Chronic obstructive pulmonary disease is a risk factor for development of intraoperative and postoperative pulmonary complications. Regarding the type and the extent of surgical procedure, patients with COPD are at risk of aggravation of pulmonary function which leads to complicated perioperative course. In order to reduce perioperative complications, preoperative evaluation and preoperative patient preparation are of great importance. Goals of preoperative preparation and anesthesia in patients with COPD are maintaining ventilation-perfusion ratio, preventing development of hypoxemia, intraoperative bronchospasm, pneumothorax and disturbances of cardiovascular system.

Key words: Chronic Obstructive Pulmonary Disease, preoperative preparation, perioperative complications, mechanical ventilation

INTRODUCTION

The Global Initiative for Chronic Obstructive Pulmonary Disease guideline (GOLD) defines COPD as follows: "COPD is a preventable and treatable disease with some significant extrapulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterized by airway limitation that is not fully reversible. The airway limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases."1 COPD includes emphysema and chronic bronchitis which are irreversible diseases.2 Chronic bronchitis is characterized by presence of productive cough in duration of three years particular in cold winter days. Emphysema is characterized by histological changes such as dilatation and destruction of airway distal of terminal bronchiolis. Global Initiative for Asthma (GINA) defines asthma as follows: "Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment."3

Majority of COPD patients are long-term smokers. Professional exposure to different gases and particles, air pollution, poverty and low life standard, repeated viral infections and α1-antitrypsin deficiency are known risk factors for COPD development. GOLD predicts that in 2020 COPD will be the third cause of mortality in world.1 COPD is important risk factor for postoperative pulmonary complications with relative risk 2,7-4,7 depending on the evaluation criteria.4 According to study which was conducted in order to detect correlation between existing preoperative pulmonary diseases and intraoperative and postoperative complications in upper abdominal surgery using logistic regression model it’s been shown significant correlation between COPD and intraoperative as well as postoperative pulmonary complications (OR 1,87; 95%; CI 1,11-3,15; p = 0,019).5 Bronchospasm and hypoxemia were the most frequently detected complications. Data analysis from retrospective study in 412 subjects has shown that COPD was the only preoperative variable related with increased risk of post-lobectomy atelectasis.6 Risk of postoperative pulmonary complications is greater in thoracic, abdominal, head and neck surgery than in orthopedic and peripheral surgical procedures.7

THE GOALS OF PREOPERATIVE PREPARATION IN PATIENTS WITH COPD

The goal of preoperative preparation is prevention of pulmonary complications- pneumonia, bronchospasm, respiratory failure with prolonged mechanical ventilation,
atelectasis and COPD exacerbation. The worst postoperative outcome have patients with pulmonary hypertension and chronic fatigue of respiratory muscles due to possibility of right heart failure, cardiovascular insufficiency and prolonged mechanical ventilation.8

During anamnesis special attention should be taken to establish the level of physical tolerance (stairs climbing) since it correlates well with pulmonary function tests.

Patients with domination of emphysema are usually thin, tachypnoic with breathlessness even in steady state. They are hypoxic and CO2 retention is developed late or is a sign of terminal phase of illness.

Patients with dominant obstructive bronchitis are usually obese with peripheral edema, weak respiratory muscle activity and CO2 retention. In clinical practice "blue bloaters" and "pink puffers" are rarely seen separate, commonly there's a combination of both features of disease.

The basic problem in COPD patients are hypersecretion and airway obstruction which worsens in presence of infection. Presence of weakened breathing sounds, prolonged expirium, wheezing and murmurs correlates with increased postoperative pulmonary complications.9 One should check if reversible obstruction (asthma) is well managed. Incidence of pulmonary complications is greater with positive findings on physical exam and pulmonary function tests showing FEV1 less than 50% of predicted and if there is hypoxemia which requires oxygen therapy.10

Pulmonary function tests and blood gas analysis can predict lung function after lung resection surgery but are not reliable predictors of postoperative pulmonary complications in non-thoracic surgery.

Study of 2000 patients showed that FEV1 and FVC had no significant predictive value regarding development of postoperative pulmonary complications in contrast to physical exam, chest radiography, Goldman’s and Carlson’s index.11 Non the less, in lung resection surgery, FEV1 and DLCO are important predictors of postoperative course.11 FEV1 less than 20% and DLCO less than 20% are associated with high risk of postoperative mortality. Patients at risk, that have FEV1 <70%, FEV1/FVC <65% or PaCO2 >45mmHg can submit to surgery, even lung resection with acceptable risk of postoperative pulmonary complications.12

Blood gas analysis, chest radiography and CT enable more detailed evaluation of respiratory system but their routine conduction is unnecessary for uncomplicated interventions. In these situations detailed anamnesis and physical exam can be sufficient to identify patients at risk. Blood gas analysis should be performed if patient have difficulties climbing up the stairs (first floor), is cyanotic, SaO2 is 95% in room air or has peripheral edema.

Chest radiography should exclude active infection or other conditions such as bronchial carcinoma.

ECG can show right heart problems - hypertrophy of right ventricle. In this case, ultrasound of heart is recommended.

Coexisting coronary diseases are common in COPD patients. Several studies showed that reduced FEV1 (for 10%) increases cardiovascular mortality (28%) with relative risk of 1,1-2,2.13,14 In order to better describe cardiovascular risk in these patients, pharmacological stress test can help detect possible coronary ischemia.

Moderate dehydration due to hyperpnea and diuretic therapy and low potassium level due to diuretic and β2 agonist therapy can be present in COPD patients. Malnutrition is present in 25%-33% of these patients.15 One should manage fluid, electrolyte and nutrition status in these patients before surgery.

Preoperative preparation should optimize respiratory function and minimize possibility for development of perioperative complications.

**SPECIAL CONSIDERATIONS IN PREOPERATIVE PREPARATION**

COPD symptoms develop usually after 55 years of age. GOLD recommends to continue established treatment plan with all hygiene - dietetic, pharmacological and rehabilitation methods.1

Bronchodilatatory therapy with addition of one more bronchodilatating agent should continue to surgery since this treatment showed reduction of respiratory postoperative complications.16,17,18 Bronchodilatators rarely improve FEV1 more than 10%.15 Nebulized bronchodilators should be applied before, as well as 24-48 hours after surgery.

Preoperative use of corticosteroids does not increase risk of pneumonia or compromise wound healing.19,20

Prophylactic use of antibiotics without bacteriological conformation of infection is not recommended but every lung infection should be properly treated before surgery.

Knowing that smoking cigarettes is a risk factor for COPD2, cessation of smoking is advised minimally 2 months before elective surgery. Prospective blinded study that was conducted in Mayo clinic on 200 subjects submitted to coronary bypass showed increased postoperative pulmonary complications in those who quit smoking 1-8 weeks before surgery - 58%, in contrast to those who quit smoking 8 and more weeks before surgery-12%. Those that didn’t quit smoking at all had 33% of postoperative respiratory complications.21 Besides positive respiratory effect, cessation of smoking 6 weeks before surgery allows liver enzymes and immune system to restore their functions.12

Acute deterioration of COPD is often treated with non invasive ventilation (NIV) through full face or nasal mask, depending on the severity of clinical manifestation. Multicentric randomized trial gave conclusion that early use of NIV decrease mortality rate and need for endotracheal intubation.22 Noninvasive ventilation decreases work of breathe, decrease respiratory muscle strength and overall patient breathing effort.22,23,24 Measurements of diaphragmatic action potential (EMG) showed that noninvasive ventilation reduced activity of diaphragm in COPD patients.23
This type of respiratory support is useful postoperatively in severe COPD cases or after major surgery.

Prolonged endotracheal intubation decreases mucociliary transport, preventing adequate evacuation of sputum from the airways and ventilating over 18 hours causes atrophy of diaphragmatic muscle bundles. Possibility for bacterial colonization of lungs and development of pneumonia associated with high mortality rate is increased especially after thoracic surgical interventions.

It is necessary preoperatively to carefully plan anesthesiological technique and to make adequate choice of agents (hypnotics, analgetics, muscle relaxants) which are suitable for COPD patients.

**ANESTHESIA IN COPD PATIENTS**

The formation of atelectasis is less than expected in anesthetized patients with COPD due to presence of intrinsic PEEP, maintaining FRC due to abdominal muscle activity in expiration25 and characteristics of ventilation-perfusion mismatch. When ever is possible, tracheal intubation should be avoided. Obese patients as well as patients preparing for major surgical procedures are not candidates for anesthesiatic techniques that maintain spontaneous breathing. Also, presence of hypersecretion demands evacuation of sputum through endotracheal tube.

If the patient has severe form of COPD, admission in ICU after major thoracic or abdominal surgery may be necessary because of respiratory failure.

**POSTOPERATIVE TREATMENT**

Extubation of these patients should be performed in sitting position. Mobilization should start as early as possible. Respiratory physical therapy (deep breathing, diaphragmatic breathing, drainage positioning of patient) prevents sputum retention, postoperative respiratory failure and development of pneumonia. If necessary, oxygen therapy can be applied.

If the patient becomes febrile with purulent sputum, bacteriological analyses must be conducted and start antibiotic treatment.

Inhalation of bronchodilators should be continued until patient is fully mobilized.

Optimal analgesia without unnecessary sedation and early mobilization contribute to rapid and uncomplicated recovery. Many studies pointed out the benefit of neuroaxial analgesia in postoperative pain management in COPD patients. Epidural analgesia improves mobilization of respiratory muscles enabling early respiratory system rehabilitation in these patients. Retrospective study in COPD patients underwent lung transplantation showed that limited use of intravenous analgetic agents and perioperative epidural analgesia create optimal conditions for early extubation COPD patients. One should keep in mind that opioid analgetics can cause ventilatory depression regardless of the way of administration, even 12 hours after administration.15

Restrictive fluid administration decreases risk of pulmonary edema, it has been accepted in thoracic surgery10 and showed good outcomes after major abdominal interventions.36

**CONCLUSION**

COPD as comorbidity, specially when it comes to major surgery (thoracic, abdominal), is important risk factor for postoperative pulmonary complications. Number of high risk patients is increasing and doctors are facing with great number of those who need surgery. Progress of diagnostic procedures, pharmacotherapy, development of minimal invasive cardio-surgical procedures and modern techniques of anesthesia enables these patients to face surgery with decreased risk of unwanted outcome. Good preoperative disease control and adequate choice of anesthesia in accordance with recommended protocols, provide uncomplicated postoperative course. Good surgical techniques and sufficient level of postoperative analgesia contribute to successful outcome of surgical treatment.

**SUMMARY**

**PREOPERATIVNA PRIPREMA BOLENIKA SA HRONIČNIM OPSTRUKTIVnim BOLESTIMA PLUćA**

Hronična opstruktivna bolest pluća (HOBP) predstavlja faktor rizika za nastanak intraoperativnih i postoperativnih plućnih komplikacija. U zavisnosti od vrste i obima hirurškog zahvata bolesnici sa HOBP su u riziku od pogošanja osnovne bolesti i razvoja komplikovanog perioperativnog toka. Preoperativnom evaluacijom i pripremom za intervenciju smanjuje se mogućnost nastanka komplikacija vezanih za perioperativni period. Ciljevi anestezije kod obolelih od HOBP su usmereni ka održavanju ventilacije-perfuzionog odnosa, sprečavanju nastanka hipoksemije, intraoperativnog bronhospazma, pneumotoraks i poremećaja kardiovaskularnog sistema.

Ključne reči: hronične opstruktivne bolesti pluća, preoperativna priprema, perioperativne komplikacije, mehanička ventilacija

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