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Modern Approaches To Studying Etiopathogenesis, Clinics And Treatment Of Acute Bronchiolitis In Children

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Abstract: The article describes the course , clinic, etiopathogenesis, A review of scientific articles on the diagnosis and differential diagnosis of acute bronchiolitis is presented. Acute bronchiolitis is an acute inflammatory disease of the lower respiratory tract, characterized by primary damage to the small bronchi and bronchioles, which develops mainly in children of chest age. Acute bronchiolitis most often occurs in the 1st year of life of children (in more than 80% of cases), 7-14% of them require treatment in inpatient conditions, while it is the most common cause of hospitalization in children under 2 years of age worldwide. To date, some issues of differential diagnosis remain problematic, especially the differential diagnosis of bronchiolitis and pneumonia caused by respiratory syncytial virus.
Keywords: bronchiolitis, diagnostics, young children, treatment, differential diagnosis

Bronchiolitis, Capillary bronchitis is an inflammation of the walls of the small bronchi caused by viruses or bacteria, which occurs mainly in children under one year of age. Influenza bronchiolitis, caused by influenza viruses, catarrhal bronchiolitis, characterized by catarrhal inflammation of the mucous membrane of the small bronchi, obliterating bronchiolitis, characterized by the growth of granulation tissue up to the bronchial orifices, etc. are distinguished [3].

Since the 1980s, the diagnosis of "acute bronchiolitis" has been actively studied and widely used in clinical practice. Before that, the disease was usually considered obstructive bronchitis or obstructive bronchopneumonia [12]. Unfortunately, according to numerous observations, bronchiolitis is considered pneumonia in up to 80% of cases and inappropriate therapy is carried out, and if the diagnosis of bronchiolitis is still established, antibiotic therapy and inhaled corticosteroids are usually prescribed.

10 % of children admitted to the hospital with a diagnosis of "acute bronchiolitis" requiring intensive care unit treatment . According to a 9-year study, the proportion of patients with ARI in the United States is 19.3% [4], with an average mortality rate of 2.8 per 100,000 children [5]. The mortality rate may reach 2-9%. Over the past two decades, guidelines for the management of patients with acute bronchiolitis have been published in many countries around the world [14].

The leading cause of acute bronchiolitis is viral infections [1,7]. In many countries, the etiology data vary significantly, but respiratory syncytial virus (RSV) is the undisputed leader, causing 60 to 80% of cases. The second most common etiology of acute bronchiolitis is rhinoviruses - from 14 to 30% (in premature infants - up to 40%), followed by bocavirus (14-15%), metapneumovirus (3-12%), rarely enterovirus (serotype D-68), adenovirus, coronavirus (not SARS-CoV-2), influenza viruses and *M. pneumoniae* ; in general, these pathogens account for 1-8% of all cases in children. In approximately one third of cases of acute bronchiolitis, more than one virus is identified. It should be remembered that co-infections lead to a longer course of the disease, a more pronounced manifestation of symptoms and an increased risk of hypoxemia. Studies have shown that *B.* pertussis occurs in 7.1% of patients with acute bronchiolitis (39.7% of children under 3 months of age), with a peak of the disease in May and a milder clinical picture than RSV [25].

Bacterial infections are less common but can exacerbate acute bronchiolitis. Bacteria such as Mycoplasma pneumoniae and Chlamydia pneumoniae can cause inflammation of the bronchi. These bacteria can exacerbate infections in the respiratory tract and cause severe inflammation [1,18].

In some cases, chronic bronchiolitis may be associated with genetic factors. Certain genetic traits may increase a person's susceptibility to bronchiolitis. Genetic predisposition, such as a predisposition to asthma or other respiratory diseases, may increase the risk of developing chronic bronchiolitis[13].

The typical manifestation of bronchiolitis is observed only 3-6 days after the onset of the disease. Its development is preceded by symptoms of viral damage to the upper respiratory tract: runny nose, nasal congestion, weak cough [2,26]. Body temperature is usually low or normal in RSV infection. Fever is often observed in adenovirus infection [19] .

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When the inflammatory process spreads to the bronchioles, difficulty breathing, involvement of the accessory muscles of respiration, nasal flaring, perioral cyanosis, and dry cough are observed [8,24].

Radiographic examination often reveals constriction of the intercostal spaces. The chest may be swollen, anteroposteriorly enlarged, and rigid . Auscultation may reveal any combination of wheezing, prolonged expiratory effort, and moist, small-bubble rales. Pulse oximetry usually reveals moderate hypoxemia (hemoglobin oxygen saturation < 95%) in the absence of clinical signs. Bronchiolitis is usually a self-limited disease with no complications . Obstruction reaches its maximum within 1–2 days. In previously healthy infants older than 6 months, normalization of breathing occurs within 2–5 days of hospitalization, although some may continue to have wheezing for a week or more [28].

In patients with severe disease, respiratory rate is increased. Intercostal spaces and supraclavicular areas are enlarged, nasal flaring is observed, and wheezing is noted during exhalation. Such patients may have signs of dehydration (due to increased fluid requirements due to fever and increased respiratory rate and decreased fluid intake due to respiratory distress and vomiting), severe cyanosis and peripheral circulatory disorders, and the patient's neuropsychiatric state is agitated or depressed [10, 29].

Apnea may occur in infants younger than 2 months of age as a criterion for the severity of bronchiolitis in premature infants [15].

Respiratory rates greater than 70 breaths per minute have been associated with an increased risk of severe bronchiolitis in some cases [9,12] . Decreased hemoglobin oxygen saturation < 95% as measured by pulse oximetry during ambient air breathing. The duration and severity of acute bronchiolitis in children indicate progression of the disease and require hospitalization of patients [21].

Risk factors that determine the severity of the disease include [25, 26]:

* premature babies (gestational age <37 weeks),
• twins ,
• low birth weight,
be less than 6-12 weeks old ,
• chronic diseases of the respiratory system (bronchopulmonary
dysplasia , cystic fibrosis) ,
congenital anomalies of the bronchopulmonary system ,
• hemodynamically significant congenital heart defects (defects
with cyanosis and pulmonary hypertension),
• immunodeficiency states,
• pathology of the nervous system .

The risk of secondary bacterial infection in infants and children under 3 years of age has been described in a nine-year follow-up study of children hospitalized with acute respiratory illness. In 565 children with confirmed MS virus infection, 1.2% developed a subsequent bacterial infection and 0.9% developed secondary bacterial pneumonia. An increased risk of secondary bacterial pneumonia in children requiring tracheal intubation was observed in infants with bronchiolitis and recurrence of other serious bacterial infections (meningitis). The risk of bacteremia, urinary tract infection, and bacterial enteritis is not significant. In infants with bronchiolitis younger than 60–90 days of age , the risk of bacteremia or meningitis is less than 1–2%, and urinary tract infections are 1% to 5% [23].

Clinical blood tests are sometimes performed to assess the possibility of bacterial infection or bacterial superinfection in children with bronchiolitis. However, studies have shown that changes in white blood cell counts do not indicate the presence of bacterial infection in infants and young children with lower respiratory tract infections caused by MS virus. [30].

Arterial or capillary blood gas analysis is necessary to assess respiratory failure in young children with severe disease .

In the diagnosis of bronchiolitis - clinical, laboratory examination and radiography are required. A general clinical blood test with leukocytosis of $17*10^{9}$ /l and $20*10^{9}$ /l in children aged 2-3 months , in the absence of other changes, does not indicate a bacterial infection in patients with bronchiolitis . C-reactive protein is usually not elevated. To reduce the frequency of unreasonable use of antibacterial drugs, it is

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necessary to use methods for rapid detection of viruses. Available methods for testing viruses that cause bronchiolitis are immunofluorescence, immunochromatography [8,17].

Virological tests for the detection of MS virus and other viruses rarely determine the outcome of treatment, but they may be useful in certain clinical situations [9,24]. There is conflicting evidence that virological testing for the detection of different viral agents may influence the treatment strategy and outcomes of children with bronchiolitis, especially in outpatient settings [19].

After bronchiolitis, some children may have a cough and wheezing for weeks or even months, and it is still not clear whether this is a continuation of bronchiolitis or another disease. Therefore, in some cases, acute bronchiolitis may be a kind of "umbrella " that hides another pathology . Only further observation of the child allows you to establish the final diagnosis, which is why in foreign literature the diagnosis of bronchiolitis is often used as "bronchiolitis syndrome " – SWAB (syndrome we agreed to Call bronchiolitis).

Many world clinicians show that children who develop bronchiolitis in the first year of life are more likely to have relapses, and children who develop bronchial asthma in the second or third year of life are more likely to have bronchiolitis. Children who develop bronchiolitis in the first year of life are usually hospitalized [13].

Acute bronchiolitis is almost always of viral etiology. RSV is the most important, accounting for 41–83% of bronchiolitis cases. Bronchiolitis can be caused by bocavirus, metapneumovirus, coronavirus, rhinovirus, adenovirus, influenza, and parainfluenza viruses. Up to 30–40% of bronchiolitis cases are co-infected and are caused by multiple viruses [2,14].

In adults and older children, these viruses usually cause only upper respiratory tract infections - such as runny nose, nasal congestion and a mild cough . Acute viral lesions of the bronchioles are characteristic mainly of children in the first year of life, the causes of which are not yet fully understood.

In temperate climates, the peak incidence of bronchiolitis is observed in the winter months from mid-March to late April, and in subtropical climates from October to February. Since bronchiolitis caused by some types of parainfluenza viruses also occurs in other months, episodic cases of bronchiolitis may occur throughout the year [5].

According to modern concepts of pathogenesis , bronchiolitis is characterized by acute inflammation, swelling, and necrosis of the epithelial cells of the bronchioles. Increased mucus production and decreased mucus secretion from the bronchioles result in obstruction of the small airways [4,3 5]. Clinical manifestations suggestive of lower airway obstruction include prolonged expiratory phase and distant wheezing.

Most children with severe bronchiolitis recover without complications within 1–2 weeks, but cough and wheezing may persist for more than 3 weeks . Severe complications of bronchiolitis, such as pneumonia and acute respiratory failure, are rare. The most common complication is otitis media, characterized by a re-elevation of temperature after a short period of remission . Failure to improve or worsening of clinical symptoms after 8–10 days of illness may indicate the presence of complications or comorbidities [11, 29].

Fine-bubble wheezing is caused by hypersecretion of mucus in the bronchioles, and dry wheezing is caused more by edema and less by bronchospasm. Accordingly, the nature of the distant wheezing in a child with bronchiolitis determines the type of noisy breathing: crepitus or wheezing. In children of the first 6 months, crepitus is more common, less often - wheezing, and in children older than 9 months - wheezing. The same child may have both oral crepitus and wheezing at the same time; both of these distant sounds may change during the course of the disease.

Bronchiolitis is not characterized by fever above 39°C, and fever lasts for 1–2 days at the onset of the disease. Febrile fever is observed in more than 30% of children with bronchiolitis . A re-eruption of fever to febrile or higher values indicates the presence of complications or the addition of a new infection [17].

Criteria for hospitalization of children with bronchiolitis include: apnea; signs of respiratory failure of grade 2-3; premature infants up to 6 months; inadequate feeding ; dehydration, difficulty eating, drowsiness; the need for constant airway clearance in clinical settings ; premorbid background; social cues [28].

Modern Treatment Methods

1. Antiviral drugs:

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Ribavirin: Used to treat RSV infections. Ribavirin is given by nebulization and is used in severe cases [29].

2. Symptomatic treatment is carried out

- Use of nebulizers and bronchodilators (beta-agonists) to improve breathing .
- Provide more fluids and a humid environment to maintain air humidity [22].

3. Adjunctive therapy includes short - term corticosteroids to reduce inflammation . These drugs are used in severe forms of the disease.

Antibacterial drugs are prescribed. when bacterial infections develop, especially with hyperthermia, toxicosis, concomitant otitis , the presence of infiltrative foci on X-ray , leukemia , leukocytosis It is recommended when. It is very difficult to exclude bacterial infection in children under 6 months of age. In such cases, especially in toxicosis, antibiotics are prescribed. Staphylococcus or Pseudomonas sp are common pathogens in children under 6 weeks of age.

If a child has severe breathing difficulties or if home treatment is not sufficient, the child should be hospitalized and treated under intensive care. The hospital uses modern technologies and monitoring systems to monitor bronchial obstructions and other problems [11, 27].

Conclusion: The importance of each component in the pathogenesis of acute bronchiolitis in children depends on the child's age, the type of virus or their combination, the presence of atopy, environmental factors (climate, dust), immunological reactivity and genetic predisposition. In bronchiolitis, the presence of small-bubble crepitating wheezes in both lungs when breathing is often misdiagnosed as “bilateral polysegmental pneumonia”. In addition, in practice, diseases such as bronchiolitis and atelectasis are often misdiagnosed as pneumonia. Therefore, when diagnosing bronchiolitis, it is necessary to have a thorough knowledge of the full history (viral infection), the child's age, and clinical signs (small-bubble wheezes during inhalation and exhalation, expiratory dyspnea, general damage to both lungs) .

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