МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
Харківський національний медичний університет

MODUL 1
SUBSTANTIAL MODUL 2

THEME 3, 4
ACUTE INFLAMMATORY DISEASES OF UPPER RESPIRATORY TRACT IN CHILDREN. BRONCHITIS

Practical policies for students

МОДУЛЬ 1
ЗМІСТОВИЙ МОДУЛЬ 2

ТЕМА 3, 4
ГОСТРІ РЕСПІРАТОРНІ ЗАХВОРЮВАННЯ ВЕРХНІХ ДИХАЛЬНИХ ШЛЯХІВ У ДІТЕЙ. БРОНХІТИ

Методичні вказівки для студентів

Затверджено
вченою радою ХНМУ.
Протокол № 11 від 20.11.2014.

Kharkov
KhNMU
2015

Module 1. Substantial module 2. Theme 3, 4. Acute inflammatory diseases of upper respiratory tract in children. Bronchitis / comp. Yu. V. Odinets, N. P. Alekseeva. – Kharkiv : KhNMU, 2015. – 24 p.

Compilers Yu. V. Odinets
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Модуль 1. Змістовий модуль 2. Тема 3, 4. Гострі респіраторні захворювання верхніх дихальних шляхів у дітей. Бронхіти : мет. вказ. для студентів / упор. Ю. В. Одинець, Н. П. Алєксєєва. – Харків : ХНМУ, 2015. – 24 с.

Упорядники Ю. В. Одинець
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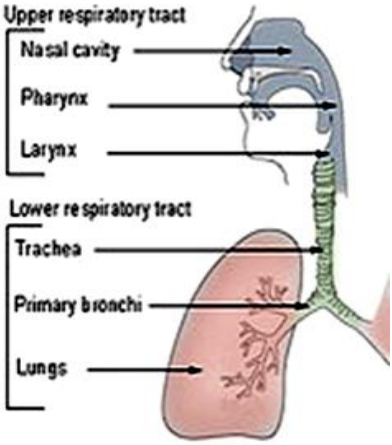
Acute Viral Upper Respiratory Tract Infections Bronchitis in children

Acute Viral Upper Respiratory Tract Infections: are a large group of infectious diseases, which are caused by virus, transmitted by droplet way, characterized by intoxication and catarrhal syndrome with predominant changes in the upper respiratory tract mucosa.



Etiology

Influenza viruses: negative-strand RNA viruses (ortomyxoviruses) of tree major antigenic types – A, B, C. All have the hemagglutination property and possess the enzyme neuraminidase.

Parainfluenza: 5 types of human parainfluenza virus that belong to paramixovirus family (large RNA viruses 150–200 nm, contain hemagglutinine and neuraminidase with stable antigen structure).

Respiratory syncitial (RS) virus, belong to paramixovirus family (large polymorph RNA viruses 120–200 nm) doesn't have neuraminidase and without hemagglutination ability, grew only on the tissues cultures.

Rhinoviruses, with over 100 serotypes, belong to picornavirus family (small RNA viruses 20–30 nm, instable in the environment)

Adenoviruses – a stable DNA-viruses of medium size, 70–90 nm, have A, B, C antigens, could agglutinate the blood.

Rheoviruses – 3 serotypes RNA-viruses of medium size, 70–80 nm, stable in the environment.

Enteroviruses

Coronaviruses

Epidemiology

A source of infection are patients with URT viral infection, and virus-carriers.

Mechanism of transmission:

- Droplet with inhalation of small or large airborne drops during coughing, sneezing, speaking, by contact with contaminated hands, toys ets.
- Also fecal-oral (for Adenovirus, Rheovirus infection).

Receptivity in early age children, from 6 month and under-fives is high (40–80%). Seasonality – autumn-winter or winter-spring flashes and sporadic diseases during a year

Pathogenesis

- Inoculations of viruses in upper respiratory tract epitheliocytes, conjunctiva, lymph nodes;
- Local reproduction of virus;
- Development of inflammatory process in upper respiratory tract, destructive changes;
- Start of immune reactions:

* Delete of virus;
* Immune factors suppression → bacterial complication;
* Possible viremia → damage of organs and systems.

Common clinical symptoms:

- Complaints: more or less severe symptoms of general intoxication, catarrhal symptoms are sore throat (considerably rarer is pharyngeal pain), cold, dry cough.
- Moderate hyperemia, mainly palatal arch, soft palate, uvula, back pharyngeal wall with the presence of graininess (lymphoid follicles are enlarged).
- Hyperemia of nasal mucosa.
- Tonsils are mainly intact (except adenovirus infection).
- Conjunctivitis (more or less severe, in dependence on the type of URTI.
- Signs of a few parts of upper respiratory tract inflammation.
- For every type of infection the prominent inflammation of one part of upper respiratory tract is characteristic with development of typical clinical signs.

Diagnostic criteria of influenza:

- Epidemic growth of morbidity.
- Expressed intoxication.
- Acute beginning, fever, headache, muscular pain and poor catarrhal phenomena, neurotoxicosis, convulsive syndrome, encephalitic reactions.
- Characteristic changes in the respiratory system (bronchitis, segmentary lung's edema, croup syndrome, hemorrhagic lung's edema).
- Positive immunofluorescence and immune-enzyme tests

Table 1 – Severity criteria of influenza

Severity	Severity criteria
Mild (also subclinical)	Body t° is normal or up to 38.5°C, the toxic syndrome is mild or is absent
Moderate	Body t° is 38.5°C-39.5°C, infectious toxicosis is expressed, probable: croup, segmental lung's edema, abdominal or other signs
Severe	t° – 40–40.5°C, short loss of consciousness, delirium, cramps, hallucinations, vomiting
Hypertoxic	Hyperthermia, meningeal-encephalitic, hemorrhagic syndromes

Course of influenza:

1. Smooth, without complication.

2. With the virus-associated complications (encephalitis, serous meningitis, neuritis).

3. With the bacterial complications (pneumonia, otitis, purulent-necrotizing laryngotracheitis.

Diagnostic criteria of parainfluenza:

- Sporadic morbidity, grows in winter;
- Latent period is 2–7 days;
- Acute beginning;
- Toxic syndrome is mild or moderate;
- Catarrhal phenomena are not severe;
- A basic clinical sign is a catarrh of upper respiratory tract;
- Peculiarities in infants and under-fives: a croup syndrome is often.

Table 2 – Croup syndrome: stenotic laryngotracheitis

Symptoms	1-st croup stage (compensated)	2-nd croup stage (subcompensated)	3-rd croup stage (decompensated)	4-th croup stage (asphyxia)
Acute beginning, more often at night with ARTI previous signs. ***Typical triad:*** - ***Barking cough*** - ***Hoarseness*** - ***Stridor***	Typical triad, but stridor appears only when child is irritable, during physical exercises. Laboratory signs of breath failure are absent (lips are pink, blood gases are normal), metabolic acidosis may be present.	Moderate respiratory failure (RF) (skin pallor, perioral cyanosis, tachycardia); irritability. Stridor with moderate involvement of all respiratory muscles. Barking cough, hoarseness; p O_2 is decreased or on the lower normal grade; p CO_2 is normal	Severe RF (stable cyanosis of lips, acrocyanosis, pallor); expressed irritability, anxiety; tachycardia, deficit of pulse during inspiration; stridor; dullness of cardiac tones, cardiopulmonary insufficiency; p O_2 is decreased, p CO_2 is increased	Skin is pallor-gray, cyanotic, cold extremities; breathing is superficial, gasping or apneal; bradycardia, subnormal t°, unconsciousness, seizures; p O_2 decreased t° 50–40 mm Hg; p CO_2 increased t° 70–100 mm Hg;

Diagnostic criteria of adnovirus infection:

- Sporadic morbidity and epidemic flashes.
- Winter seasonality, possible flashes in summer.
- Latent period is 2–12 days.
- Acute beginning.
- The first symptom is a catarrh of upper respiratory tract.

- Toxic syndrome is moderate.
- Conjunctivitis.
- Lymphoprolipherative syndrome (acute viral tonsillitis, neck lymph nodes enlargement, hepatomegaly, rare splenomegaly).
- Intestinal syndrome.
- Peculiarities in infants: often dyspeptic syndrome (vomiting, diarrhea), bronchitis, interstitial pneumonia, rare – lymph nodes enlargement, conjunctivitis.

Diagnostic criteria of RS-infection:

- Latent period is 3–7 days.
- Winter seasonality.
- Acute beginning.
- The children of senior age have mild forms (as an acute bronchitis).
- Croup is less common.
- Peculiarities in infants: often bronchiolitis, interstitial pneumonia.

Diagnostic criteria of Rhinovirus infection:

- Epidemic flashes (in winter, in autumn)
- Latent period is 1–5 days.
- Intoxication is absent or mild.
- Acute rhinitis with large effusion (mucous) from the first days of illness.
- Often bacterial complications (later – purulent effusion from the nose).
- Peculiarities in infants: rhinoviral infection with often development of tracheobronchitis.

Laboratory and instrumental investigations:

- Identification of virus from nasopharyngeal smears (also feces or blood in adenovirus infection) by culture, immunofluorescence, or ELISA.
- Serologic diagnosis to find antibodies against viruses (Complement Binding Reaction - CBR, DHAR) with fourfold increasing of antibodies titre in 10–14 days may be used.
- Polymerase chain reaction.
- In CBC mainly leucopenia (normocytosis) with relative lymphomonocytosis.

Complications of acute respiratory viral infections

- Otitis
- Acute attack of the chronic tonsillitis
- Maxillary sinusitis and polysinusitis
- Bronchitis
- Pneumonia, often segmental, polysegmental, lobar
- Infection of the urinary tract
- Myocarditis, pancarditis
- Meningoencephalitis
- Gastrointestinal disorders

Treatment of acute respiratory viral infections:

- Bed rest up to the normalization of body temperature
- Vitaminized milk-vegetable food
- Adequate rehydration with oral fluids

The indication for the hospitalization:

- young children with severe forms of ARVI, bronchitis, bronchiolitis with the respiratory failure grade 2–3 who live in unfavorable conditions;
- newborns with the compromised premorbid background.

Medicamentous therapy

- Etiotropic: antiviral drugs are effective within the first 2-3 days of the disease (Arbidol, Remantadin, Amyxin, Interferons, DNAse, RNAse, Inosini pranobex, etc).
- Symptomatic therapy:
- Control of fever – when the t° is more than 38.5°C in children elder 3 months; in children before 3 months and in case of perinatal CNS damage, seizures in the history, severe heat diseases – when the t° is more than 38°C with acetaminophen 10–15 mg/kg per dose or ibuprophen 5–10 mg/kg per dose;
- Nasal drops (in infants before 6 mo – only physiologic saline solutions; in elder children – decongestants)
- In case of dry cough – cough suppressors
- Mucolytics in case of the moist nonproductive cough
- Antihistamine drugs in the case of allergic symptoms.

Antibiotics are appointed

1) In case of complications caused by bacteria, mycoplasma or chlamydia, as:

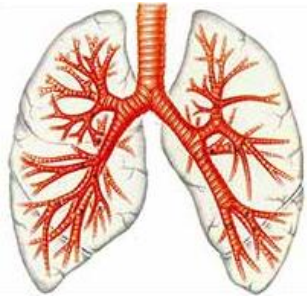
- Middle otitis
- Sinusitis
- Acute tonsillitis
- Bronchitis
- Pneumonia

2) At suspicion of secondary bacterial infection, children that are risky for bacterial infection development, with body temperature >38°C more than 3 days, leukocytosis more than 15×10^9/l

Prevention of URVI:

- Adherence to the antiepidemic regimen (to avoid a contact with person which has signs of ARVI, to ventilate an apartment more frequent, to teach children not to stay with the patients nearer than on one and a half – two meters, ill children must stay at a home, the moist cleaning up of apartments is needed not less than two times a day);
- Sanitization of the foci of chronic infection;
- Increase of the resistance;
- Immunization as prophylactic measure against influenza.

BRONCHITIS



Epidemiology

Data collected from the National Ambulatory Care Survey 1991 Summary showed that 2,774,000 office visits by children younger than 15 years resulted in a diagnosis of bronchitis. Although the report did not separate diagnoses into acute and chronic bronchitis, the frequency of visits made bronchitis just slightly less common than otitis media and slightly more common than asthma. However, in children, asthma is often underdiagnosed and is frequently misdiagnosed as chronic or recurrent bronchitis. Since 1996, 9–14 million Americans have been diagnosed with chronic bronchitis annually.

Bronchitis, both acute and chronic, is prevalent throughout the world and is one of the top 5 reasons for childhood physician visits in countries that track such data. The incidence of bronchitis in British schoolchildren is reported to be 20.7%.

Weigl et al noted an overall increase in hospitalization for lower respiratory tract infection (laryngotracheobronchitis, bronchitis, wheezing bronchitis, bronchiolitis, bronchopneumonia, pneumonia) among German children from 1996 to 2000; this is consistent with observations among children from the United States, United Kingdom, and Sweden. The incidence rate of bronchitis in children in this German cohort was 28%.

Differences in population prevalences have been identified in patients with chronic bronchitis. For example, because of the association of chronic bronchitis with asthma and the concentration of asthma risk factors among inner-city populations, this population group is at higher risk.

The incidence of acute bronchitis is equal in males and females. The incidence of chronic bronchitis is difficult to state precisely because of the lack of definitive diagnostic criteria and the considerable overlap with asthma. However, in recent years, the prevalence of chronic bronchitis has been reported to be consistently higher in females than in males.

Acute (typically wheezy) bronchitis occurs most commonly in children younger than 2 years, with another peak seen in children aged 9–15 years. Chronic bronchitis affects people of all ages but is more prevalent in persons older than 45 years.

Acute bronchitis is a clinical syndrome produced by inflammation of the trachea, bronchi, and bronchioles. In children, acute bronchitis usually occurs in association with viral respiratory tract infection. Acute bronchitis is rarely a primary bacterial infection in otherwise healthy children.

Classification of bronchitis

Forms of bronchitis:

- acute:
  acute bronchitis (common)
  acute obstructive bronchitis
  acute bronchiolitis
- recurrent: acute attack, remission
- chronic:
  primary – the pathological process localized in bronchial tree;
  secondary – is a complication of another pathology (cystic fibrosis, congenital abnormality of bronchi, etc).

ICD–10

J20. Acute bronchitis
J20.0 Acute bronchitis caused by Mycoplasma pneumonia
J20.1 Acute bronchitis caused by Haemophilus influenzae (Pfeiffer's bacillus)
J20.2 Acute bronchitis caused by streptococcus
J20.3 Acute bronchitis caused by Coxsackie virus
J20.4 Acute bronchitis caused by parainfluenza virus
J20.5 Acute bronchitis caused by respiratory syncytial virus
J20.6 Acute bronchitis caused by rhinovirus
J20.7 Acute bronchitis caused by ECHO virus
J20.8 Acute bronchitis caused by other specified agents
J20.9 Acute bronchitis caused by unspecified

Acute bronchitis (common)

Acute bronchitis (common) is an acute inflammation of bronchial mucosa without the signs of obstruction. Acute bronchitis is generally caused by respiratory infections; approximately 90% are viral in origin, and 10% are bacterial.

Viral infections include the following:

- Adenovirus
- Influenza
- Parainfluenza
- Respiratory syncytial virus
- Rhinovirus
- Human bocavirus
- Coxsackievirus
- Herpes simplex virus

Secondary bacterial infection as part of an acute upper respiratory tract infection is extremely rare in non–smoke-exposed patients without cystic fibrosis or immunodeficiency but may include the following:

- S pneumoniae

- M catarrhalis
- H influenzae (nontypeable)
- Chlamydia pneumoniae (Taiwan acute respiratory [TWAR] agent)
- Mycoplasma species

Air pollutants, such as those that occur with smoking and from second-hand smoke, also cause incident bronchiolitis. Tsai et al demonstrated that in utero and postnatal household cigarette smoke exposure is strongly linked to asthma and recurrent bronchitis in children.

Other causes include the following:

- Allergies
- Chronic aspiration or gastroesophageal reflux
- Fungal infection

PATHOGENESIS OF ACUTE BRONCHITIS:

Viruses, which having tropism to epithelium of respiratory tracts, damage of epithelium of airways, inhibit protective properties of walls of bronchi, disturb of mucociliary clearance and generate conditions for development of bacterial inflammation. In addition, respiratory viruses could cause of damage of motor nerve endings and ganglia. It is cause disordered of nervous regulation and trophism of bronchial tree.

Acute bronchitis begins as a respiratory tract infection that manifests as the common cold. Symptoms often include coryza, malaise, chills, slight fever, sore throat, and back and muscle pain.

The cough in these children is usually accompanied by a nasal discharge. The discharge is watery at first, then after several days becomes thicker and colored or opaque. It then becomes clear again and has a mucoid watery consistency before it spontaneously resolves within 7-10 days. Purulent nasal discharge is common with viral respiratory pathogens and, by itself, does not imply bacterial infection.

Initially, the cough is dry and may be harsh or raspy sounding. The cough then loosens and becomes productive. Children younger than 5 years rarely expectorate. In this age group, sputum is usually seen in vomitus (ie, posttussive emesis).

Lungs may sound normal. Crackles, rhonchi, or large airway wheezing, if any, tend to be scattered and bilateral. The pharynx may be injected.

DIAGNOSTIC CRITERIA OF ACUTE BRONCHITIS:

- At the beginning of disease the cough is dry, since the second week the cough becomes wet and productive, then the cough disappear gradually.
- Palpation and percussion do not reveal the alterations in the lung.
- Auscultation reveals the rough breath sounds with extended expiration. The rale are heard on both sides in various divisions of the lungs. The rale change when the child coughs. In the beginning, the dry rale are evident, later the moist rale appear (medium and large bubbling rale, rare – small bubbling.
- The respiratory failure and intoxication symptoms are not evident.

- CBC – sometimes, the increased ESR is evident while the leukocyte count is normal or decreased.

- In chest X-ray, the lung pattern is enhanced with the broadened nondistinct shadow of the root of the lung (*image 1*).

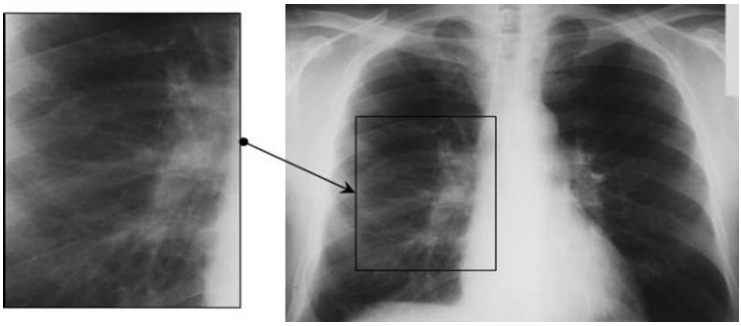


Image 1 – The chest X-ray of patient with bronchitis

TREATMENT OF ACUTE BRONCHITIS:

- Etiologic therapy takes into account the fact that 90–92% of acute bronchitis are caused by viral infection: antiviral drugs are effective within the first 2–3 days of the disease.
- Expectorant and mucolytic drugs.
- Antitussive drugs in low productive, dry cough.
- In hyperthermia, antipyretic drugs are used (paracetamol, ibuprofen).

Medical therapy generally targets symptoms and includes use of analgesics and antipyretics. Antitussives and expectorants are often prescribed but have not been demonstrated to be useful. Few data outside of the research laboratory support the efficacy of expectorants.

The prototype antitussive, codeine, has been successful in some chronic-cough and induced-cough models, but few clinical data address their use in acute bronchitis. The data that are available suggest little benefit. Data show codeine is little or no better than guaifenesin or dextromethorphan in cough suppression.

Preliminary studies suggest a possible role for EPs 7630, an herbal drug preparation derived from Pelargonium sidoides roots, in the treatment of pediatric patients (1–18 y) with acute bronchitis outside the strict indication for antibiotics. Kamin et al demonstrated reduced bronchitis severity symptom scores in patients treated with EPs 7630, with good overall tolerability.

INDICATIONS FOR USE ANTIBIOTICS IN ACUTE BRONCHITIS:

- The age below 6 months
- The compromised premorbid background (premature birth, birth injury, hypotrophy, etc.)
- The active chronic foci of infection (tonsillitis, otitis, etc.)

Suspected concomitant bacterial infection:

- fever with elevation of body temperature above 39°C;
- flaccidity, refusal of food;
- pronounced intoxication;
- Asymmetry of rale;
- leukocytosis, increased ESI.

OBSTRUCTIVE BRONCHITIS

Obstructive bronchitis is acute inflammation, predominantly in the mucosa of the small bronchi with the obstruction of airways.

Etiology of obstructive bronchitis in children is viral infections in 90–95% causese (RS-virus, parainfluenza, adenovirus, cytomegalovirus).

Committee of experts World Health Organization (WHO) defines obstruction of airways as narrowing or occlusion of airways.

Leading mechanisms of obstructive syndrome are the following:

1. Reversible (functional), endobronchial:

- spasm of smooth muscles of bronchi;
- inflammatory edema, swelling, infiltration of mucous and submucous of bronchi during inflammatory process;
- disturbance of mucociliary clearance: hypersecretion of viscous sputum.

2. Irreversible:

- expiratory collapse of small bronchial tubes («an air trap»)
- congenital or acquired tracheobronchial pathology – a dyskinesia of membranous parts of a trachea and the main bronchial tubes;
- remodulation of bronchial tubes (their recalibration and narrowing owing to fibrosis) (*image 2*).

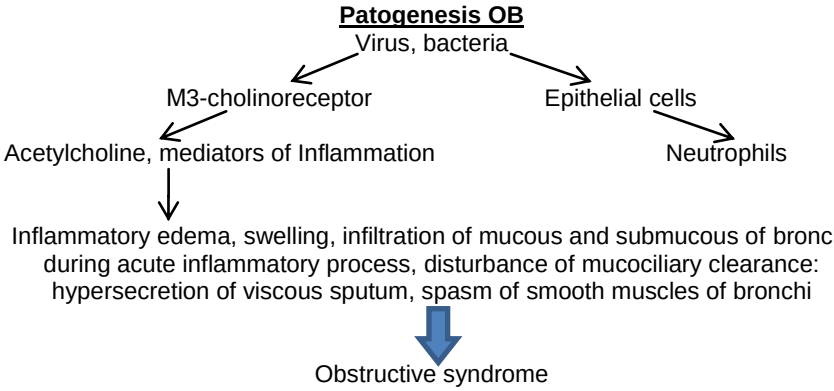


Image 2. Scheme of obstructive syndrom mechanism

PREDISPOSING FACTORS OF OBSTRUCTIVE SYNDROME IN CHILDREN:

Anatomico-physiological peculiarity of respiratory tract of infancy:

- The narrowness of bronchi and airway considerably increase aerodynamic resistance;
- Pliability of cartilages of airway;
- Inadequate rigidity of thorax: intercostal retraction following increase of pressure in airway;
- Structural peculiarity of bronchial wall: large quantity of goblet cells; increased viscosity of bronchial mucus, which accompanied with high level of sialic acid.

Obstructive syndrome is more probable, if affected distal bronchial tubes.

DIAGNOSTIC CRITERIA OF OBSTRUCTIVE BRONCHITIS:

- Deterioration of the general patient's condition with the catarrhal symptoms;
- The body temperature in most case is normal or low grade fever;
- Persistent, "spastic" cough;
- The symptoms of the bronchial obstruction:
- Enlargement of anterioposterior chest size;
- The horizontal positions of the ribs;
- The prolapse of the diaphragm;
- Band-box percussion sounds;
- Auscultation: the rough breath sounds, the extended expiration, dry rale wheezing is evident with medium and large bubbling muffled rale.

X-ray:

- strengthened lung figure, at the same time absence of focal shadow;
- signs of disturbances of bronchial permeability: irregular pneumatisation of lungs (focus of hyper- and hypoventilation), lobular atelectasis.

Laboratory

- hematological: normal leukocyte count or leukopenia, lymphocytosis, monocytosis. ESR is slitly increased.

Differential diagnosis of acute bronchitis is associated with acute bronchiolitis, pneumonia; obstructive bronchitis – with bronchial asthma paroxysm.

THERAPY OF OBSTRUCTIVE BRONCHITIS:

Etiology therapy: antiviral or antibacterial.

Pathogenesis therapy: bronchodilators:

- β_2-adrenomymetics+cholynolitics, theophyllins;
- Mucolytics and expectorants of synthetic or herbal origin

ACUTE BRONCHIOLITIS:

Acute bronchiolitis – acute inflammation in the mucosa of small bronchi and bronchioles, predominantly in young children with the concomitant obstruction of respiratory ways.

ETIOLOGY:

- Respiratory syncytial virus (RSV) (>50%)
- Parainfluenza
- Adenovirus
- Mycoplasma

ICD-10

J21 Acute bronchiolitis
J21.0 Acute bronchiolitis caused by respiratory syncytial virus
J21.8 Acute bronchiolitis caused by other specified
J21.9 Acute bronchiolitis non-specified

PATHOPHYSIOLOGY OF ACUTE BRONCHIOLITIS:

- Acute bronchiolitis is characterized by bronchiolar obstruction due to edema and accumulation of mucus and cellular debris and by invasion of smaller bronchial radicles by virus.

- Minor thickening of the bronchiolar wall in infants may profoundly affect airflow (because resistance to airflow in a tube is inversely related to the fourth power of the radius)

- Resistance in small air passages is increased during the inspiratory and expiratory phases, but because the radius of an airway is smaller during expiration, the resultant ball valve respiratory obstruction leads to early air trapping and overinflation. Atelectasis may occur when an obstruction becomes complete and trapped air is absorbed.

- The pathologic process impairs the normal exchange of gases in the lung. Ventilation perfusion mismatch results in hypoxemia, which occurs early in the course. The higher the respiratory rate, the lower is the arterial oxygen tension. Hypercapnia usually does not occur until respirations exceed 60/min; it then increases in proportion to the tachypnea.

CLINICAL MANIFESTATIONS OF ACUTE BRONCHIOLITIS:

- Catarrhal symptoms, the symptoms of rhinitis, nasopharyngitis, body temperature in most case is 38.5–39°C;

- Respiratory failure, the expiratory dyspnea, the cyanosis of nasolabial triangle, enlargement of anterioposterior chest size, the horizontal positions of the ribs;

- Percussion: tympanic percussion sounds;

- Auscultation: the rough breath sounds, the extended expiration, widespread fine crackles, The significant tachycardia with the weekend heart sounds;

- Cyclic course: the disease continues for 6–8 days and to 8–10th day it may be complete recovery.

DIAGNOSTIC CRITERIA OF ACUTE BRONCHIOLITIS

- In chest X-ray, the lung pattern is enhanced, the transparence of the lungs increases due to the emphysema, the bronchial pattern is also enhanced;
- The white blood cell and differential counts are usually normal; ESR is normal or slightly increased.
- Viral testing (usually rapid immunofluorescence, polymerase chain reaction, or viral culture) is helpful if the diagnosis is uncertain or for epidemiologic purposes.

TREATMENT OF ACUTE BRONCHIOLITIS

- Infants with respiratory distress should be hospitalized;
- The patient is placed in an atmosphere of cool, humidified oxygen to relieve hypoxemia;
- Oral intake must often be supplemented or replaced by parenteral fluids to offset the dehydrating effect of tachypnea;
- Antiviral agent (Ribavirin)
- Corticosteroids
- Antibiotics have no therapeutic value unless there is secondary bacterial pneumonia
- Bronchodilating aerosolized drugs (e.g., albuterol)
- Some patients may progress rapidly to respiratory failure, requiring ventilatory assistance.

Recurrent bronchitis

Is the disease with relapsing of acute bronchitis 2 and more times a year during 1–2 years. The absence of clinical obstruction and duration of clinical manifestation for 2 weeks and longer every relapse are common.

Recurrent episodes of acute or chronic infectious bronchitis are unusual in children and should alert the clinician to the likelihood of asthma. Bronchitis is often repeatedly diagnosed in children in whom asthma has remained undiagnosed for many years.

Similarly, a family history of asthma in parents or siblings may be masked within a history of “recurrent bronchitis.” The diagnosis of "asthmatic bronchitis" or "wheezy bronchitis" is simply asthma.

Recurrent episodes of acute or chronic bronchitis may be associated with immunodeficiency. Stiehm identifies the 4 most common immunodeficiencies in pediatric patients:

- Transient hypogammaglobulinemia of infancy (THI)
- Immunoglobulin G (IgG) subclass deficiency
- Impaired polysaccharide responsiveness (partial antibody deficiency)
- Selective IgA deficiency (IgAD)

A summary of immunodeficiency registries in 4 countries listed IgAD in 27.5% of the patients, IgG subclass deficiency in 4.8%, and THI in 2.3%. Patients typically have normal cellular immune systems, phagocyte function, and complement levels. All 4 immunodeficiency states are characterized by recurrent bacterial respiratory infections, such as purulent rhinitis, sinusitis, otitis, and bronchitis. Some patients with selective immunodeficiency may benefit from the use of intravenous immunoglobulin (IVIG), and the long-term prognosis is generally excellent.

Ozkan studied immunoglobulin A (IgA) and IgG deficiency in children who presented with recurrent sinopulmonary infection and found that the overall frequency of antibody defects was 19.1%. IgA deficiency was observed in 9.3%, IgG subclass deficiency was observed in 8.4%, and both IgA and IgG subclass deficiencies were observed in 1.4%. The prevalence of IgA and/or IgG subclass deficiency was 25% in patients with recurrent upper respiratory tract infections, 22% in patients with recurrent pulmonary infections, and 12.3% in patients with recurrent bronchiolitis.

Common variable immunodeficiency is the most frequent of the primary hypogammaglobulinemias. In a Finnish study by Kainulainen et al of patients with common variable immunodeficiency receiving immunoglobulin replacement therapy, sinopulmonary infections were the most common clinical presentation: 66% had recurrent pneumonia, 60% had recurrent maxillary sinusitis, and 45% had recurrent bronchitis.

In the Kainulainen study, the mean interval from the time of onset of symptoms to diagnosis was 8 years. Evidence of chronic lung damage was noted in 17% of patients at the time of diagnosis, highlighting the importance of early recognition in the prevention of chronic pulmonary sequelae.

To improve the recognition of common variable immunodeficiency, the authors suggest consideration of this condition in patients with recurrent sinopulmonary infection. In addition to a low serum IgG concentration, measurement of specific antibody production is recommended to establish the diagnosis.

Phases of pathologic process:

- exacerbation,
- remission.

Chronic bronchitis

Is a chronic spread inflammatory damage of bronchi with rebuilding of mucous secretory apparatus and sclerotic degeneration of deep layers of bronchial wall. Chronic bronchitis has also been defined as a complex of symptoms that includes cough that lasts more than 1 month or recurrent productive cough that may be associated with wheezing or crackles on auscultation.

Chronic bronchitis may be caused by repeated attacks of acute bronchitis, which can weaken and irritate bronchial airways over time, eventually resulting in chronic bronchitis. Industrial pollution is also a common cause; however, the chief culprit is heavy long-term cigarette smoke exposure.

Pathophysiology:

In children, chronic bronchitis follows either an endogenous response (eg, excessive viral-induced inflammation) to acute airway injury or continuous exposure to certain noxious environmental agents (eg, allergens or irritants). An airway that undergoes such an insult responds quickly with bronchospasm and cough, followed by inflammation, edema, and mucus production. This helps explain the fact that apparent chronic bronchitis in children is often actually asthma.

Mucociliary clearance is an important primary innate defense mechanism that protects the lungs from the harmful effects of inhaled pollutants, allergens, and pathogens. Mucociliary dysfunction is a common feature of chronic airway diseases.

The mucociliary apparatus consists of 3 functional compartments: the cilia, a protective mucus layer, and an airway surface liquid (ASL) layer, which work together to remove inhaled particles from the lung. Animal study data have identified a critical role for ASL dehydration in the pathogenesis of mucociliary dysfunction and chronic airway disease. ASL depletion resulted in reduced mucus clearance and histologic signs of chronic airway disease, including mucous obstruction, goblet cell hyperplasia, and chronic inflammatory cell infiltration. Study animals experienced reduced bacterial clearance and high pulmonary mortality as a result.

The role of irritant exposure, particularly cigarette smoke and airborne particulates, in recurrent (wheezy) bronchitis and asthma is becoming clearer. Kreindler et al demonstrated that the ion transport phenotype of normal human bronchial epithelial cells exposed to cigarette smoke extract is similar to that of cystic fibrosis epithelia, in which sodium is absorbed out of proportion to chloride secretion in the setting of increased mucus production. These findings suggest that the negative effects of cigarette smoke on mucociliary clearance may be mediated through alterations in ion transport.

McConnell et al noted that organic carbon and nitrogen dioxide airborne particulates were associated with the chronic symptoms of bronchitis among children with asthma in southern California.

A chronic or recurrent insult to the airway epithelium, such as recurrent aspiration or repeated viral infection, may contribute to chronic bronchitis in childhood. Following damage to the airway lining, chronic infection with commonly isolated airway organisms may occur. The most common bacterial pathogen that causes lower respiratory tract infections in children of all age groups is Streptococcus pneumoniae. Nontypeable Haemophilus influenzae and Moraxella catarrhalis may be significant pathogens in preschoolers (age <5 y), whereas Mycoplasma pneumoniae may be significant in school-aged children (ages 6–18 y).

Children with tracheostomies are often colonized with an array of flora, including alpha-hemolytic streptococci and gamma-hemolytic streptococci. With acute exacerbations of tracheobronchitis in these patients, pathogenic flora may include Pseudomonas aeruginosa and Staphylococcus aureus (including

methicillin-resistant strains), among other pathogens. Children predisposed to oropharyngeal aspiration, particularly those with compromised protective airway mechanisms, may become infected with oral anaerobic strains of streptococci.

Phases of pathological process:

- exacerbation
- remission

Clinical chronic bronchitis:

- productive cough for several months during 2 years;
- permanent various rales;
- 2–3 relapses in a year during 2 years;
- the signs of lungs ventilation disturbances in remission phase.

Note: none of the above mentioned signs may be regarded alone as reliable evidence of chronic bronchitis. The sings must be considered in complex in view of possible development of chronic process.

Brunton et al noted that adult patients with chronic bronchitis have a history of persistent cough that produces yellow, white, or greenish sputum on most days for at least 3 months of the year and for more than 2 consecutive years. Wheezing and reports of breathlessness are also common. Pulmonary function testing in these adult patients reveals irreversible reduction in maximal airflow velocity.

DIAGNOSTIC CRITERIA OF CHRONIC BRONCHITIS:

X-ray, especially bronchography:

- increasing and deformity of lungs figure, the disturbances of root of the lungs structure.

Bronchoscopy gives information about the character of endobronchitis. It is of great value for differential diagnosis.

Primary chronic bronchitis is diagnosed after exclusion of cystic fibrosis, bronchial asthma, lungs and cardiovascular malformations, ciliary dysgenesis.

Emergency care for acute bronchitis or exacerbation of chronic bronchitis must focus on ensuring that the child has adequate oxygenation. Outpatient care is appropriate unless bronchitis is complicated by severe underlying disease. General measures include rest, use of antipyretics, adequate hydration, and avoidance of smoke.

Proper care of any underlying disorder is of paramount importance. Recognition of the role of asthma and institution of appropriate therapies are key to the successful treatment of many patients.

Febrile patients should increase oral fluid intake. Instruct the patient to rest until the fever subsides.

Resolution of symptoms, normal findings on physical examination, and normal pulmonary function test results indicate the end of the need for acute treatment. Patients in whom asthma is diagnosed will likely require ongoing

therapy for that disease. Patients with defined hypogammaglobulinemia may need periodic immunoglobulin replacement treatments. These are best coordinated with the assistance of a pediatric allergy, immunology or pulmonary specialist.

Consider the following in the diagnosis of bronchitis in pediatric patients:

- Retained foreign body
- Bronchopulmonary allergy
- Immunosuppression

Chronic bronchitis is often part of an underlying disease process, such as asthma, cystic fibrosis, dyskinetic cilia syndrome, foreign body aspiration, or exposure to an airway irritant. Recurrent tracheobronchitis may also be seen in patients with tracheostomy or with certain forms of immunodeficiency. In all of these patient groups, chronic bronchitis should not be the primary diagnosis, because it does not describe the pathology of the underlying disorder.

Testing in Hospitalized Children

For hospitalized children, serum C-reactive protein screen, respiratory culture, rapid diagnostic studies, and serum cold agglutinin testing (at the appropriate age) help to classify whether the infection is caused by bacteria, atypical pathogens (eg, Chlamydia pneumoniae, Mycoplasma pneumoniae), or viruses. Obtain a blood or sputum culture if antibiotic therapy is under consideration.

For the child admitted to the hospital with a possible chlamydial, mycoplasmal, or viral lower respiratory tract infection for which specific therapy is considered, test nasopharyngeal secretions for these pathogens, using antigen or polymerase chain reaction testing for Chlamydia species and respiratory syncytial, parainfluenza, and influenza viruses or viral culture. Results will guide appropriate antimicrobial selection.

For the child who has been intubated, collect a specimen of deep respiratory secretions for Gram stain, chlamydial and viral antigen assays, and bacterial and viral cultures.

Cystic Fibrosis Testing

Many states are now using tests for immunoreactive trypsinogen (IRT) coupled with cystic fibrosis transmembrane receptor (CFTR) mutational analyses in newborn screening programs. In newborns with positive results, sweat testing is required to diagnose or rule out cystic fibrosis.

In the United States, sweat chloride analysis using pilocarpine iontophoresis is typically conducted at accredited or affiliated pediatric cystic fibrosis centers. According to recommendations from the US Cystic Fibrosis Foundation (CFF) and the European Cystic Fibrosis Society (ECFS), sweat chloride results for infants aged 6 months or younger are classified as normal (chloride levels $\leq$29 mmol/L), abnormal (chloride levels $\geq$60 mmol/L), or intermediate/equivocal (chloride levels 30–59 mmol/L). If results fall within

the intermediate/equivocal diagnosis range, the CFF recommends a repeat sweat test within 2 months.

Additional testing may include comprehensive CFTR analysis, fecal elastase evaluation, and pulmonary cultures. Although the sensitivity of newborn screening is high, sweat chloride testing may also be pursued for infants or children with recurrent respiratory infection, chronic diarrhea, or failure to thrive who had negative newborn screening results for cystic fibrosis.

Immunodeficiency Testing

For children in whom immunodeficiency is suspected, measurement of total serum immunoglobulins, immunoglobulin G (IgG) subclasses, and specific antibody production is recommended to establish the diagnosis.

Chest Radiography

Chest radiography is typically not warranted but, if obtained, appears normal in most patients with uncomplicated bronchitis. Abnormal findings are minimal and may include atelectasis, hyperinflation, and peribronchial thickening. Focal consolidation is not usually present. These findings are similar to the radiographic findings in patients with asthma. Radiographic findings may help exclude other diseases or complications, particularly when abnormalities in either vital signs or pulse oximetry findings are present.

Pulmonary Function Testing

Pulmonary function tests may show airflow obstruction that is reversible with bronchodilators. Bronchial challenge, such as with exercise or with histamine or methacholine exposure, may demonstrate the airway hyperreactivity characteristic of asthma.

Bronchoscopy

On fiberoptic bronchoscopy, a diagnosis of chronic bronchitis is suggested if the airways appear erythematous and friable. Bronchoalveolar lavage may be useful in establishing an infectious cause. Bronchoalveolar lavage may reveal numerous monocytic or polymorphonuclear inflammatory cells. In children with chronic aspiration of gastric contents, lipids may be present within macrophages.

Therapy

Antibiotics should not be the primary therapy. They usually do not result in a cure and may delay the start of more appropriate asthma therapies. However, antibiotics may be appropriate in children with chronic wet cough and symptoms persisting beyond 2–4 weeks, most of whom have protracted bacterial bronchitis.

Bronchodilator therapy should be considered and instituted; a beta-adrenergic agonist, such as albuterol or terbutaline may be effective. Several studies have demonstrated that bronchodilators delivered by metered dose

inhalers with spacer device are as, or in some cases more effective, in all age groups than nebulized bronchodilators.

In the child who continues to cough despite a trial of bronchodilators and in whom the history and physical examination suggest a wheezy form of bronchitis, corticosteroids should be added. Short courses of dexamethasone (1-2 dose schedules) have been shown to be as effective as longer (5 d) courses of prednisolone; this was preferred by caretakers likely due to the reduced need to administer medication and a lower incidence of vomiting. "Stepped-up" courses of inhaled corticosteroids may also be effective for some patients.

If the response to initial therapies is suboptimal or if fever persists, antibiotic therapy with an agent such as a beta-lactamase–resistant antimicrobial or macrolide may be considered. Certain antibiotics including the macrolides and fluoroquinolones have the potential to prolong the QT interval and in studies have been associated with a higher risk for lethal arrhythmias.

Subsequent studies have demonstrated no added risk for adverse cardiovascular events among young and middle-aged adults taking azithromycin who do not have cardiovascular risk factors. Due to potential concerns, the US Food and Drug Administration (FDA) updated its warning for azithromycin with information related to the risk of QT interval prolongation and torsades de pointes, a specific, rare heart rhythm abnormality. Care must be exercised when considering these medications, particularly in patients with congenital or acquired forms of long QT syndrome, forms of congenital or acquired heart disease, patients with bradyarrhythmias, hypokalemia, hypocalcemia, or hypomagnesemia and those taking other medications known to be associated with QTc prolongation. Giudicessi and Ackerman (2013) provide a table of factors to consider when assessing this risk.

Chronic obliterating bronchiolitis (COB)

Is chronic inflammatory bronchial disease of viral or immunopathological origin which appears as a result of bronchi or bronchioles obliteration of one or several lungs lobes. It leads to lungs blood circulation disorders and development of emphysema.

Phases of pathologic process: relapse, remission.

Forms of COB.: total one-sided, focal one-sided, focal two-sided, partial

Criteria of chronic obliterating bronchiolitis:

I. Clinical:

- severe respiratory infection with obstructive syndrome in case history;
- persistent fine bubbling rales under the weakened breathing.

II. X-ray:

one-sided weakening of lung figure, lessening of the lung field size on bronchogramme – unfilling by contrast of bronchi of 5–6th level and lower; prominent decreasing of lung perfusion in zones of pathologic process.

Control question:

1. Etiologic factors in spasmodic croup are thought to include

A. allergy
B. viral infection
C. psychologic factors
D. gastroesophageal reflux
E. all of the above

2. A 4 mo old infant presents with a cough, irritability, breathlessness, wheezing. T – 38,2º. Physical examination reveals a pallor, peripheral cyanosis, expiratory dyspnea (68 resp/min) with participation of accessory muscles, widespread fine crackles, expiratory phase is prolonged. What investigation should be prescribed for differentiation with pneumonia?

A. X-ray
B. Bronchoscopy
C. Blood test
D. Spirography
E. C-reactive protein

3. A 1-year-old presents with an acute onset of cough, choking, and respiratory distress. Physical examination reveals a respiratory rate of 45 and wheezing. There is no family history of asthma, and no one at home is ill. The older sister states that they were both playing house and that they both had eaten granola (a mixture of rolled oats, brown sugar, nuts, fruit, etc). The most likely diagnosis is

A. anaphylaxis
B. bronchiolitis
C. cystic fibrosis
D. foreign body aspiration
E. angioedema

4. A 3-year-old has had a dry cough, rhinitis, low-grade fever for 3 days. Physical examination reveals that condition of child is satisfactory. T – 37,2º, Ps – 108/min, Resp. Rate – 26–28/min. Auscultation – roughening of breath sounds, coarse moist rales under both lungs. What diagnosis is probable?

A. acute bronchitis
B. laryngitis
C. pneumonia
D. nasopharyngitis
E. acute bronchiolitis

5. A 2-year-old previously well male is brought to you with fever (39.5º). His history is unremarkable. Which of the following drugs is optimal for administration?

A. Paracetamol 10–15 mg/kg
B. Aspirin 20–30 mg/kg
C. Indomethacin 2–3 mg/kg
D. Augmentin 25–50 mg/kg
E. Diazepam 0,2–0,5 mg/kg

6. A 5 mo old infant presents with a cough, irritability, breathlessness, wheezing. T – 37,6°C. Physical examination reveals a pallor, peripheral cyanosis, expiratory dyspnea (68 resp/min) with participation of accessory muscles, widespread fine crackles, expiratory phase is prolonged. The most appropriate diagnosis is

A. acute bronchitis
B. laryngitis
C. pneumonia
D. cystic fibrosis
E. acute bronchiolitis

7. A 1-year-old child has had a dry cough, rhinitis, low-grade fever for 2 days. Physical examination reveals that condition of child is satisfactory. T – 37,5ºC, Ps – 108/min, Resp. Rate – 28/min. Auscultation – roughening of breath sounds, coarse moist rales under both lungs. What diagnosis is probable?

A. laryngitis
B. acute bronchitis
C acute bronchiolitis
D. nasopharyngitis
E. pneumonia

8. An 6-year-old female is noted to be underweight and not growing well. Past medical history reveals 3–4 episodes of prolonged bronchitis without bronchial obstruction every year for 3 years. What investigation should be prescribed for differentiation between chronic and recurrent bronchitis

A. bronchoscopy
B. blood test
C. stool á1-antitrypsin measurement
D. sweat chloride measurement
E. X-ray examination

9. What is the most causative agent in etiology of acute bronchiolitis

A. Streptococcus pneumonia
B. parainfluenza 3 virus
C. mycoplasma
D. respiratory syncytial virus
E. adenoviruses

10. Features of recurrent bronchitis are thought to include

A. Absence of bronchial obstruction
B. Prolonged course of bronchitis
C. Exacerbation of bronchitis 2-3 times/year for 2 or more years
D. Absence of irreversible changes in bronchi
E. All of the above.

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Навчальне видання

МОДУЛЬ 1
ЗМІСТОВИЙ МОДУЛЬ 2

ТЕМА 3, 4
ГОСТРІ РЕСПІРАТОРНІ ЗАХВОРЮВАННЯ ВЕРХНІХ ДИХАЛЬНИХ ШЛЯХІВ У ДІТЕЙ. БРОНХІТИ

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План 2015, поз. 72.
Формат А5. Ризографія. Ум. друк. арк. 1,5.
Зам. № 15-3274.

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Свідоцтво про внесення суб'єкта видавничої справи до Державного реєстру видавництв, виготівників і розповсюджувачів видавничої продукції серії ДК № 3242 від 18.07.2008 р.

MODUL 1
SUBSTANTIAL MODUL 2

THEME 3, 4
ACUTE INFLAMMATORY DISEASES OF UPPER RESPIRATORY TRACT IN CHILDREN. BRONCHITIS

Practical policies for students