RESPIRATORY RISK FACTORS IN DEVELOPMENT OF POSTOPERATIVE COMPLICATIONS AFTER THE LUNG RESECTION

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Abstract

The objectives of the study were to identify possible associated respiratory risk factors and to assess incidence of overall postoperative complications after the lung resection. We reviewed 110 patients who underwent lung resections due to malignant neoplasms or benign lung diseases. The risk of postoperative complications was evaluated using the univariate analysis. Results confirmed that low FEV1, postoperative high PaCO2, ASA-status and advanced age were factors associated with development of postoperative complications .

Key words: respiratory risk factors, postoperative complications, lung resections.

Introduction

The lung resections belong to the group of the most difficult surgical procedures because they are accompanied by a high percentage of postoperative complications as well as mortality. Despite significant advancement in surgical technique, anaesthesia and postoperative treatment, mortality that accompanies this operative procedure is between 2-12 % (1). In the last decades this percentage dropped down and significant results on its reduction are attained but, on the other hand, the percentage of postoperative complications increased to 49 % (2).

Several clinical studies, using precise clinical data and definitions identified a number of risk factors which accompany postoperative complications (3). However, the same studies which delt with postoperative complications and risk factors in the lung resection are interpreted with some sort of deficiency and difficulties.

Primarily, the definition of postoperative complications vary in a wide range. Then, although a large number of risk factors were identified many of them are in interrelations and it is difficult to distinguish the factors that independantly influence the final outcome of the lung resection (4). The quoted elements open the possibility to continue the research in this area and to contribute to the decrease of morbidity and mortality after the lung resection.

Patients And Methods

The study presents a prospective analysis of patients who underwent the lung resections at the Department of Thoracosurgery, University Clinics Center Tuzla. In the analysis we reviewed 110 adult patients of both sexes who underwent the elective resection performed by the same team of thoracosurgeons and anaesthesiologists.

The criterion for the analysis included: performed pulmectomy, bilobectomy, lobectomy or the wedge-shaped lung resection due to benign plasms or malignant diseases of lungs with the adequate anaestaesiologic protocol, antibiotic prophylaxis and preoperative administrating of the low molecular heparin.

Data from records included: year of birth, sex, nicotine abuse, histological data, TNM status, preoperative antibiotic prophylaxis.

The following potential respiratory risk factors were analysed: the imposed expiratory volume in the first second (FEV1), vital capacity (VC), partial pressure of oxygen in blood (PaO2), increased partial pressure of carbon dioxide in blood (PaCO2) and values of PaO2 and PaCO2 within 48 hours after the operation.

Groups are formed according to the presence or the absence of risk factors.
1. group with presence of respiratory risk factors;
2. group without presence of respiratory risk factors;

In the univariate analysis we compared the number of patients with complications from the first and second group connected to the certain respiratory factor or variable.
Postoperative complications which appeared within 30 days following the lung resection were analysed and divided into respiratory and cardiovascular ones.

All results are presented as average ± standard deviation for continuous variables and as a percentage for categorical variables. In the univariate analysis for comparison of continuous variables t-test and x-test for comparison of categorical variables were used.

Results

Lung resection was performed on 110 patients (average age 58±15). The lobectomy was performed on 60, pulmectomy on 45 and wedge-shaped resections on 5 patients. There were no statistically significant differences between the degree of complications and the type of the lung resection (Table 1). Malignant diseases featured 95 (86.38 %) patients. The planocelular cancer was found in 58 patients, adenocancer in 25 patients and other types of cancer in 12 patients. The benign disease was diagnosed in 15 patients. The anaesthesiologists classified 45 patients as ACE 3-4.

Postoperative complications

In 31 patients out of 110 or 27.2% postoperative complications have developed. Bronchi-pleural fistula and prolonged loss of air were the most frequent complications 8.18%, followed by pneumonias 7.27%, emphysema 5.45%, acute respiratory insufficiency 5%, atelectasis 3.6%, pneumothorax 1.81% and pleural gush 0.9%.

Nine patients had cardiovascular complications including: arrhythmias 3.6%, gastrointestinal bleeding 2.72% and cerebro-vascular stroke 1.81 %. The total mortality was 6.6%.

Risk factors

Values of respiratory risk factors, in other words functional tests are presented in Table 2.

Patients with FEV1 < 79 % before and PaCO2 > 6kPa after the surgery have demonstrated an increased degree of postoperative complications. Complications developed in 16 out of 31 patients (51 %) with FEV1 < 79 %-pre in the contrast to 15 out of 71 patients (21 %) with the preoperative FEV1 > 79 %-pre ($p< 0.05$). Out of 28 patients with PaCO2 >6kPa within 48 hrs 13 or 11.8 % developed complications after the lung resection as opposed to 18 patients with complications out of 82 with PaCO2 <6kPa or 16.3 % (Table 3). These data have shown a high level of association with the development of postoperative complications and identified a potential risk factor.

Variables that were analysed as possible predictors of complications in univariate analysis are: abuse of nicotine, ACE physical status, histological status, TNM status and preoperative antibiotic prophylaxis. ACE physical status 3-4 and age of patients above 65 have also demonstrated association with the development of complications (Table 4).

Administration of Xiclav in a dose of 1200mg in the preoperative prophylaxis has remarkably reduced the total morbidity and occurrance of infective postoperative complications (Table 5). The other factors are without significance.

Discussion

Researches have shown that certain clinical and functional findings are useful in the evaluation of development of postoperative complications following the lung resection. This study shows a degree of 27.2% of postoperative complications. In the literature this degree ranges from 7 % to 49 % (5).

The complications are bronchi-pleural (BP) fistula and prolonged loss of air that was confirmed in studies per-

Table 1. The incidence of postoperative complications by the type of surgical procedure*

Type of resection	Complications	Respiratory	Cardiovascular
Pulmectomy (45)	18 (16)	15 (14)	3 (2)
Lobectomy Bilobectomy (60)	24 (22)	19 (17)	5 (4)
The wedge-shaped resection (5)	2 (2)	1 (1)	1 (1)
* Data are presented as numbers (%). No statistical significant difference was found.			

Table 2: Lung functional tests in 110 patients*

Parameters	n =110
FEV1, L	2,37±0,52 (1,43-4,18)
FEV1, %-pred	77,32±14,71 (51-117)
VC, L	3,28±0,72 (1,76-5,37)
VC, % -pred	86,48±12.68 (55-120)
PaO2, kPa preop.	10,24±0,91 (7,89-13,03)
PaCO2, kPa preop.	4,91±0,34 (3,81-6,55)
PaO2, kPa postop.	9,62±0,65 (7,43-12,12)
PaCO2, kPa postop.	5,32±0,45 (4,14-7,78)
* data expressed as average value±standard deviations of number or (%)	

Table 3: Univariate analyses of potential respiratory risk factors and postoperative total morbidity*

Respiratory factor	No. of patients (n)	Morbidity(%)	p value
FEV1 < 79%-pred	31	14,5 (16)	p<0,05
FEV1 > 79%-pred	79	13,6 (15)	
VC < 79%-pred	39	10,9 (12)	NS
VC > 79%-pred	71	17,2 (19)	
PO_2 preop.			
<9 kPa	28	10,0 (11)	NS
>9 kPa	82	18,1 (20)	
PCO_2preop.			
>6 kPa	12	4,5 (5)	NS
<6 kPa	98	23,6 (26)	
PO_2 postop.			
<9 kPa	95	22,7 (25)	NS
>9 kPa	15	5,4 (6)	
PCO_2postop.			
>6 kPa	28	11,8 (13)	p<0,05
<6 kPa	82	16,3 (18)	
*Data expressed as (%) or in numbers.			

Table 4: Characteristics and univariate analysis of variables and postoperative morbidity of patients with lung resection*

Variables	Patients (n)	Morbidity (%)	p value
Age, years			
> 65	35	15 (16)	p<0.05
< 65	75	14 (15)	
Sex			
Male	91	23 (25)	NS
Female	19	5 (6)	
Smoking			
Yes	73	18 (20)	NS
No	37	10 (11)	
ASA status			
3/4	45	16 (18)	p<0,05
1/2	65	12 (13)	
TNM status			
III/IV	44	13 (12)	NS
I/II	51	16 (15)	
*Data are expressed as (%) or in numbers			

Table 5. Antibiotic prophylaxis in patients with lung resection*

Antibiotic	Patients (n)	Infective (n)	Noninfective (n)
Xiclav (amoksicilin +clavulanic acid)	72	6 (7)	3 (4)p<0.05
Cefazolin (cefalosporin)	38	15 (16)	3 (4)
*Data expressed as numbers.(%). Dose 1200mg in the moment of introducing the general anaesthesia. Dose 1000mg 2h before the surgery.			

formed earlier (6). BP fistula is one of the most difficult complications after the pulmectomy and associated with the large degree of mortality. On the contrary a prolonged loss of air, which follows lobectomies and wedge-shaped resections, induce a low degree of mortality but have been associated with longer hospitalization (7). The incidence of pneumonia in this study is smaller than indicated in the literature where it ranges from 15% to 22% (2). Emphysema is the third complication which has the incidence of 5.45% while in the literature this percentage ranges from 4.7% to 26.9%. The total mortality in this study is 6.6%.

The preoperative evaluations of lung function are factors the most widely investigated as a predictor of mortality and morbidity after the lung resection. Studies have yielded contradictory results.

Some studies have identified FEV1 and VC as possible risk factors, while the others have not (8). In this research two respiratory factors and two variables have been identified as possible risk factors of postoperative complications after the lungs resection. FEV1 < 79 % namely COPD has shown large influence on the development of postoperative complications, while PaCO2 in the first 48 hrs after the resections has also proved to be a possible risk factor in the process of development of the postoperative complications. The hypercapnia was considered a contraindication for the lung resection but many papers confirm that it is possible to resect the lung even when PaCO2 is > 6kPa (9). However, our study shows that PaCO2 > 6kPa in the first 48 hrs after the operation is strongly associated with the appearance of postoperative complications. In this study one of the predictors of postoperative complications is the ACE physical status and it presents the most frequent risk factor in the development of postoperative complications. The potential weakness of ACE classification lies in the fact that it is based on subjective evaluation of the state of a patient, so it is opened for different variants. However, in this study we consider that, before the thoracotomy, anesthesiologists have determined the ACE physical status of patients as a rather objective information. One of the advantages of the ACE status is that it includes both respiratory and non-respiratory risk factors. So we can conclude that coexisting factors influence the development of postoperative complications after the lung resection more strongly than the age of the patient (10).

Conclusions

Determined respiratory risk factors along with the ACE-status have a great role in the development of postoperative complications following the lung resection. Age and antibiotic prophylaxis are responsible for the development of some kinds of postoperative complications.

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