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Effects of thoracic epidural analgesia on postoperative pulmonary complications after major abdominal surgery

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Abstract

The incidence of postoperative pulmonary complications (PPC) has been reported to be 5-40% following major abdominal surgery. Thoracic epidural analgesia (TEA) reduces PPC. The aim of this study was to determine the incidence of PPC and to assess the effect of TEA on PPC in patients who underwent major abdominal surgery in a tertiary university hospital. The files of patients who underwent major abdominal surgery between January 2016 and December 2017 were reviewed retrospectively. The patients were divided into general anesthesia (group 1) and general anesthesia with TEA (group 2) groups. Patient demographic data, smoking history, COPD (Chronic obstructive pulmonary disease) history, diagnosis, surgical process, type of surgery (open / laparoscopic), duration of surgery and PPC at 7 days were recorded. A total of 52 patients' records were reviewed. PPC occurred in 11 patients in group 1 and in 5 patients in group 2. There was no statistically significant difference between groups in terms of PPC (p = 0.496). The most common PPC was atelectasis (Group 1: 7,Group 2: 5). Weak correlation was found between development of PPC and duration of surgery (r: 0,391, p = 0.004). We found 30% incidence of PPC in our institution in this study. We could not demonstrate a significant reduction in the incidence of PPC with TEA.

Keywords: Thoracic epidural anesthesia, major abdominal surgery, postoperative pulmonary complications

Introduction

Incidence of postoperative pulmonary complications (PPC) after abdominal surgery is reported to be between 5-40% [1]. In addition to increasing morbidity and mortality, PPC also [2] increase the duration and the cost of the hospitalization [3]. The risk of PPC is determined by the patient's health status and the effects of the surgical trauma [4]. Low preoperative arterial oxygen saturation, acute respiratory infections in the past month, advanced age, pre-operative anemia, upper abdominal or intra-thoracic surgeries, surgeries that last more than 2 hours and emergency surgical interventions are all risk factors for PPC [5].

It was reported that thoracic epidural analgesia decreases the consumption of opioids, improves pulmonary functions and decreases pulmonary complications by providing effective analgesia [6,7]. The aim of this study is to determine the effects of TEA on the development of PPC in patients who have undergone major abdominal surgery in the general surgery clinic of a tertiary hospital and to determine the incidence of PPC in such patients.

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Material and Methods

In this retrospective study, the records of the patients who have undergone major abdominal surgery between the dates of January 2016 and December 2017 were examined after the approval of ethics board (KSU KAEK 2017-252). Organ transplantation surgeries and patients with preoperatively intubated trachea were excluded from the study. Abdominal procedures that are expected to last longer than 2 hours and procedures that are expected to involve blood loss more than 500 mL were defined as major abdominal surgeries. Protective ventilation strategies are employed routinely in our clinic during major abdominal surgeries. In this strategy, low tidal volumes (6-8 mL/ kg) and 6-8 cmH_2O PEEP are employed. After the surgery is completed, PEEP is increased gradually to carry out a recruitment maneuver before extubation. The patients were divided into two groups: the general anesthesia group (group 1) and the thoracic epidural anesthesia in addition to general anesthesia group (group 2). Postoperative analgesia was provided using patient controlled epidural analgesia with bupivacaine 1.25 mg/mL and fentanyl 3 mcg/mL (basal infusion 4 mL/hr, bolus dose 3 mL, lockout interval 20 min.) in group 2 and intermittent iv paracetamol and tramadol injections in group 1. Demographic data of the patients, smoking history, COPD (chronic obstructive pulmonary disease) history, their diagnoses, their previous surgical treatment, the type of the surgery

(open/laparoscopic), the duration of the surgery and pulmonary complications that occurred during the postoperative 7 days were recorded. European Perioperative Clinical Result definitions were taken as basis for PPC diagnosis (8) (Table 1). Postoperative chest radiographs, chest tomography scans if available, ward and intensive care nursing flow sheets, pulmonology consultation notes and daily doctor progress notes were evaluated to detect PPC's.

IBM SPSS for Windows Version 22.0 (IBM statistics, Armonk, New York, United States) was used for statistical tests. The suitability of the variables to normal distribution was analyzed by visual (histogram) and analytical methods (Kolmogorov-Simirnov / Shapiro-Wilk Tests). Descriptive analyses were expressed as the mean (M±SD) for normally distributed variables. For variables that are not in normal distribution, medians and interquartile ranges were used for defining. Variables within normal distribution were compared using Student t test while variables that are not were compared using Mann-Whitney U test. Whether or not there are differences between the groups in terms of these frequencies were examined using Chi-square or Fisher tests (if the values observed in cells are not in accordance with Chi-square test assumptions). For all analyses $p<0.05$ was considered statistically significant.

Table 1. Postoperative pulmonary complications

Complication	Definition
Respiratory infection	Patient has received antibiotics for a suspected respiratory infection and met one or more of the following criteria: new or changed sputum, new or changed lung opacities, fever, white blood cell count > 12000/ µL
Respiratory failure	Postoperative PaO2 < 60 mmHg on room air, a PaO2:FI02 ratio <300 mmHg or arterial oxygen saturation measured with pulse oximetry < 90% and requiring oxygen therapy
Pleural effusion	Chest radiograph demonstrating blunting of the costophrenic angle, detection of pleural effusion on chest computed tomography scan
Atelectasis	Lung opacification with a shift of the mediastinum, hilum or hemidiaphragm toward the affected area, and compensatory over-inflation in the adjacent non-atelectatic lung
Pneumothorax	Air in the pleural space with no vascular bed surrounding the visceral pleura
Bronchospasm	Newly detected expiratory wheezing treated with bronchodilators
Aspiration pneumonia	Acute lung injury after the inhalation of regurgitated gastric contents

Results

Records of 52 patients in total were accessed. There were 34 patients in group 1 and 18 patients in group 2. There was no difference between the two groups in terms of demographic data (Table II). There were significant differences in the type and duration of surgeries between the two groups (Table III). Only 2 patients underwent laparoscopic surgery in Group 2 and surgery durations were significantly longer in this group. The total incidence of PPC was 30% (16/52) in both groups. 5 patients in group 2 and 11 patients in group 1 developed PPC (Table IV). There were no statistically significant differences between the groups in terms of PPC development (p=0.496). Atelectasis was the most prevalent among PPCs (Group 1: 7; Group 2: 5) (Table IV). There were 5 pneumonia and 7 respiratory insufficiency patients in group 1 while 1 patient developed pneumonia and 2 patients developed respiratory insufficiency in group 2. None of the patients developed bronchospasm or aspiration pneumonia. There were no significant differences between groups in terms of the type of PPC . A weak correlation was detected between PPC development and the duration of surgery (r:0.391, p=0.004).

Table 2. Demographic Data

		Group 1 (n=34)	Group 2 (n=18	P
Genre	Male/Female	17/17	7/11	0.319
Age		48.8±18.6	56.7±14.9	0.128
Height(m)		1.66±0.09	1.66±0.07	0.973
Weight		70.3±14.9	71.6±15.3	0.765
BMI (Body mass index)		25.6±4.9	26±5.3	0.72
ASA	I	7	1	0.143
	II	21	13	
	III	6	4	

Table 3. Risk Factors for Postoperative Pulmonary Complications

		Group 1 (n=34)	Group 2 (n=18)	P
Type of Surgery	Open	17 (%50)	15 (%83)	*0,018
	Laparoscopic	17 (%50)	3 (%17)	
Duration (min)		176,5±70,7	229,2±81,4	*0,019
COPD	Yes	3 (%9)	3 (%17)	0,339
	No	31(%91)	15 (%83)	
Smoking	Yes	5 (%15)	5 (%28)	0,219
	No	29 (%85)	13 (%72)	

*: statistically significant difference

Table 4. Number of complications according to the groups

Postoperative Pulmonary Complication	Group 1 (n=34)	Group 2 (n=18)	P
Atelectasis	7 (%21)	5 (%28)	0,399
Pneumonia	5 (%15)	1 (%6)	0,312
Pneumothorax	1 (%3)	0	0,654
Pleural Effusion	2 (%6)	1 (%6)	0,728
Respiratory Failure	7 (%21)	2 (%12)	0,327
Number of patients with any PPC	11 (%32)	5 (%28)	0,496

Discussion

In this study, we have retrospectively examined patients who underwent major abdominal surgery in a tertiary hospital, in terms of PPC's. The contribution of anesthesia to PPC development is a well known fact and anesthesists are working on preventive measures [9,10]. Protective ventilation strategies are employed routinely in our clinic during major abdominal surgeries. In this strategy, low tidal volumes (6-8 mL/ kg) and 6-8 cmH2O PEEP are employed. After the surgery is completed, PEEP is increased

gradually to carry out a recruitment maneuver before extubation. Heat and moisture exchange filters are used for each patient. Perioperative restrictive fluid management is also employed. Despite measures such as these, the incidence of PPC was 30% in our patients . This ratio is similar to 5-40% incidence stated in the literature [1].

The beneficial effects of epidural anesthesia on PPC has been suggested by several studies [11,12]. It is assumed that, the benefit of TEA increases when the surgery is more traumatic and closer to the diaphragm[13-15].

Despite expectations towards decreased rate of PPC's and the superiority of thoracic epidural analgesia in especially post-operative analgesia, our study has revealed no statistically significant differences between the two groups in terms of PPC development. Laparoscopic surgery for gastrointestinal procedures has been shown to decrease PPCs compared with open procedures [16,17] and duration of surgery is an independent risk factor for PPC [1]. The number of patients who underwent laparoscopic surgery was relatively small and the duration of surgeries were longer in group 2 compared to group 1. These factors may have masked the beneficial effects of TEA in our study population.

With their research on PPC's, Patel et al. have put forth that operations for malignancies are a risk factor for PPC development [1]. In our study, 13 out of 18 patients in group 2 had malignancies while in group 1 fewer patients had malignancies (14 out of 34 patients). This also might be cause for the lack of differences between two groups in terms of PPC.

We could not reach any data about postoperative opioid consumption and postoperative pain scores of the patients which may influence PPC development. These are the limitations of this retrospective study.

Conclusion

Despite advancements in surgery and anesthesiology, PPC's are amongst the most important causes of postoperative morbidity and mortality. We could not demonstrate a significant reduction in the incidence of PPC with TEA. However, TEA may have beneficial effects on PPC especially in patients undergoing open major abdominal surgeries.

Competing interests
The authors declare that they have no competing interest.

Financial Disclosure
The financial support for this study was provided by the investigators themselves.

Ethical approval
In this retrospective study, the records of the patients who have undergone major abdominal surgery between the dates of January 2016 and December 2017 were examined after the approval of ethics board (KSU KAEK 2017-252).

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