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Postoperative complications after abdominal surgery in patients with chronic obstructive pulmonary disease

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Background/aims: *Chronic obstructive pulmonary disease is a well-known independent risk factor for the development of postoperative pulmonary and cardiac complications after thoracic or nonthoracic surgery. We aimed to determine the risk factors and complications of abdominal surgery in chronic obstructive pulmonary disease patients.* ***Material and Methods:*** *Thirty-two patients diagnosed with chronic obstructive pulmonary disease out of 89 patients who underwent abdominal surgery at Zonguldak Karaelmas University Medical School Hospital enrolled in the study.* ***Results:*** *Pulmonary and cardiac complication ratios were found high in chronic obstructive pulmonary disease patients. Postoperative pulmonary and cardiac complications were documented in 21.8% and 28.1% of chronic obstructive pulmonary disease patients respectively. There were no differences in terms of complications, according to the severity of the disease in chronic obstructive pulmonary disease patients. While smoking and age did not effect the postoperative complications in chronic obstructive pulmonary disease patients, bronchodilator use increased postoperative cardiac risks. We found that laparoscopic surgery reduced the risk for postoperative pulmonary complications compared with open surgical procedures. No differences were found in terms of complication regarding to the type of incision and the duration of surgery.* ***Conclusion:*** *The patients with chronic obstructive pulmonary disease had high ratio of the pulmonary and cardiac complications. The complication rate was higher for surgical sites closer to the diaphragm such as the upper abdomen. Laparoscopy will reduce the risk for postoperative pulmonary complications compared with open surgical procedures. Based on our preliminary data and considering the lack of controlled trials, bronchodilators should be used with great caution particularly in the individuals with chronic obstructive pulmonary disease and cardiac comorbidity*

Key words: Abdominal surgery, pulmonary complications, cardiac complications, ASA, PFTS

Kronik obstrüktif akciğer hastalığı olan olgularda abdominal cerrahi sonrası postoperatif komplikasyonlar

Amaç: *Kronik obstrüktif akciğer hastalığı torasik veya torasik olmayan cerrahide postoperatif pulmoner ve kardiyak komplikasyonların gelişimi için iyi bilinen bağımsız risk faktörüdür. Biz kronik obstrüktif akciğer hastalığı olanlarda batın ameliyatı sonrası gelişen komplikasyonları ve bu komplikasyonlara neden olan koşulları araştırmayı amaçladık.* ***Yöntem:*** *Zonguldak Karaelmas Üniversitesi Tıp Fakültesi Hastanesinde batın cerrahisi uygulanan 89 olgunun kronik obstrüktif akciğer hastalığı olan 32'si çalışmaya alındı.* ***Bulgular:*** *Kronik obstrüktif akciğer hastalıklı olgularda pulmoner ve kardiak komplikasyon oranı yüksekti. Abdominal cerrahi uygulanan kronik obstrüktif akciğer hastalıklı olgularda postoperatif pulmoner komplikasyon ve kardiyak komplikasyon sırasıyla %21.8 ve %28.1 olarak bulundu. Kronik obstrüktif akciğer hastalığı'nda hastalığın şiddeti ile komplikasyon gelişimi açısından farklılık saptanmadı. Kronik obstrüktif akciğer hastalığı olgularında sigara içimi ve yaş postoperatif komplikasyonu etkilemez iken, bronkodilatatör kullanımı postoperatif kardiyak komplikasyonu artırdı. Açık cerrahi girişim ile karşılaştırıldığında laparoskopik cerrahinin postoperatif pulmoner komplikasyonu azalttığı saptandı. Cerrahi süresi ve insizyon tipi ile komplikasyonlar arsında ilişki bulunmadı.* ***Sonuç:*** *Kronik obstrüktif akciğer hastalığı olan olgularda pulmoner ve kardiak komplikasyon oranı yüksek bulundu. Diyafragmaya yakın üst batın cerrahisinin komplikasyon oranını yükseltmesi ve laparoskopik cerrahinin açık cerrahi ile karşılaştırıldığında postoperatif pulmoner komplikasyonu azaltması nedeniyle kronik obstrüktif akciğer hastalığı olan olgularda laparoskopi tercih edilmesi gereken bir yöntemdir. Bizim ön sonuçlarımıza dayanarak, kontrollü çalışmaların olmaması nedeniyle, kronik obstrüktif akciğer hastalığı olan olgularda kardiyak komorbid durumlar varlığında bronkodilatörlerin dikkatli kullanılmasını önermekteyiz.*

Anahtar kelimeler: Abdominal cerrahi, pulmoner komplikasyonlar, kardiak komplikasyonlar, ASA, SFT

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INTRODUCTION

Pulmonary complications after surgery are a leading cause of postoperative morbidity and mortality. Advances in anesthesia and surgical technique have made operative intervention possible in patients with serious underlying cardiopulmonary disease who previously would have been denied surgery. There is general agreement that thoracic and upper abdominal surgery carry the highest risk of postoperative respiratory complications. Postoperative pulmonary complications contribute significantly to overall perioperative morbidity and mortality (1). In a study of patients undergoing elective abdominal surgery, as an example, pulmonary complications occurred significantly more often than cardiac complications and were associated with significantly longer hospital stays (2). The National Surgical Quality Improvement Program (NSQIP) also found that postoperative pulmonary complications were the most costly of major postoperative medical complications (including cardiac, thromboembolic and infectious) and resulted in the longest length of stay (3).

The reported frequency of postoperative pulmonary complications in the literature varies from 2-70%. This wide range is due in part to patient selection and procedure-related risk factors, although differing definitions for postoperative complications account for much of the variability and make comparison of reported incidences across different studies difficult. One broad definition of postoperative pulmonary complications includes all patients with fever and either pulmonary signs or symptoms (e.g., productive cough, rhonchi or diminished breath sounds) or changes on chest X-ray (e.g., atelectasis, consolidation or incomplete expansion) (4,5).

Chronic obstructive pulmonary disease (COPD) is a well-known independent risk factor for the development of postoperative complications after thoracic or non-thoracic surgery (6-8). Although there is no incremental risk with an increasing severity of airflow limitation in patients undergoing non-cardiothoracic surgery, such an association has been found in patients undergoing thoracic surgery (8). As the impact of pulmonary complications following surgery has become increasingly apparent, estimation of their risk should be a standard element of all preoperative medical evaluations.

We aimed to determine the effect(s) of obstructive airways disease on complication rates following abdominal operations. The definition of postoperative pulmonary complications, identification of patient- and procedure-related risk factors and the role of preoperative pulmonary function testing will be reviewed herein.

MATERIALS AND METHODS

The study site was Zonguldak Karaelmas Universty Medical School. Thirty-two patients diagnosed with COPD out of 89 patients who underwent abdominal surgery at Zonguldak Karaelmas University Medical School Hospital were enrolled in the study. Three (9%) patients with severe COPD, 19 (60%) with moderate obstruction, and 10 (31%) with mild obstruction were selected. Using proposed criteria as a guide (9), the presence of airflow limitation is defined by forced expiratory volume in 1 second (FEV_1)/forced vital capacity (FVC) <70%, and staging of disease severity is defined as follows: severe, if FEV_1 is less than 50% of predicted; moderate, if FEV_1 is from 50-79% of predicted; and mild, if FEV_1 is more than 80% of predicted. All of these patients were subjected to evaluations with detailed history, physical examination, chest X-ray, respiratory function tests, and arterial blood gases (when needed).

The American Society of Anesthesiologists (ASA) classification system (10) is based on the presence of systemic disturbances, which may be: absent (class 1), mild (class 2), moderate (class 3), severe (class 4), or almost certain to cause death (class 5). We used the ASA status recorded in the anesthesiologist's preoperative note. Table 1 lists the interventions performed in the patients with COPD.

Table 1. List of interventions in patients with COPD

Intervention	No. (%) of Patients
Exploratory laparotomy or laparoscopy	13 (40.6%)
Cholecystectomy	3 (9.3%)
Gastrectomy	2 (6.25%)
Gastrectomy and gastrojejunostomy	1 (3.12%)
Colectomy	3 (9.3%)
Coloanal anastomosis and ileostomy	1 (3.12%)
Ileostomy	2 (6.25%)
Small-bowel resection	3 (9.3%)
Appendectomy	1 (3.12%)
Pancreatodigestive anastomosis	1 (3.12%)
Pancreatic resection	1 (3.12%)
Low anterior resection	1 (3.12%)

Anesthesia

All the patients were maintained with sevoflurane or desflurane following induction with propofol, fentanyl and midazolam. In five patients with cardiac morbidity, etomidate was used for induction instead of propofol.

Postoperative Pulmonary Complications

Data concerning postoperative pulmonary complications were obtained from the medical records by a trained research fellow. Complications were defined as follows: pulmonary infection (2 patients) documented on chest radiograph associated with a temperature of >38.5°C and/or the use of antibiotic treatment, prolonged mechanical ventilation (3 patients) due to respiratory failure, and refractory hypoxemia and unexpected postoperative use of aerosol treatment (2 patients).

Cardiac Complications

Complications were defined as follows: supraventricular tachycardia (SVT) (5 patients), ventricular arrhythmia (2 patients) and congestive heart failure (2 patients).

Statistical Analysis

Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS version 11.5) program. Compliance of numerical variables to normal distribution was assessed by Kolmogorov-Smirnov test. Definitive statistics for normally distributed data were expressed as mean±standard deviation and for categorical variables as number and percent. Relationships between the categorical variables were assessed by chi-square test. Results were evaluated within 95% confidence interval, and values of $p<0.05$ were considered statistically significant.

RESULTS

Eighty-nine patients who underwent abdominal surgery were evaluated. Of these 89 patients, 32 (35%) suffered from COPD. There were 22 male and 10 female patients, aged 70.06±8.49 years (mean±SD). All the patients were former smokers, with a 57.96±84.48 pack-year (mean±SD) smoking history.

Pulmonary ($p=0.000$) and cardiac ($p=0.000$) complication ratios were higher in the COPD patients compared with the patients without COPD (Table 2). Postoperative pulmonary and cardiac complications were documented in 21.8% and 28.1% of our patients with COPD, respectively, who underwent abdominal surgery. There were no differences in terms of complications according to the severity of the disease in patients with COPD ($p>0.05$) (Table 3). While no differences were determined in terms of postoperative pulmonary and cardiac complications regarding age, abnormal chest X-ray, smoking history, or changes in preoperative ECG ($p>0.05$) in the patients with COPD, cardiac complication ratios were observed to be high in the patients using bronchodilator therapy ($p=0.02$).

Procedure-specific risk factors for pulmonary complications include the surgical site, duration of surgery and type of anesthesia. Laparoscopic surgery reduces the risk for postoperative pulmonary complications compared with open surgical procedures. The complication rate is higher for upper abdominal surgery. There were no differences bet-

Table 2. Complications of patients with and without COPD

Postoperative complications	With COPD N=32	Without COPD N=57	*P* value
Pulmonary complications	7/32	0/57	0.000
Cardiac complications	9/32	2/57	0.000

Table 3. The distribution of postoperative complications in the patients undergoing abdominal operations according to the degree of obstructive airway disease

Complications	Mild COPD N	Moderate COPD N	Severe COPD N	*P* value
Pulmonary				
No complications	9	15	1	
Prolonged mechanical ventilation	-	2	1	p >0.05
Pneumonia	-	1	1	
Refractory hypoxia	1	1	1	
Cardiac				
Complications present/absent	5/10	3/19	1/3	p >0.05

ween type of incision and the duration of surgery in the patients (Table 4).

Likewise, no differences were determined in the COPD patients for anesthesia applied. Whereas high ASA seemed to increase the cardiac complication rate (Table 5), no differences were found with respect to the pulmonary complication rate. Pulmonary complications developed in 4/16 of ASA 2 patients, 2/11 of ASA 3 patients, and 1/5 of ASA 4 patients (p=0.262).

DISCUSSION

The major novel findings of the present study are as follows: (1) Pulmonary and cardiac complication ratios were higher in the COPD patients; (2) Postoperative pulmonary and cardiac complications were respectively documented in 21.8% and 28.1% of our patients with COPD who underwent abdominal surgery; (3) There were no differences in terms of complications according to the severity of the disease in patients with COPD; (4) Higher ASA class and bronchodilator administration were significantly associated with higher cardiac complication rates; and (5) There were no differences between the type of incision and the duration of surgery in the patients, but upper abdominal surgery caused more pulmonary complications than lower abdominal surgery, and significantly fewer complications were seen in laparoscopic procedures than in open surgical procedures.

Table 4. Procedure-specific risk factors for pulmonary complications

	Postoperative pulmonary complications/N	p value
Surgical site		
Upper abdominal	6/16	**0.04**
Lower abdominal	1/16	
Surgical procedures		
Laparoscopic procedures	0/12	**0.021**
Open surgical procedures	7/20	
Type of incision		
Transverse incision	5/14	0.271
Median incision	1/4	
Duration of surgery		
>60 minutes	5/23	0.346
≤60 minutes	2/9	

Table 5. ASA class and cardiac complications

ASA class	Cardiac complication N	p
2	2/16	
3	3/11	p=0007
4	4/5	

ASA: American Society of Anesthesiologists.

The reported incidence of postoperative pulmonary complications in patients undergoing noncardiothoracic surgery varies widely (from 2% to 19%) (11). Pulmonary function is altered in patients undergoing surgery. Decreased functional residual capacity, vital capacity and cough contribute to aspiration, atelectasis and pneumonia, frequent causes of operative morbidity. More recently, the definition of a 'pulmonary complication' has been restricted to those that are clinically significant, including pneumonia, respiratory failure with prolonged mechanical ventilation, bronchospasm, atelectasis, and exacerbation of underlying chronic lung disease. The preoperative risk factors associated with abdominal surgery have been addressed in a number of studies. COPD is a well-known independent risk factor for the development of postoperative pulmonary complications after thoracic or non-thoracic surgery (7,12-13). COPD also increases the risk of postoperative arrhythmias in patients undergoing surgery (13). Our cases with COPD had higher rates of both pulmonary and cardiac complications. Hence, many of the criteria used to evaluate surgical risk are extrapolated from the results in patients with COPD (14). Classically, a decrease in the FEV1 or the FVC below 70% is understood to suggest an increase in the risk of pulmonary complications. Nevertheless, in various studies, it has been shown that the patient's clinical situation at the time of the surgery is more important than the lung function parameters (15,16).

Patient-specific risk factors for pulmonary complications include COPD, smoking, age, obesity, and poor general medical status. In our study, except for COPD, only high ASA increased cardiac complications. Poor general medical status is a risk factor for pulmonary complications. It may be that ASA and age simply reflect underlying comorbidity (14).

In our patients, severity of COPD did not affect the incidence of pulmonary complications. No studies have suggested a pulmonary function test value that would contraindicate surgery. In fact, empiric observations suggest that even patients with significant obstructive lung disease can successfully undergo anesthesia and major surgery (17).

In our patients, although the severity of the disease did not lead to a difference in complication rates, severe COPD patients suffered from serious pulmonary complications. However, type II error should be considered since the number of patients with severe COPD was small. While no differences were determined in terms of postoperative pulmonary and cardiac complications with respect to age, abnormal chest X-ray, smoking history, and changes in preoperative ECG ($p>0.05$) in the patients with COPD, cardiac complication ratios were seen to be high in the patients using bronchodilator therapy ($p=0.02$). The results of the study by Kroenke (16) were similar to our results. Perioperative bronchodilator administration was associated with a high cardiac complication rate. In patients without cardiac disease, selective β2-agonists rarely cause significant arrhythmias or myocardial ischemia; however, patients with underlying coronary artery disease or preexisting arrhythmias are at greater risk for these complications.

Procedure-specific risk factors for pulmonary complications include the surgical site, duration of surgery, type of anesthesia, and type of neuromuscular blockage. The surgical site is the most important risk factor. The complication rate is higher for surgical sites closer to the diaphragm, such as the thoracic region and the upper abdomen. Differences were determined in our patients with COPD who underwent upper versus lower abdominal surgery. In a recent study, unadjusted postoperative pulmonary complication rates for upper abdominal, lower abdominal, and any abdominal surgery from 43 studies were obtained. These were 19.7%, 7.7% and 14.2%, respectively (18). Prolonged surgical procedures are associated with higher risk; however, in our patients, no such associations were determined.

It seems that laparoscopic procedures should reduce the risk for postoperative pulmonary complications compared with open surgical procedures, as they are associated with less postoperative pain, which should facilitate deep breathing and improve postoperative lung volumes. Nevertheless, evidence for whether laparoscopic surgery reduces the risk of pulmonary complications has varied until recently. In 2008, however, Weller and Rosati published an analysis of a nationally representative database of 19,156 patients who underwent bariatric surgery in 2005. After adjustment for comorbidities, they found that the rate of postoperative pulmonary complications was nearly double if patients underwent open surgery as opposed to laparoscopic surgery. Open surgery was also associated with significantly higher rates of sepsis, cardiovascular events and reoperation compared with laparoscopic procedures. This study suggests that preference for laparoscopic procedures is another strategy that may reduce pulmonary complication rates, at least in the setting of bariatric surgery (19).

Although controversial, a systematic review of 141 trials including 9,559 patients reported a reduction in risk with the use of epidural or spinal anesthesia compared to general anesthesia (20). The negative effect of general anesthesia on lung mechanics, gas exchange and respiratory center drive is well known. The persistence of these effects in the postoperative period can make extubation difficult or else precipitate the appearance of respiratory failure (21). Moreover, depending on the type of surgery performed, the risk of the appearance of complications during the postoperative period may increase. This risk is due to the severe alteration these procedures exert on lung mechanics (22).

In conclusion, our patients with COPD had higher rates of both pulmonary and cardiac complications. Hence, many of the criteria used to evaluate surgical risk are extrapolated from the results in patients with COPD. Our preliminary data in conjunction with the lack of controlled trials make one wonder if routine bronchodilator use triggered solely by spirometric abnormalities is warranted. The complication rate is higher for surgical sites closer to the diaphragm, such as the upper abdomen. Because it is “minimally invasive”, laparoscopic surgery might have advantages in patients with underlying lung disease.

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