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THE ROLE OF BRONCHOLOGICAL SANITATION IN THE TREATMENT OF BRONCHIECTASIS

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Abstract:
Bronchiectasis is a very common condition that is a leading cause of respiratory problems. Treatment methods remain relevant: conservative and surgical. Attempts to give one of them a dominant character did not materialize. Sanitation of the tracheobronchial tree is a therapeutic measure that eliminates the accumulation of mucus on the affected bronchi. The main objectives of sanitation bronchoscopy are to influence the nature of the secretion of the mucous glands, improve the drainage function of the bronchi by removing secretions, and provide anti-inflammatory therapy.

Keywords: Bronchiectasis, inflammation, sanitation bronchoscopy, bronchial drainage function, bronchoalveolar lavage, anti-inflammatory therapy

Bronchiectasis refers to polyetiological (several causes of occurrence) processes. The main reason for the development of bronchiectasis in childhood and adolescence is productive inflammation of the airways . Destructive (destructive) changes in the muscular and elastic layers of the bronchial wall are accompanied by dilatation (expansion) and functional disorders of the bronchi. Stagnation of mucus causes a hacking cough with stretching of the walls, blockage of the terminal bronchioles (the final sections of the "bronchial tree"). In parallel with ventilation disturbances, the perfusion (filling with blood) of the lung tissue decreases. The formation of bronchiectasis is often combined with chronic bronchitis and emphysema. Among patients, COPD (chronic obstructive pulmonary disease) is detected in 18-27% of cases [22, 31].

The prevalence of bronchiectasis is not clearly defined. Weicker et al reported that between 340,000 and 522,000 adults in the US population were treated for bronchiectasis , and that 70,000 adults were newly diagnosed with bronchiectasis in 2013 [32, 40]. Another study reported that there were more than two million adults with bronchiectasis worldwide in 2012 , and the number is expected to increase to more than three million by 2020 [33, 39].

Treatment methods remain relevant: conservative and surgical. Attempts to give one of them a dominant character did not materialize. Each of them pursues specific goals at separate stages of the disease. Conservative treatment can be carried out with the independent goal of clinical recovery and stabilization of the process, ensuring quality of life, preventing exacerbation of the process, its progression. On the other hand, conservative treatment can be considered as preoperative preparation, postoperative rehabilitation and prevention of disease progression and relapse. Conservative treatment includes respiratory hygiene, sanitation of the bronchial tree, antimicrobial therapy, specific treatment for individual causes of the disease, correction of hypoxia, etc.

Sanitation of the tracheobronchial tree is a therapeutic measure that eliminates the accumulation of mucus on the affected bronchi. The main objectives of sanitation bronchoscopy are to influence the nature of the secretion of the mucous glands, improve the drainage function of the bronchi by removing secretions, and provide anti-inflammatory therapy. Single courses of therapeutic sanitation bronchoscopy are effective for pneumonia, suppurating lung cyst, lung abscess, and for chronic obstructive pulmonary disease, chronic obstructive bronchitis, bronchiectasis , cystic fibrosis, multiple courses of treatment are necessary.

Bronchoalveolar lavage is an additional study to determine the nature of the pulmonary disease, in which a significant volume of isotonic sodium chloride solution (about 120-240 ml) is injected into the lumen of small-caliber bronchi. Moreover, the lavage fluid obtained during aspiration contains cells not only from the lumen of the smallest bronchi, but also from the alveoli. Diagnostic bronchoalveolar lavage is indicated for patients whose chest X-ray reveals unclear changes in the lungs, as well as diffuse changes. Diffuse interstitial lung diseases (sarcoidosis, allergic alveolitis, idiopathic fibrosis, histiocytosis X, pneumoconiosis, collagenosis, bronchiolitis obliterans) present the greatest difficulty for clinicians, since their etiology is often unknown.

Unclear changes can be of infectious, non-infectious, or malignant etiology. Even in cases where lavage is not diagnostic, its results can suggest a diagnosis, and then the doctor's attention will be focused on the necessary further studies. For example,

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even in normal lavage fluid there is a high probability of detecting various abnormalities. In the future, bronchoalveolar lavage is potentially used in establishing the degree of disease activity, to determine prognosis and necessary therapy.

The idea of lavaging the bronchi to empty the contents belongs to B.Kline and M.Wintemitz (1915), who performed endobronchial lavage for experimental pneumonia by introducing a washing solution into the respiratory tract of animals. These researchers did not note any adverse effects from the administration of isotonic sodium chloride solution into the bronchi.

The main tasks of sanitation bronchoscopy:

- influence the nature of the secretion of the mucous glands;
- improve the drainage function of the bronchi by removing secretions;
- improve microcirculation;
- carry out anti-inflammatory therapy;
- influence the microflora of the bronchi;

Many different methods of bronchoscopic treatment of chronic obstructive bronchitis have been proposed, these include attempts to intrabronchially administer an emulsion of hydrocortisone, antibiotics and other antibacterial drugs, proteolytic enzymes, mucolytics, etc. [9, 10, 11, 12, 14, 19, 30].

Some of them were abandoned as they had not been tested by practice, others took a strong place in the arsenal of therapeutic agents for patients with diseases of the bronchopulmonary system. But, despite their many, the search for optimal ways to influence lower respiratory tract infections remains relevant.

According to many researchers, maintaining a therapeutic level of antibiotic in blood serum alone is not enough. The effectiveness of therapy is determined by the level of drug concentration directly in the zone of infectious inflammation in the bronchopulmonary tissue. This is due to the fact that with the long-term existence of the pathological process in the lungs, fibrosclerotic changes develop. Drugs circulating in the blood do not penetrate well into foci of chronic inflammation with impaired vascularization [29, 33, 38].

Factors of ineffectiveness of therapy include the presence of bronchiectasis in patients with COPD. Traditional therapy used to treat severe exacerbations of COPD does not allow for complete subsidence of the inflammatory process in the bronchial tree. This leads to short periods and incompleteness of remissions, rapid progression of the disease with the formation of irreversible changes in the bronchial tree.

In connection with the above, an important direction in the treatment of chronic purulent-inflammatory diseases has been the use of methods of local influence on the bronchial microflora during therapeutic bronchoscopy. The therapeutic effect of bronchoscopy depends on two main points: aspiration of bronchial contents and the administration of drugs that have a direct effect on the local inflammatory process and bronchial microflora, drugs that help liquefy bronchial secretions and facilitate their removal [13, 19, 24, 86, 27].

The combination of traditional therapy and a series of therapeutic bronchoscopy aimed at mechanical evacuation of viscous secretions and local administration of drugs (antiseptics) allows to reduce inflammatory swelling of the bronchial mucosa, improve the vasomotor, reflex and secretory function of the bronchi, which facilitates their self-cleaning, improves conditions for gas exchange and aeration lung tissue.

Therapeutic bronchoscopy increases the effectiveness of antibacterial therapy. This is especially important for purulent endobronchitis, since it is with the endobronchial administration of antibiotics through a bronchoscope that the possibility of creating effective therapeutic concentrations at the site of inflammation opens up. In cases where the bronchi are clogged with secretions and then with formed compacted plugs, which turns off the corresponding areas of the lung from gas exchange, leads to the development of arteriovenous shunting, aggravates bronchospasm and maintains inflammation, treatment of patients should begin with the immediate restoration of bronchial patency [19, 35, 41].

Today, more than a hundred years after the "father of bronchoscopy" Gustav Killian first inserted a bronchoscope into the trachea and removed an aspirated meat bone from a patient, bronchoscopy is one of the leading methods for diagnosing and treating respiratory diseases. The development of bronchoscopy can be divided into three stages.

At the first stage, which began at the end of the 19th century and lasted until the 50s of the twentieth, bronchoscopy was performed under local anesthesia, usually using rigid esophagoscopes, which had a dual purpose - examination of the tracheobronchial tree and the esophagus. The progress of bronchoscopy during this period was facilitated by Ch.Jackson, J.Lemoine, A. Soulas, A.Olsen, H.Andersen, and in Russian - A.Delens, V.Voyachek, V.Trutnev, A.Likhachev and M. Elova. The priority for introducing bronchoscopy into the clinic of internal diseases belongs to Russian doctors [24, 27, 34].

Bronchoscopy during this period was performed mainly by otolaryngologists to remove foreign bodies from the respiratory tract. The procedure was very traumatic, and the patients had a hard time bearing it. With the advent and improvement of general anesthesia, pulmonary surgery began to actively develop, and the indications for bronchoscopy expanded significantly. This was facilitated by the creation in the late 50s - early 60s of respiratory bronchoscopes (H.Friedel, P.Hollinger, G.I.Lukomsky), which made it possible to perform bronchoscopy under anesthesia with myoplegia and injection ventilation of the lungs, which significantly alleviated the suffering of patients and made the study safer.

A true revolution in bronchology and the beginning of the third, modern stage in the development of bronchoscopy was the creation in 1968 of a *flexible bronchofiberscope ,* with the help of which it became possible to examine the lobar, segmental, subsegmental bronchi of all parts of the lung, perform a visually controlled biopsy, and administer medicinal solutions. The fiberoptic bronchoscope has significantly changed the technique of bronchoscopy. They began to perform it under local anesthesia, causing almost no discomfort to the patients. Bronchofibroscopy began to be successfully performed on an outpatient basis, in pulmonology hospitals and offices, and in intensive care units. It seemed that the need for rigid bronchoscopes had disappeared forever. However, the creation of high-energy medical lasers determined a new direction in bronchology - surgical endoscopy, and rigid endoscopes were again required for it. Therefore, modern bronchoscopy is equipped with both flexible and rigid endoscopes and instruments that allow performing a wide range of diagnostic and therapeutic manipulations in the trachea and bronchi, both under local anesthesia and under general anesthesia.

The choice of a bronchoscope and the method of its insertion, the type of anesthesia and the position of the patient is determined by the purposes of bronchoscopy, the conditions in which it is performed and the condition of the patient. Thus, for most diagnostic and therapeutic bronchoscopy in patients with COPD, especially in an outpatient setting, local anesthesia and a flexible bronchofiberscope are quite sufficient . In cases where the patient has severe respiratory failure or certain additional manipulations in the bronchi are expected, carried out for differential diagnostic purposes, especially if they are associated with the risk of bleeding, it is better to use a rigid bronchoscope and general anesthesia.

The main medications used during therapeutic bronchoscopy are antiseptics (dioxidin, miramistin, chlorhexidine), mucolytics (fluimucil), antibiotics (fluimucil - antibiotic), immunomodulators (lysozyme, T-activin, polyoxidonium) [9, 10, 11, 19]. Until recently, antibiotics were installed into the lumen of the bronchial tree at the end of therapeutic bronchoscopy. Subsequently, a method of intrabronchial regional lymphatic therapy was developed and introduced into clinical practice [27, 37].

With widespread purulent-inflammatory changes, sanitation bronchoscopy does not give the desired effect. This is due to the fact that it is not always possible to create stable and long-term therapeutic concentrations of antibacterial drugs in the area of chronic pulmonary inflammation.

Low-intensity helium-neon laser irradiation has found wide application for the treatment of many diseases, including the respiratory system [9, 10, 11, 27, 29, 32]. The authors obtained good results from the use of these methods, which help improve the drainage function of the bronchi and improve the local immune defense of the respiratory tract.

The date of birth of diagnostic bronchoalveolar lavage (BAL) can be considered 1961. At this time, O.N. Myrvik et al . carried out bronchial lavage in order to obtain and study alveolar macrophages. Technological progress contributed to the improvement of bronchial lavage techniques , and in 1973 E. T. Cantrell et al. For the first time, bronchoalveolar lavage was performed through a fiberoptic bronchoscope . Currently, this method is used quite widely [13, 16, 21, 23, 25, 26, 30]. The BAL technique involves catheterization of the subsegmental bronchus during bronchoscopy using lavage of sterile isotonic sodium chloride solution in a certain volume. Currently, to obtain bronchoalveolar fluid, both a thin fiberglass bronchoscope and a rigid one are used, which allow reaching the subsegmental bronchi. Typically, a sterile isotonic saline solution warmed to body temperature is used. Typically administered in three successive 60 ml doses, for a total of 180 ml of liquid. The liquid is aspirated by gentle suction into a silicone glass container and centrifuged. As a result of this procedure, bronchoalveolar lavage fluid is obtained , the components of which are tracheobronchial mucus, respiratory tract cells, and injected solution.

The main source of bronchial secretions is the secretory epithelium of the serous and mucous glands of the trachea, large bronchi and goblet cells. The composition of bronchial secretions includes alveolar surfactant, plasma components that enter there by exudation or transudation, locally secreted proteins, as well as products of degeneration and decay of microorganisms and the own tissues of the respiratory tract.

Laboratory studies of bronchoalveolar fluid currently include the determination of a significant

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number of its components, for which cytological, immunological, microbiological and other methods of studying lavage are used. Bronchoalveolar lavage allows you to assess the state of the local immunity of the respiratory tract, characterize the cellular immunity, study the microbial spectrum, the level of cytokines, immunoglobulins. The study of bronchoalveolar lavage parameters more accurately reflects the phase of the inflammatory process in the lungs than the hemogram and clinical symptoms [17, 35].

Cellular composition of bronchoalveolar lavage fluid.

The most common study currently recognized is the study of the cellular composition of bronchoalveolar lavage fluid [18 , 36, 40]. The cellular composition of BALF in healthy people is 87-93% alveolar macrophages, 7-10% lymphocytes, 1% neutrophils and less than 1% eosinophils. Alveolar macrophages and leukocytes are the main phagocytic cells that secrete biologically active substances, destroy and absorb microbial and other bodies and particles.

Normal composition of BALF (Recommendations of the European Respiratory Society):

- bronchial epithelium - 5-20%
- cylindrical 4-15%
- squamous epithelium 1-5%
- alveolar macrophages 64-88%
- neutrophils 5-11%
- lymphocytes 2-4%
- mast cells *0-0.5%*
- eosinophils 0-0.5%

Normal cytogram of the alveolar portion of BAL fluid:

- alveolar macrophages 82-98%
- lymphocytes 7-12%
- neutrophils 1-2%
- eosinophils less than 1 *%*
- mast cells less than 1%

The study allows us to assess the degree of activity of the inflammatory process and the effectiveness of the therapy. A low degree of inflammatory activity is characterized by an increase in the proportion of neutrophils in the BAL within 10%, an average - up to 11-30%, a high - more than 30% [23].

Leukocytes are practically not found in the cytogram of bronchoalveolar lavage fluid in a healthy person (no more than 1.5%). Their role increases significantly in any inflammatory process in the bronchopulmonary system, although it should be noted that in smokers the percentage of leukocytes is increased. With chronic inflammation, the cellular composition changes significantly, the content of neutrophils significantly increases and the percentage of macrophages clearly decreases. These changes increase in parallel with the duration of the disease. With severe inflammation in the bronchial-lung system, the number of leukocytes increases sharply to 60-70%, reaching 90-95% with high inflammation activity. During the period of clinical well-being, the results of a cytological study convincingly indicate the persistent persistence of the inflammatory process in the bronchi.

Thus, cytomorphological examination of BAL fluid is a promising method of pulmonology, and its cytogram serves as a reflection of the pathological process in the lung tissue [25].

Microbiological examination of BAL fluid.

The liquid obtained during fibrobronchoscopy serves as material for bacteriological research. Samples are collected in sterile dishes and sent to the microbiology laboratory within 1 hour of receipt. The material is sown on solid nutrient media (blood agar, Endo medium , chocolate agar, Sabouraud medium) and cultivated for 18-24 hours at 36-37°C. The sensitivity of isolates to antibacterial drugs is determined by the disk diffusion method according to NCCLS recommendations . According to the cumulative data of many studies, bacterial pathogens are detected in 50-60% of patients with exacerbation of COPD.

Immunological study of bronchoalveolar lavage fluid .

Markers of the inflammatory response of the respiratory tract in COPD can be the level of cytokines in bronchoalveolar lavage fluid [1, 6]. Chronic colonization of bacteria in the bronchopulmonary system is a constant stimulus for maintaining the inflammatory process, which contributes to the progression and chronicity of these forms of pathology. Toxins released by bacteria damage the bronchial epithelium and stimulate the production of cytokines. Cytokines are a group of polypeptide mediators involved in the formation and regulation of the body's defense reactions. The great importance of cytokines in the development of inflammation in the respiratory tract and the diagnostic significance of determining their spectrum and concentration in the BALF were noted. Traditionally, the level of cytokines is studied, the increase of which is characteristic of the inflammatory process in COPD.

A number of studies have noted that in COPD, hypercytokinemia is recorded due to the proinflammatory cytokines IL-6, IL-8, and TNF-a. The nature of changes in hypercytkinemia has a clear tendency to increase from the initial stage to the final

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stage of the disease. An increase in the content of IL-8 and TNF-a correlates with the number of neutrophils in the BALF in patients with COPD [1, 14, 20].

These results are explained by the fact that intense and prolonged processes in the bronchi are accompanied by the accumulation of proinflammatory cytokines in the bronchoalveolar fluid. Researchers note a direct relationship between the severity of obstruction, the intensity of progression of the pathological process and the concentration of proinflammatory cytokines in BAL fluid [2, 3, 4, 5].

S.N.Avdeev emphasizes that studying the cytokine status in COPD can change approaches to the treatment of COPD. The role of specific anti-inflammatory drugs needs clarification. The effectiveness of antibodies directed against TNF-a has been shown in rheumatoid arthritis and Crohn's disease. But there is no data to judge the anti-inflammatory effect of these drugs in patients with COPD. The relationship between pathogen detection and cytokine levels in BAL fluid is noteworthy.

IgA is present throughout the respiratory tract - a marker of the so-called "local immunity". Assembly of this secretory immunoglobulin occurs on the basement membrane of lymphoid and epithelial cells from the precursor of the secretory component and the dimer of serum IgA [15]. Main functions of slgA boil down to protecting the mucous membrane by neutralizing toxins and viruses and blocking bacterial adhesion to epithelial cells. Moreover, the protective effect of slgA appears exclusively in mucus [7, 8]. Change in the amount of slgA (as a rule, its decrease) in the bronchoalveolar fluid allows us to assess the state of secretory immunity in COPD, as well as monitor the dynamics of treatment.

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