and 25 mcg fentanyl citrate were diluted with 0.9% isotonic sodium chloride to 10 cc. Twenty-five patients (26%) diagnosed with acute cholecystitis and 71 patients (74%) diagnosed with chronic cholecystitis were operated. Three patients (3%) developed hypotension. Ephedrine hydrochloride and fluid resuscitation therapies were performed for the patients (The mean blood pressure below 60 mmHg was evaluated as hypotension. Ephedrine was used at the rate of 27.5 mg for three patients in total and 9.2 mg for each patient in average). The heart rate below 50 beats per min^{-1} was considered as bradycardia and treated intravenously with atropine. Bradycardia developed in three patients during operation (heart rates; 38 beats per min^{-1}, 40 beats per min^{-1}, 40 beats per min^{-1}) and normal rtythm was reached after administration of 1 mg atropine.

No cardiopulmonary complication that would increase postoperative morbidity and mortality was observed in patients. Considering postoperative side effects, seven patients had nausea and vomiting and six patients had shoulder pain.

In within group comparisons, the mean preoperative heart rate and blood pressure values were compared to the values at the intraoperative 5th, 10th, 20th, 30th, 45th and 60th min. The decrease in the mean blood pressure was found to be significant at the 10th, 20th and 30th min ($p<0.05$) (Table 4). When preoperative heart rate was compared to the value at the intraoperative 10th min, the decrease in the heart rate values was found to be significant ($p<0.05$) (Table 4).

Patients diagnosed with acute cholecystectomy were discharged 2 days after the surgery, and patients diagnosed with chronic cholecystectomy were discharged 1 day later.

Discussion

Laparoscopic cholecystectomy is accepted to be the gold standard for the treatment of gallstone disease. It should be remembered that anaesthetic problems associated with pneumoperitoneum can develop in addition to surgical complications in laparoscopic interventions.

In patients having cardiopulmonary dysfunction, haemodynamic instability can develop in association with pneumoperitoneum and the position of patient (12). Venous return, heart rate, blood pressure and cardiac output can be affected depending on the pneumoperitoneum pressure that has been created (13, 14). Dexter et al. (14) created low pressure (7 mmHg) and high pressure (15 mmHg) pneumoperitoneum in 20 patients who would undergo elective cholecystectomy. They found the heart rate and mean arterial blood pressure as increased in both groups. Moreover, they reported a decrease of 10% in the stroke volume and of 26% in the cardiac output in the patients for whom 15 mmHg pneumoperitoneum was created. The pneumoperitoneum pressure value of 8-12 mmHg was reported to be safe for laparoscopic cholecystectomy patients (12, 15). We also created the pneumoperitoneum pressure value of 12 mmHg in our patients and observed decreased arterial blood pressure at the intraoperative 10th, 20th and 30th min and decreased heart rate at the intraoperative 10th min.

In our cases, bispectral index was not used for measuring sedation depth; however, bispectral index-controlled sedation

Table 3. Ramsey Sedation Scoring

Patient is anxious, agitated or restless.	1
Patient is cooperative, oriented and calm.	2
Patient only obeys the instructions.	3
Patient sleeps but wakes up when tapped on the forehead and called.	4
Patient sleeps and responds poorly when tapped on the forehead and called.	5
Patient sleeps and responds poorly when tapped on the forehead and called.	6

Table 4. Comparison of preoperative mean blood pressure and mean heart rate values to the values at the intraoperative 5th, 10th, 20th, 30th, 45th and 60th min (mean±standard deviation)

MBP		MHR	
Preop. (n=96)	99±16.5	Preop. (n=96)	77±12.6
5th min (n=96)	97±15.7	5th min (n=96)	74±13.7
p=0.10		p=0.10	
Preop. (n=96)	99±16.5	Preop. (n=96)	77±12.6
10th min (n=96)	94±15.2	10th min (n=96)	73±14.5
p=0.001*		p=0.004*	
Preop. (n=93)	99±15.8	Preop. (n=93)	76±12.2
20th min (n=93)	94±13.7	20th min (n=93)	75±11.9
p=0.004*		p=0.52	
Preop. (n=85)	100±16.1	Preop. (n=85)	77±12.6
30th min (n=85)	96±13.8	30th min (n=85)	75±11.2
p=0.03*		p=0.40	
Preop. (n=56)	100±17.4	Preop. (n=56)	77±12.6
45th min (n=56)	95±18.4	45th min (n=56)	77±12.6
p=0.80		p=0.78	
Preop. (n=41)	97±14.6	Preop. (n=41)	75±14.8
60th min (n=41)	96±11.1	60th min (n=41)	75±10.3
p=0.85		p=0.75	

Preop.: preoperative; MBP: mean blood pressure; MHR: mean heart rate; mean±standard deviation for MBP, MHR; *p<0.05. Statistically significant

can make deep sedation safer. In most of our patients (62 patients), we preferred midazolam and ketamine as sedative agents. It was aimed to reduce the irritating effect of increased intra-abdominal pressure with the help of sedation. Shoulder pain developed in six patients. However, in one of them, local anaesthesia was switched to general anaesthesia because of severe shoulder pain.

CO_2 is generally used for creating pneumoperitoneum (16). Hypercarbia can occur because of systemic absorption of CO_2 in patients under general anaesthesia. Ciofolo et al. (17) applied epidural anaesthesia for patients who would undergo laparoscopic cholecystectomy surgery. In their study, they compared postoperative pCO_2 value 1 h after CO_2 was removed from the intraperitoneal area and preoperative pCO_2 value and they found no statistically significant difference. Furthermore, they revealed that administration of adequate oxygen by a facial mask prevented respiratory acidosis in patients with spontaneous ventilation. In our cases, preoperative, postoperative and intraoperative blood gas analyses were not performed. We suggest that intraoperative blood gas analysis is useful, particularly for patients with limited respiratory reserve (such as obese, advanced age and COPD). In a 78-year-old patient with severe lung disease, laparoscopic cholecystectomy surgery was successfully performed under thoracic epidural anaesthesia and no complication was reported (18).

It has been specified that epidural anaesthesia can be safely used for patients having severe respiratory problem (18). Kim et al. (19) applied thoracic epidural anaesthesia to an 80-year-old patient with bronchiectasis and severe pulmonary function impairment, who would undergo laparoscopic cholecystectomy. They reported that preoperative and postoperative (6 h after the operation) pulmonary function test results were similar. Pulmonary complications can be encountered in patients undergoing laparoscopic cholecystectomy under general anaesthesia. In a study conducted, postoperative pulmonary complications were noted in patients who were exposed to laparoscopic cholecystectomy. Of 40 patients included in the study, 13 had (32.5%) atelectasis, four (10%) had pneumonia, and 7 (17.5%) had respiratory failure and 7 of 13 patients older than 60 years developed respiratory failure (20). Ledowski et al. (21) stated that mucociliary clearance can be impaired after general anaesthesia application; therefore, secretions can increase. They also reported that severe pulmonary infections such as atelectasis and lower respiratory tract infections can develop.

The management of anaesthesia is difficult in obese patients and special attention should be paid to airway. Restricted temporomandibular and atlantooccipital joint movements, short sternomandibular distance and narrow upper airway make airway control and intubation difficult. Moreover, the risk of increased aspiration is available in obese patients. Metoclopramide can be used before operation for reducing this risk. We had 22 patients whose body mass index was ≥30 kg m^{-2}. Although metoclopramide was not applied in our cases, no patient developed aspiration of gastric contents. In obese patients, functional residual capacity is decreased. General anaesthesia contributes to a ventilation/perfusion inconsistency and an increase in intrapulmonary shunt in these patients. Obese patients are under risk, particularly in terms of early postoperative respiratory complications. These postoperative respiratory complications can be reduced with continuous epidural anaesthesia (22-24). In our cases undergoing thoracic epidural anaesthesia, no respiratory complication such as desaturation requiring endotracheal intubation or stomach content aspiration was encountered in any patient, including three patients with preoperative COPD diagnosis, two morbid obese patients and 10 patients >60 years. The advantage of epidural anaesthesia over general anaesthesia has been reported in many studies. For instance, it was reported that it decreased thrombotic complications and increased blood flow to the damaged areas in ischemic myocardium (10, 25). In another study, general anaesthesia and epidural anaesthesia were compared with respect to postoperative congestive heart failure, myocardial infarction and mortality rates. It was revealed that the risk increased four-fold in interventions under general anaesthesia (4, 26). Furthermore, it was specified that epidural analgesia decreased atrial fibrillation, supraventricular tachycardia, deep vein thrombosis, ileus, postoperative nausea and vomiting (27).

It is known that early ambulation is ensured, and hospitalization time is reduced by providing effective analgesia after epidural anaesthesia application (28). In our cases, the duration of hospitalization was 2 days for acute laparoscopic cholecystectomy patients and 1 day for conical laparoscopic cholecystectomy patients. Patient and surgeon satisfaction were not questioned. Lee et al. (1) asked patients to complete a questionnaire on operation comfort on the postoperative 1st day and they reported that satisfaction levels of all patients were good or very good. It was also reported that the results of the survey questioning surgical satisfaction revealed no problem related to surgical technique or muscle relaxation and that there was no difference between general anaesthesia and epidural anaesthesia. Laparoscopic cholecystectomy operations can also be performed under spinal anaesthesia successfully (2). However, it is known that spinal anaesthesia can lead to some undesired side effects such as urinary retention, low level of anaesthesia due to accumulation of local anaesthetic in the sacral area because of lumbar lordosis, obtaining an anaesthesia level that cannot be predicted due to the volume of cerebrospinal fluid in patients and occurrence of postspinal headache associated with spinal anaesthesia (6, 29). Because segmental block appeared in our patients having undergone thoracic epidural anaesthesia, a decrease in the anaesthesia level or overincrease was not observed and postspinal headache did not develop.

Blood gas analysis was not performed in our cases. Moreover, respiratory function tests were not performed in patients hav-

ing COPD. Bispectral index was not used for identifying the depth of sedation.

Conclusion

In laparoscopic cholecystectomy operations, thoracic epidural anaesthesia can be considered as an alternative to general anaesthesia because it affects respiratory functions less, leads to fewer postoperative complications and provides more effective postoperative analgesia.

Ethics Committee Approval: Ethical approval for this study was not taken because retrospective study.

Informed Consent: Informed consent for this study was not taken because retrospective study.

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