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FEATURES OF BRONCHIO-OBSTRUCTIVE SYNDROME IN YOUNG CHILDREN

Abstract. Broncho-obstructive syndrome (BOS) is one of the most common symptom complexes accompanying various diseases of the bronchopulmonary system. Its development can be caused by many factors, including congenital and hereditary pathologies of the respiratory system, anomalies in the formation of the bronchi, respiratory distress syndrome of the newborn, primary immunodeficiency states, aspiration of foreign bodies, consequences of perinatal lesions, gastroesophageal reflux, thymus hyperplasia, enlargement of the intrathoracic lymph nodes, tumor processes and other pathological conditions. Clinical manifestations of broncho-obstructive syndrome are characterized by prolonged exhalation, the appearance of expiratory noises (wheezing), varying degrees of respiratory failure, retraction of compliant areas of the chest, as well as possible signs of hypoxemia, including perioral or diffuse cyanosis. Diagnosis of broncho-obstructive syndrome is based on a comprehensive analysis of anamnestic data, clinical symptoms, physical examination results, instrumental and laboratory research methods. The key diagnostic methods are lung auscultation, spirometry assessment, pulse oximetry, chest radiography, bronchoscopy and, if necessary, CT of the respiratory organs. Treatment of broncho-obstructive syndrome should be comprehensive and aimed primarily at eliminating the cause of bronchial obstruction. Therapeutic tactics include bronchodilators, mucolytics, anti-inflammatory and antibacterial drugs (in the presence of infection), as well as oxygen therapy in case of severe hypoxia. Inhaled glucocorticosteroids can be used for chronic forms of BOS, and surgical treatment in case of anatomical anomalies of the respiratory tract. Broncho-obstructive syndrome is a serious clinical condition that requires timely diagnosis and adequate treatment aimed at both relieving symptoms and eliminating the underlying cause of the pathology.

Key words: broncho-obstructive syndrome, children, clinical manifestations, diagnosis, treatment, respiratory failure, therapy.

616-053.2

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ОСОБЕННОСТИ БРОНХИООБСТРУКТИВНОГО СИНДРОМА У МАЛЕНЬКИХ ДЕТЕЙ

Аннотация. Бронхообструктивный синдром (БОС) — один из наиболее распространенных симптоматических комплексов, сопровождающих различные заболевания бронхолегочной системы. Его развитие может быть вызвано многими факторами, включая врожденные и наследственные патологии дыхательной системы, аномалии в формировании бронхов, респираторный дистресс-синдром новорожденных, первичные иммунодефицитные состояния, аспирацию инородных тел, последствия перинатальных поражений, гастроэзофагеальный рефлюкс, гиперплазию тимуса, увеличение внутригрудных лимфатических узлов, опухолевые процессы и другие патологические состояния. Клинические проявления бронхообструктивного синдрома характеризуются удлинением выдоха, появлением шумов выдоха (хрипов), различной степенью дыхательной недостаточности, втяжением податливых участков грудной клетки, а также возможными признаками гипоксии, включая периоральный или диффузный цианоз. Диагностика бронхообструктивного синдрома основывается на комплексном анализе анамнестических данных, клинических симптомов, результатов физикального обследования, инструментальных и лабораторных методов исследования. Ключевыми методами диагностики являются аускультация легких, спирометрия, пульсоксиметрия, рентгенография грудной клетки, бронхоскопия и, при необходимости, КТ дыхательных органов. Лечение бронхообструктивного синдрома должно быть комплексным, и направлено прежде всего на устранение причины бронхиальной обструкции. Терапевтическая тактика включает в себя бронходилататоры, муколитики, противовоспалительные и антибактериальные препараты (при наличии инфекции), а также кислородную терапию в случае тяжелой гипоксии. Ингаляционные глюкокортикостероиды могут применяться при хронических формах БОС, а хирургическое лечение – при анатомических аномалиях дыхательных путей. Бронхообструктивный синдром — это серьёзное клиническое состояние, требующее своевременной диагностики и адекватного лечения, направленного как на облегчение симптомов, так и на устранение основной причины патологии.

Ключевые слова: бронхообструктивный синдром, дети, клинические проявления, диагностика, лечение, дыхательная недостаточность, терапия.

Introduction. Broncho-obstructive syndrome (BOS) is one of the most significant problems in modern pediatrics, occupying a leading position in the structure of respiratory pathologies in young children [1,3,5,10,20]. The high prevalence of this syndrome among bronchopulmonary diseases, its severe course, and potential complications make it a topic of medical research.

BOS is a complex of symptoms arising from obstruction of bronchial patency of organic or functional origin. Clinical manifestations include paroxysmal cough, expiratory dyspnea, episodes of suffocation, and wheezing on exhalation [6,8,14, 17]. In children in the first years of life, broncho-obstruction accompanies 30-50% of acute respiratory infections, the main cause of which is acute obstructive bronchitis (AOB) [2,9,11,21]. BOS accompanies a wide range of bronchopulmonary diseases, including congenital and hereditary pathologies of the respiratory system, bronchial developmental anomalies, respiratory distress syndrome, immunodeficiency states, foreign body aspiration, perinatal pathology, gastroesophageal reflux, thymic hyperplasia, hilar lymphadenopathy, and neoplasms [12, 13, 22]. The similarity of clinical manifestations in various diseases significantly complicates timely diagnosis and the selection of effective treatment tactics, which can contribute to a protracted or recurrent course of the pathology.

Epidemiology and causes of BOS. Statistics on the prevalence of BOS in young children vary. According to several studies, every third child under three years of age has experienced at least one episode of bronchial obstruction [17,18]. Other authors indicate that already in the first year of life, many children experience acute bronchiolitis or obstructive bronchitis caused by a viral infection [4,7,15].

Viral bronchiolitis experienced in early childhood often predicts recurrent episodes of broncho-obstruction in preschool age [16,19]. Furthermore, there has been a steady increase in the incidence of bronchial asthma among children, with this disease increasingly being diagnosed in infants in recent years [4,21].

Among infants, who frequently suffer from respiratory infections, the incidence of BOS reaches 50% or more [19,22]. At the same time, broncho-obstruction developing against the background of lower respiratory tract infections occurs in 5-40% of cases [11,12].

The high prevalence of BOS, its clinical diversity, the characteristics of its course, and potential consequences make this problem a subject of active study by both researchers and practicing physicians. Differential diagnosis of broncho-obstructive syndrome remains a complex task, necessitating further in-depth study of this pathology [20].

The most common pathogens of bronchiolitis in young children are respiratory syncytial virus (RSV), rhinovirus, and mixed viral infections, including parainfluenza, influenza, metapneumovirus, enterovirus, coronavirus, and adenovirus [1,3,5]. RSV accounts for up to 70% of hospitalizations of infants with bronchiolitis under one year of age.

Viral infections can increase the production of neurotrophins, which may contribute to the remodeling of airway nerve structures and increased nonspecific reactivity [7,8]. However, the role of RSV in the development of bronchial asthma after bronchiolitis becomes apparent only in combination with certain genetic factors or environmental exposures [21].

Atopy is an important predisposing factor for the subsequent development of bronchial asthma in children with virus-induced BOS. A high risk of developing asthma is observed in children who experienced BOS in infancy and who have

signs of allergic predisposition, such as sensitization to allergens, atopic dermatitis, eosinophilia, or elevated levels of allergen-specific immunoglobulin E [20,22].

Clinical manifestations of BOS. Broncho-obstructive syndrome (BOS) manifests itself most clearly in children in the first years of life, due to the structural and functional characteristics of the respiratory system at this age. These include narrow airways, insufficient elasticity of lung tissue, soft bronchial cartilage, mild chest rigidity, a tendency toward edematous reactions, hyperproduction of viscous mucus, and underdevelopment of bronchial smooth muscle structures [17,21].

Clinical manifestations of BOS include prolonged expiration, expiratory noise in the form of wheezing and noisy breathing, episodes of suffocation, and active participation of accessory muscles in the respiratory process. In English-language medical literature, this symptom complex is known as "wheezing" syndrome, since wheezing (both remote and detected by auscultation) is the key sign of broncho-obstruction [7,16,22].

Early symptoms, such as shortness of breath and wheezing, appear in most children during the first years of life [20,21]. According to various data, between 30% and 50% of infants experience at least one episode of broncho-obstruction, with 30% of children experiencing their first episode before the age of one year [1,8,22]. However, in 80% of children, such symptoms disappear as they grow older, and in the remaining 20%, BOS persists into later years [21].

Research by Morales E. et al. shows that recurrent wheezing is detected in 40% of preschool children [22]. According to Zaitseva O.V., bronchial asthma (BA) causes broncho-obstruction in 30–50% of young children [6]. Nearly half of patients with ARIs show signs of bronchial obstruction of varying severity in their clinical presentation [8,9,15]. In particular, wheezing associated with ARIs is recorded in 50% of children under six years of age [12].

Diagnosis. Primary care physicians, when encountering manifestations of BOS in children, most often diagnose obstructive bronchitis or bronchiolitis, which are accompanied by respiratory failure and typically occur in the context of an acute respiratory infection [13,16,22].

In some cases, broncho-obstruction can be caused by allergic inflammation of the tracheobronchial tree, mechanical bronchial obstruction, or vascular disorders [15,16].

Diagnosing broncho-obstructive syndrome (BOS) in young children presents certain difficulties, as functional respiratory examination methods are uninformative at this age. Furthermore, obtaining sputum for cytological and bacteriological analysis, which is necessary to confirm the diagnosis, is difficult [21]. In cases of frequent recurrences of BOS that are resistant to standard drug therapy, endoscopic examination of the bronchial tree may be required. This method allows for visual assessment of changes in the bronchi and analysis of the obtained biospecimens [18].

However, due to its invasive nature, bronchoscopy is rarely used in young children [14,17].

The diagnosis of bronchial obstruction is established based on the patient's medical history, clinical manifestations, and physical and instrumental examination data. For children over 5-6 years of age, the functional state of the respiratory system is assessed using spirography (analysis of the flow-volume curve) and pneumotachometry (peak flowmetry). Particular attention is paid to family history, in particular the presence of allergic diseases in relatives and frequent episodes of bronchoobstruction in the child. In cases of recurrent BOS, the examination includes a range of diagnostic methods:

1. Complete blood count.
2. Serological tests for chlamydial, mycoplasmal, cytomegalovirus, and herpes infections (IgM and IgG are tested; if IgM is absent and diagnostic IgG titers are detected, testing is repeated after 2-3 weeks to analyze antibody dynamics).
3. Determination of specific antibodies to helminths (toxocariasis, ascariasis).
4. Allergological examination, including determination of total and specific IgE, skin prick tests, and additional immunological tests after consultation with an immunologist.

Highly informative diagnostic methods include PCR analysis and bacteriological examination of sputum obtained by bronchoscopy or deep expectoration.

However, upper respiratory tract swabs reflect the composition of the nasopharyngeal microflora more than the bronchopulmonary system.

Chest X-rays are performed in the following cases:

• suspected complications (e.g., atelectasis);
• the need to rule out pneumonia;
• the possibility of a foreign body;
• frequent recurrences of BOS, if X-ray examination has not been performed previously.

If indicated, bronchoscopy, CT scan of the lungs, and other tests may be performed. Severe forms of broncho-obstruction, as well as frequent recurrences of BOS, require mandatory hospitalization to determine the cause of the disease and select effective treatment.

Treatment. Treatment of broncho-obstructive syndrome (BOS) should be aimed at eliminating the factors causing airway obstruction. According to current clinical guidelines, bronchodilators, primarily administered by inhalation, play a key role in the treatment of BOS. This method of administration ensures high local drug concentrations, reduces the risk of systemic side effects, and allows for a reduction in the required dosage. Effective delivery of the drug to the respiratory tract is achieved using metered-dose inhalers (MDIs) and nebulizers. First-line medications include short-acting β2-adrenergic agonists (salbutamol, terbutaline, fenoterol). Their effect develops within 5-10 minutes after inhalation and lasts for 4-6 hours. For children, inhalation is performed using special devices such as babyhalers, spacers, or volumatic devices. The recommended single dose of salbutamol via spacer is:

• 200 mcg for children under 2 years old,

• 100 mcg for children over 2 years old.

These medications are highly selective and have a minimal risk of adverse reactions.

Given the pathogenesis of BOS, anticholinergic bronchodilators such as ipratropium bromide can also be used. In pediatric practice, the most commonly used combination drug is Berodual, which combines adrenergic receptor stimulation and M-cholinergic receptor blockade. It contains ipratropium bromide and fenoterol, their synergistic action enhances the antispasmodic effect and dilates the bronchi.

The average single dose for children under 6 years of age is 2 drops per 1 kg of body weight 3-4 times daily. Before inhalation, the drug is diluted in 2-3 ml of saline.

For severe forms of BOS, topical or systemic glucocorticosteroids (GCS) may be prescribed. In the acute phase, the use of inhaled corticosteroids (ICS) via a nebulizer is preferable, as their therapeutic effect becomes pronounced after 1-2 weeks of treatment.

Additionally recommended:

• Oral rehydration, which helps improve bronchial drainage.

• Mucolytic and expectorant therapy (Lazolvan - ambroxol, acetylcysteine - under medical supervision in children under 3 years of age).

• Physiotherapy methods (massage, postural drainage, breathing exercises).

For persistent dry cough without expectoration, alkaline diet is helpful.

It is important to note that first-generation antihistamines (Fenistil, Fenkarol, Peritol, Suprastin) impair mucociliary clearance and are not recommended for BOS.

If necessary, children with atopy are prescribed new-generation antihistamines (Claritin, Erius) once daily.

If BOS develops due to viral bronchiolitis or obstructive bronchitis, antiviral drugs (interferon, Viferon, etc.) may be included in the treatment regimen. Antibiotics are prescribed only if a bacterial infection is present.

Conclusion

Broncho-obstructive syndrome, especially in young children, remains an important clinical problem. It often develops as a result of acute and recurrent infections, as well as allergic inflammation or mechanical airway obstruction.

This requires a thorough diagnosis, including instrumental and laboratory tests. However, comprehensive diagnostic measures should not delay the timely initiation of treatment, as prompt and effective therapy plays a key role in reducing the risk of complications.

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