Chapter 8

Preoperative Evaluation before Lung Resection

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Abstract

Lung resection is applied in some patients with bronchiectasis, especially lung cancer, and uncontrollable pulmonary hemorrhages after trauma. Changes in respiratory physiology due to perioperative anesthesia cause the development of postoperative pulmonary complications. The patient in the perioperative period and the risk factors associated with the procedure should be evaluated with preoperative risk scoring (Canet, Arozullah, ARISCAT). Necessary treatments should be applied in the preoperative preparation period and postoperative complication follow-up should be performed in high-risk patients. Appropriate FEV1 values for wedge resection, lobectomy, and pneumonectomy, which are among the recommended PFT parameters for lung resection, are 1 L, 1.5 L, and 2 L, respectively. Patients above these values are considered to be able to tolerate the operation. If these values are below, additional tests (calculation of estimated postoperative FEV1 values, ventilation/perfusion scattering, cardiopulmonary exercise tests, and stair climbing tests) should be performed. For the curative treatment of lung cancer with resection in these patients, it is necessary to ensure the optimal condition of the patient in terms of suitability for the operation, as well as to minimize the morbidity and perioperative deaths due to the effects on the cardiorespiratory function that may occur after resection.

Lung resection is mainly performed for curative treatment and sometimes for diagnostic purposes in patients diagnosed with lung cancer, but it can also be applied in cases of bronchiectasis and uncontrollable bleeding after trauma.

Lung cancer, the most common indication for resection, is a leading cause of death in both men and women worldwide (1). According to the current statistical data, lung cancer ranks first in men and breast cancer ranks first in women (4th in lung cancer frequency in women). First cardiovas-

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cular diseases, second respiratory system diseases, and cancer are in the 3rd rank among the general mortality data in the TUIK data portal. In terms of cancer mortality, lung cancer ranks first. Because most lung cancer patients are diagnosed at an advanced stage, this precludes curative treatment. About 1.6 million people die from lung cancer each year, and the overall 5-year survival rate is only 15% (1,2).

In general, after all, operations, changes occur in respiratory functions due to anesthesia. In particular, the proximity of the surgery to the diaphragm increases the risk of postoperative complications.

Perioperative Pulmonary Physiology

Postoperative pulmonary complications should be considered as a result of normal perioperative pulmonary physiology. Decreased lung volume after resection contributes to the development of postoperative pulmonary complications.

In thoracic and upper abdominal surgery, lung volume reduction occurs in a restrictive pattern (VC decreases 50-60%, FRC decreases 30%) due to diaphragm dysfunction (3-5).

In addition to diaphragm dysfunction, postoperative pain and limitation of thoracic movements also contribute to a decrease in lung volumes if optimal pain palliation is not achieved. A decrease in functional residual capacity below the closing volume causes atelectasis, ventilation/perfusion mismatch, and pneumonia, which leads to impaired gas exchange and postoperative hypoxemia (6).

Decreased tidal volume, inability to breathe deeply, and an increase in respiratory rate after thoracic surgery increases the risk of complications. In addition, the effect of anesthesia does not wear off immediately and opioids given postoperatively also suppress respiration. Patient avoidance of cough due to pain and inhibition of cough due to opioids; deterioration in the mucociliary clearance of respiratory secretions causes an increase in the risk of infection (3,7).

Resection in lung cancer

Surgical treatment of lung cancer started with the first successful pneumonectomy performed by Graham in 1933 (8). Afterward, with technical advances, Churchill, shortly after Graham, reported that lobectomy could also be preferred in suitable patients (9). Although the mortality rates

during surgery have decreased significantly with today's medical developments, deaths due to postoperative complications continue.

It is important to determine the postoperative complications with various risk scorings (Arozullah, Canet, ARISCAT) during the preoperative evaluation and to make recommendations to reduce possible complications. However, it is important to carefully evaluate the threshold values for lung functions suitable for surgery and predicted postoperative lung functions. Suggested to do for this purpose;

1- Spirometry

2- Calculation of postoperative estimated lung functions,

3- Measurement of carbon monoxide diffusion capacity (DLCO),

4- Exercise tests.

Although arterial blood gas measurements are also evaluated, PO2 and PCO2 alone are not sufficient for postoperative pulmonary complications. Although it has been reported that preoperative hypercapnia (PaCO2 > 45 mmHg) increases the risk of postoperative pulmonary complications, it ttttt an independent risk factor for perioperative complications. Although preoperative arterial oxygen saturation below 90% may increase the risk of complications, hypoxemia alone is not sufficient to determine postoperative pulmonary complications. Because in these patients, the chance of curative treatment to be provided by surgery may also improve postoperative oxygenation after the removal of areas with ventilation/perfusion mismatch (10,11).

Postoperative Pulmonary Complications

Postoperative pulmonary complications cause increased perioperative general morbidity and mortality. Even in elective abdominal surgeries, postoperative pulmonary complications occur more frequently than cardiac complications. In thoracic surgeries, the rate of postoperative pulmonary complications is much higher and hospital stay is longer.

The incidence of postoperative pulmonary complications ranges from 2-70%. This is primarily due to the unclear definition of postoperative complications, and also to the variability of patient selection and procedure-related risk factors. Postoperative pulmonary complications; fever and accompanying pulmonary symptoms (cough, sputum, shortness of breath) or changes in chest X-ray (consolidation, atelectasis) (3,12,13).

Some postoperative risk factors are independent of the preoperative process, especially; Care should be taken in terms of the decrease in respiratory capacity due to insufficient postoperative analgesia and the development of atelectasis as a result, and the risk of embolism due to immobilization.

There are relevant dossiers and processing risks for pulmonary complexities (Table 1).

Table 1: Risk distributions for pulmonary complications (14)

Patient-related risk factors	Procedure-related risk factors
Age	The proximity of the surgical field to the diaphragm
Chronic lung disease	Duration of surgery
Smoking history	Type of anesthesia
Obesity	Neuromuscular blockade
Obstructive sleep apnea syndrome	
Pulmonary hypertension	
Heart failure	
General health status	
Upper respiratory tract infection	
Low albumin	
BUN height	

Preoperative Pulmonary Function Test Evaluation

The relationship between pulmonary function tests and postoperative outcomes of patients who underwent lung resection was first reported in 1955 (15). As might be expected, preoperative pulmonary function tests are closely associated with post-surgical complications. Measurement of DLCO together with spirometry is also important in determining the risks that may develop after lung resection.

FEV1, FVC, FEV1/FVC ratios, among the parameters we look at in spirometry, are important in determining the diagnosis and severity of COPD. It has been shown that the FEV1 value, that is, the forced expiratory volume in the first second, is more important than other parameters in the preoperative evaluation. The postoperative complication rates of patients with a

preoperative FEV1 value below 60% were found to be significantly higher (16-20).

Threshold FEV1 values for pneumonectomy, lobectomy, and wedge resection, which were reported to be tolerable in studies, are shown in Table 2 (21,22).

Table 2: Threshold FEV1 values

	FEV1 (L)
Pneumonectomy	2
Lobectomy	1,5
Wedge resection	1

Lung cancer is frequently associated with COPD of the same etiology (cigarettes), and spirometry values are an important factor for postoperative complications in the preoperative evaluation, while it has been suggested to measure DLCO levels in addition to spirometry, especially in cases of interstitial lung disease with lung cancer, such as IPF (22). That is, if the preoperative FEV1 is > 80% predicted or > 2 L, it should be considered suitable for pneumonectomy without further investigation. However, if there is a concomitant interstitial disease or exertional dyspnea, DLCO measurement should also be performed in these patients. Likewise, patients with FEV1 > 1.5 L should be considered eligible for lobectomy, and similarly, DLCO should be measured in these patients if they have concomitant interstitial disease or effort dyspnea.

If FEV1 or DLCO is less than 80% predicted at initial evaluation, additional testing should be performed to determine postoperative lung function.

It should be noted here that while the remaining segment number ratio is sufficient for lobectomy, the percentage of lung perfusion found after evaluation with perfusion scintigraphy is required for pneumonectomy. Quantitative ventilation/perfusion scintigraphy is not preferred for lobectomy because of the overlap of lobes in a standard nuclear medicine scan images and the limited number of studies on the specificity of this technique.

If the estimated postoperative FEV1 <30%, calculated as in the figure above, is high-risk resection. These patients are considered inoperable (23).

If the predicted postoperative FEV1 or DLCO is less than 40% predicted, then evaluation with exercise tests should be performed. This is because

preoperative assessment based on lung function alone cannot assess other important comorbidities, particularly heart disease, or the impact of malnutrition on postoperative risks.

Exercise Tests

Exercise tests have high sensitivity but low specificity in patients with limited exercise capacity. Patients who are restricted due to lack of effort or formlessness may not be differentiated.

As a simple practice to assess effort capacity, it is possible to climb the patient several flights of stairs and assess the general form and respiratory reserve. The ability of the patient to climb three flights of stairs for lobectomy and five flights for pneumonectomy has a high predictive value for the uncomplicated surgical course. However, stair-climbing tests are highly subjective and difficult to standardize (24).

Therefore, with VO2 max achieved by cardiopulmonary exercise tests, which give more objective results, we can divide patients into low-risk, medium risk, and high risk groups. Postoperative risks increase as the maximum oxygen uptake (VO2 max/kg) decreases. If VO2 max < 10 ml/kg/min, or if VO2 max < 15 ml/kg/min, the predicted postoperative FEV1 or DLCO is less than 40% of predicted surgery in these patients is considered inoperable because of high risk.

Recommendations for reducing pulmonary complications preoperatively;

- Application of bronchodilators, corticosteroids, chest physiotherapy before surgery in patients with obstructive pulmonary disease,
- Postponing elective surgery by recommending re-evaluation after appropriate treatment in the presence of respiratory tract infection (upper and lower respiratory tract),
- Quitting smoking preferably at least eight weeks before surgery, due to the postoperative risks associated with smoking,

Suggesting that morbidly obese patients lose weight due to the increased risk caused by obesity hypoventilation and hypercapnia, and providing appropriate noninvasive mechanical ventilator support in patients with obesity hypoventilation syndrome,

- -Teaching breathing exercises (deep breathing techniques, use of airflow) to patients.

In conclusion; Patients who are candidates for lung resection should be evaluated multidisciplinary. These patients should not be considered inoperable only because of advanced age, and concomitant cardiopulmonary diseases should be handled carefully.

Lung function and exercise test results are only a guide to eligibility for resection and results should be evaluated on a patient basis.

It should be taken into account that the basal respiratory functions of the patients who will be resectioned are already poor. It is necessary to aim both to increase the curative treatment in lung cancer cases and to minimize the morbidity and perioperative deaths due to the effects of resection on cardiorespiratory function.

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