

Experimental methods of treatment used during the bronchoscopy

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Abstract

The universality of respiratory diseases induces specialists to look for newer solutions regarding their safe and effective treatment. Particular interest in bronchoscopy is attributable to lower invasiveness of these, simultaneously with the magnitude of possibilities. Experimental methods used during this endoscopy procedures are bronchial thermoplasty and valvular therapy. Bronchial thermoplasty is one of the alternative methods of treating asthma. Qualified for these patients are in the age between 18-65 years old, at whose standard treatment brings no results. From conducted research arise, that after the procedure comes improvement in clinical tests of patients and decreases the count of the exacerbation of asthma. Valvular therapy is a new method of treating the emphysema- frequent complication of chronic obstructive pulmonary disease. It is a safe method, but no longer effective. Research shows, that the greatest effectiveness is until one year after the procedure. Despite this, valvular therapy is the recommended alternative for the surgery.

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Introduction

Respiratory diseases are the third cause of death in the world. Growth of the population above 65 years old, smoking cigarettes and increasing air pollution are the main causes of morbidity and mortality chronic pulmonary diseases. The most common chronic diseases of the pulmonary system are chronic obstructive pulmonary disease (COPD), asthma and malignant neoplasms [1,2].

Increasing morbidity for respiratory system-related diseases contributes to the development of diagnostic methods, preventing and treating this type of afflictions. Usually, subjective symptoms like cough, breathlessness, haemoptysis induce patients to see pulmonologist [2]. The doctor instructs patients to run some tests, and one of them is often bronchoscopy, main diagnostic procedure, but increasingly also therapeutical [3].

Bronchoscopy – a diagnostic and therapeutic method

Bronchoscopy is a procedure involving endoscopic examination of the trachea and bronchial tree [4]. It is an invasion technique, however safe, encumbered with a small amount of complications. Among them is cough, slightly increase of temperature of the body and minor cardiac arrhythmias. Next to harmless complications may occur also life-threatening, like hypoxaemia, breath-hold, pulmonary oedema, pneumothorax, circulatory arrest and obstruction of the respiratory tract [4,5,6].

This test enables accurate macroscopic evaluation of the larynx, vocal bands, trachea and bronchial tree. During the endoscopy, there is a possibility of charging matter for laboratory tests, such as histopathology, cytology, mycology, microbiology. In addition to diagnostic techniques, there are also using treating procedures (table 1). Bronchoscopy is most often used for diagnostic neoplasms, tuberculosis, sarcoidosis, pneumonia [2,7].

We may singularize 3 types of indications for performing a bronchoscopy. There are clinical, radiological and therapeutic indications (table 2).

There are way fewer contraindications than indications for performing a bronchoscopy, but deciding that need to be individual for every patient [9,10]. Before the procedure, should be decided if the advantages of bronchoscopy are overtopped of the potential loss. Contraindications for performing this procedure are:

- acute respiratory failure
- acute myocardial insufficiency rated as IV in NYHA functional classification
- myocardial infarction past in 2 last weeks
- unstable angina
- ventricular arrhythmias [2,5,11,12].

Bronchoscopy – equipment

The endoscope is called speculum equipped with a light source, about 1-meter length, with different diameters chosen according to a planned procedure [13]. The endoscope is used for examination inside of the body by entering it through its natural openings [14,15]. The procedure of bronchoscopy is performing with use of bronchoscope or bronchofiberscope [16].

Table 1.

Sposoby wykorzystania bronchoskopii [2,5,8]

Use of bronchoscopy	Diagnostic techniques used during the bronchoscopy	tracheal and bronchial rinsing bronchoalveolar lavage (BAL) protected specimen brush (PSB) transbronchial lung biopsy brush (exfoliating) biopsy transbronchial needle aspiration biopsy autofluorescence bronchoscopy
	Treatment methods performed during the bronchoscopy	clearing bronchial tree of thick mucus serving antibacterial and mucolytic drugs laser ablation in main bronchus and trachea removing of foreign bodies from the respiratory system thermoplastic surgery of bronchi installing prosthetic devices in the respiratory system removing tuberous transmutation from trachea and bronchi

Table 2.

Wskazania do wykonania bronchoskopii [2,5,8]

Indications to perform a bronchoscopy	Clinical	haemoptysis inflammation of lower air ways or often remittent pneumonia airlessness of unknown etiology expectoration serious amount of mattery or mucosal sputum persistent for more than 3 months cough symptoms of bronchi stenosis in physical examination
	Radiological	interstitial changes in the lungs pneumothorax scattered (tuberous) changes in lungs enlargement of lymph nodes in mediastinum persistent inflammation of pleural cavity
	Therapeutical	clearing of bronchial tree by sucking matterymucus removing the foreign body from airways decongestprocedures for stenosedbronchi airwayprosthesis evaluation of therapy

Experimental treating methods with the use of bronchoscopy

Currently, about 90% of the procedures with the bronchoscope around the world is making for diagnostic purposes, however increasingly it is using for treating a patient. It is common using this kind of endoscopy for treating goals, such as cleansing the bronchial tree, drug administration directly to the bronchial tree or removing the foreign body.

Technological progress procures, that more and more advanced endoscopic equipment is available, which provides good quality of the picture, and access to many respiratory system structures. Potentiality was given by bronchoscopy is letting its increasing use. New, experimental methods of treating respiratory system diseases are developing. These methods include thermoplastic surgery used for treating bronchial asthma, but also installing prosthesis with a built-in valve, for treating emphysema.

Thermoplasty of bronchial muscles – experimental asthma treating

The essence of asthma is airways obstruction, causes a significant decrease in airflow through the bronchi [17,18]. Despite pharmacological methods of treatments, not always improving the quality of life comes. Deficient efficiency standard methods of treatment induce specialists to look for experimental solutions. One of them is bronchial termoplasty [19].

Bronchial thermoplasty is a procedure involves local exterminating the layer of smooth muscles in the bronchial wall, using electromagnetic wave. Effect of this procedure is the expansion of the bronchi and increase airflow in airways [20].

Thermoplasty – description of the procedure

During the procedure, the doctor put bronchofiberscope empowered with the electrode in the shape of capitulum into the bronchi. Electrode emanates electromagnetic waves about the frequency 460kHz, which generate heat energy around 65 Celsius degree.

Effect of this decreases overly expanded muscles of the bronchial tree, owing to asthma. Patient while this procedure is under general anaesthesia. Modality goes ahead in 3 series, with 3 weeks break between each of treatment. The first round includes thermoplasty of right lower lobe, second of left lower lobe. The last series includes thermoplasty of upper lobes both of the lungs [21,22].

Advanced bronchial thermoplasty method form sometimes the only way to decrease symptoms of asthma. This carry improvement of life quality among people:

- with allergic or eosinophilic asthma
- after biological treatment failure
- with severe non-allergic, refractory, uncontrolled asthma.

Qualification for bronchial thermoplasty is founded on indications and contraindications for the procedure (table 3) [23,24].

With lots of benefits of bronchial thermoplasty, research in many countries in the world shows, that this method carries the risk of small percentage side effects. This might be inflammation of lower airways, whistles, cough, pain in chest, breathlessness, bronchitis or haemoptysis.

Research on bronchial thermoplasty

In UK Severe Asthma Registry (UKSAR) noted hospital admission rate 11.8%, in 59 cases subjected bronchial thermoplasty. Moreover, for 86 patients subjected bronchial thermoplasty between 01.06.2011. and 30.09.2016. report significant clinical improvement in AQLQ scale after 12 months of observation, and decrease hospital admission rate after 24 months. Observation research on patients showed improvement in AQLQ scale, decrease of exacerbation and/or drop of treatment at 50-75% patients subjected bronchial thermoplasty [17,25,26,27,28,29].

Research in the USA and Canada shows, that 3 years after treatment, the proportion of people with severe exacerbations and hospitalizations decrease respectively about 45% and 40% besides 12 months before treatment. Spirometry did not show any changes in 3 years of observation after bronchial thermoplasty.

Whereas tests in China, released in 2016 shows a decrease of annual exacerbations about 79,4%, hospitalizations caused by exacerbation about 89,4% and orally taken corticosteroids besides the previous year [30].

Table 3.

Kwalifikacja do termoplastyki oskrzeli

Qualification for bronchialthermoplasty	Indications	Age between 18- 65 years old Despite of treating maximum tolerated dose patient still have symptoms and/ or high risk of exacerbation in future The necessity of taking oral corticosteroids permanently or while exacerbation The occurrence of 2 or more exacerbation in one year Score 6,25 or lower in AQLQ scale
	Contraindications	Age less than 18 or more than 65 years old 3 or more infections of lower airways in last year (AIR2 trial); in last 3 months (RISA trial) Artificial cardiac pacemaker, implantable cardioverter defibrillator or other implantable electric device Allergy to drugs essential for bronchofiberoscopy, like: lidocaine, atropine, benzodiazepines, propofol Taking anticoagulants, antiplatelet drugs, NSAIDs or acetylsalicylic acid Treating in same bronchi after bronchial thermoplasty Blood coagulation disorders

Experimental treating for emphysema- endoscopic valvular therapy

Another persistent disease of the respiratory system is a chronic obstructive pulmonary disease (COPD), which may cause emphysematous transformations. The essence of the emphysema is the pathological enhancement of alveoli pulmonis, which leads to its destruction. This creates so-called emphysema blisters, increasing lungs volume. Emphysema affects drop of effectiveness gas exchange in the lungs. Despite steady medicine progress, treating emphysema focus only on buffering symptoms of this disease. The past form of treating emphysema was a surgical decrease in lungs volume (LVRS).

In the last years, considerable development of endoscopic methods (ELVR) can be observed, which became alternative ways of treating emphysema. Advantage of ELVR over surgical methods is fewer complications occurring and small invasiveness. According to the recommendation of the Polish Society of Lung Diseases endoscopic valvular therapy forms a real extension of therapeutic potential for infirm with emphysema [17,31].

Intrabronchial valve endoscopic engrafting essence

Endoscopic emphysema treatment is aimed to decrease lungs volume and improvement in patient breathing efficiency. With bronchoscope into treated bronchus one-way valve is placing, which prevents airflow into emphysema embraced lung, enables air outflow. This causes a collapse in this part of the lung. Owe to that, the fine part has a chance to re-expand and take over the respiratory function. The procedure is linked with about 5% risk of the uprising a pneumothorax, what happens when air comes into the pleural cavity.

Research on the bronchoscopic decrease of the lung volume

Research shows, as a result of endoscopic valvular therapy at about 30-40% patients comes progression in lungs activity parameters, which can be seen in spirometry. This method is not long-lasting effects. Benefits of the treatment been reported until 12 months after the procedure. Because of the lack of research on long term observation of patients after engrafting the valve, the effectiveness of this method is estimated at 3 years. This time concern patients with advanced emphysema [32].

According to research made in 2006 - 2013 at 256 patients with severe emphysema subjected valvular therapy, year after procedure clinical benefits gradually decrease caused by COPD progress. Based on checkup, which includes: lungs activity test (VC, FEV1, RV, TLC), 6-minute march test (6 MWT) and breathlessness questionnaire (mMRC), radiological result, presumed, that after 3, 6, 12 months after valve engrafting all of lungs parameters improves. On the other hand, according to research done between September 2013 and March 2014 at 40 patients after this procedure, made conclusions, that treating is effective in an average part of the time, and safe for people with emphysema.

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) in the report from 2019 claims, that endoscopic valvular therapy increases lungs volume and contribute to improving toleration for manual effort, lungs functioning and overall health state for 6 to 12 months from treatment [32,33].

Summary

Along with technical potential development comes development in bronchoscopy treating methods. Experimental methods of treating emphysema and asthma contribute to the improvement of life and health quality at patients with these respiratory diseases. They are a relatively safe alternative for standard treatment. Regrettably, lack of refund, limited

access to these procedures and constricted access to the information about this, constitute, that only a few patients, especially in Poland have a chance for making use of this therapy.

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