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V.N. Karazin Kharkiv National University

DIFFERENTIAL DIAGNOSIS OF INHERITED, CONGENITAL AND CHRONIC DISEASES OF RESPIRATORY TRACT IN CHILDREN

Methodical recommendations
for medical students of the 6th years of study

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INTRODUCTION

Chronic bronchopulmonary diseases take a significant place in children disorders (diagnosed in 1 % of children), whereas hereditary and congenital diseases occur in 10% of patients. Macroorganism status and environmental factors play an important role in their development. Developing in childhood, chronic nonspecific lung diseases are some of the important causes of health deterioration and early morbidity of adult population. Considering multifactoriality of these diseases, their prevention should be provided by specialists of various fields.

GENERAL CHARACTERISTICS OF CHRONIC BRONCHOPULMONARY DISEASES IN CHILDREN

Chronic bronchopulmonary pathology is an inflammatory process of infectious origin which is recurring, usually bronchogenic, and is based on functional and organic lesions of the bronchi, vessels, parenchyma and interstitial tissue of the lungs, pleura, resulting in development of sclerosis.

Chronic bronchopulmonary diseases include chronic bronchitis, chronic oblitering bronchiolitis, bronchoectatic diseases, interstitional diseases, congenital and hereditary diseases of the respiratory system.

The clinic is manifested as symptoms of general nature and directly related with the bronchopulmonary system. It should be remembered that in 80% of cases chronic bronchopulmonary pathology occurs in the first 3 years of life and approximately 50% in the first year of life, when it is difficult to make diagnosis at the initial stage. It is necessary to clarify the frequency of respiratory episodes in a child, and their duration. With increasing frequency of these episodes, their duration and probability of chronization of the process increase.

Coughing is a reflex aimed at self-purification of the respiratory tract from mucus, pus, blood, foreign bodies, and other particles, which are normally not present in the bronchial tree. In chronic respiratory pathology there is proliferation of the bronchial mucosa in relation to the inflammatory reaction, hypersecretion of glands, disorder of peristalsis, accumulation of mucus and pus, compression of the bronchi and trachea by the enlarged lymph nodes. Cough is mostly loose, accompanied by sputum, in case of emphysema it is severe, unproductive, in remission – it is dry.

Sputum is puromucous or purulent, more often in the morning. It is not a three-layer, as in adults, in small quantities (30-50 ml), it is difficult to obtain it, because in most cases children cannot expectorate. For bacteriological examination sputum is taken during bronchoscopic lavage or after digital pressure with a spatula on the tongue root, which causes reflex cough with expectoration.

Cyanosis appears at exacerbation of chronic respiratory pathology or with the development of chronic pulmonary vascular disease, when it is constant and, depending on the activity of the pathological process, only its intensity changes. Often increase in the body temperature is observed, accompanied by hyperhidrosis. In moderate and severe cases chest deformation is evident. It means the pathological process affected a significant area of in the lungs and long-term hypoxemia.

"Chicken" or "pigeon" chest and depressed sternum are the signs of chronic bronchopulmonary diseases in preschool age; barrel chest – in schoolchildren. The asymmetry of the chest, deformation, a marked decrease in the size of the half

of it when measuring with centimeter tape – all this makes it possible to analyze the severity, duration and localization of the process during the inspection.
Shortness of breath at chronic bronchopulmonary disease is mixed, sometimes expiration. "Drum stick fingers" and "watch glass" nails are the signs of prolonged hypoxemia.

Percussion reveals bandbox sound (emphysema), at marked sclerotic changes shortening is detected. Auscultation at exacerbation reveals diversity of dry and moist rales. Constant local fine bubbling moist rales are the criteria of chronic bronchopulmonary disease.

Cardiovascular system. Expansion of the right heart, accent of the second tone in the pulmonary artery, weak tones and functional systolic murmur, the ECG changes show myocardial hypoxia.

Digestive system. Appetite is reduced, the liver is increased in size, its function is disrupted, there are disorders in hydrolysis and absorption of food, in severe cases, a child retards in mass and growth. The skin is dry and is characterised by visible pallor, reduced flexibility, opacity; and the hair become brittle.
Sometimes there is short-term allergic rash, one-time rise of temperature (due to decreases drainage of purulent sputum).

Headache, fatigue, irritability, aggression, memory decline are the signs of CNS disorder. Pulmonary hemorrhage is very rare in children.

Investigations which are performed for children with chronic bronchopulmonary diseases: chest X-ray, bronchography, bronchoscopy, CT of the chest, sputum culture, tuberculin reaction is done to exclude tuberculosis, pilocarpine iontophoresis is done for estimating sweat chlorides in cases suspected to be suffering from cystic fibrosis.

CHRONIC BRONCHITIS

Chronic bronchitis is a common chronic inflammatory disorder of bronchi with the restructuring of the secretory apparatus of the mucous membrane and development of sclerotic changes in the deeper layers of the bronchial wall.

Pathogenic factors of chronic bronchitis include failure of mucociliary clearance; disorder of the drainage function; reduction of local immunity; hypertrophy and hyperfunction of the bronchial glands; decrease in proteolytic activity of tracheobronchial secretions; failure of nonspecific enzyme protection.

Primary chronic bronchitis is diagnosed if recurrent bronchitis, bronchial asthma, cystic fibrosis, abnormalities of the pulmonary and cardiovascular systems, ciliary dyskinesia syndrome, and other chronic lung diseases are excluded.

Secondary chronic bronchitis is a complication of congenital abnormalities of the lungs and cardiovascular system, cystic fibrosis, hereditary diseases of the lungs as well as the other specific bronchopulmonary processes.

There are 4 types of chronic bronchitis:

— common uncomplicated bronchitis;
— purulent bronchitis;
— obstructive bronchitis;
— purulent-obstructive bronchitis.

The phases of pathologic process are exacerbation or remission.

Clinical diagnostic criteria of chronic bronchitis

Clinical criteria for diagnosis of chronic bronchitis are an exacerbation of the process lasting for several months during 2 years or more; 2-3 exacerbations a year for at least 2 years; the signs of lung ventilation disorder during remission.

Cough in chronic bronchitis is usually productive. In the morning hacking cough can be unproductive, as a result of failure of the mucociliary transport that is evident only at night time. Sputum is different in nature, but increased viscosity prevails. Shortness of breath first appears in acute condition, later it increases after physical exertion.

On physical examination a doctor's attention can be drawn by chest deformity such as kyphosis, as well as such symptoms as drum sticks, limitation of excursion of the thorax during breathing, participation of auxiliary muscles when breathing.

Lung percussion reveals an empty box-like tone in the areas affected by emphysema, dull sound — in the areas of the inflammatory process. Auscultation reveals extended exhalation, and hard breathing; in emphysema — the breathing is weakened; in case of small bronchial tubes are affected — dry whistling rales are heard; in bronchiectasis, moist rales are of different caliber. The nature of intermittent wheeze may disappear after coughing. X-ray examination reveals disruption of the lung root structure, intensification and deformation of lung pattern, pneumosclerosis.

Methods of diagnosis of chronic bronchitis

1. A swab from the nose and throat to identify etiologic pathogens.
2. Sputum tests to identify pathogens and viruses.
3. X-ray examination.
4. Bronchoscopy and brush biopsy of bronchial mucosa (see Appendix).
5. Bronchography or computed tomography (CT).
6. Spirography
7. Pneumotachometry
8. Peakflowmetry

Basic principles of treatment

Etiotropic therapy of acute exacerbations of chronic bronchitis begins with considering a possible pathogen. Indication for prescription of antibiotics is an active bacterial process, indicator of which is a febrile temperature lasting for more than 3 days, as well as corresponding changes in the blood (leukocytosis and shift of blood formula to the left, accelerated ESR). Antibacterial drugs are prescribed depending on the type of bacterial pathogen.

In case of dry painful cough in the first days of the disease, cough medicines of central action are prescribed.

In obstructive syndrome, bronchodilators are prescribed: (beta-agonists of short action such as salbutamol, alupent, atrovent, fenoterol, etc, anticholinergic agents and drugs of theophylline (methylxanthines).

To liquefy and produce mucus, mucolytics (acetylcysteine, bromhexine) are prescribed.

Pathogenetic therapy of acute exacerbations of chronic bronchitis should include antioxidants and stabilizers of cell membranes, vitamin complexes with microelements.

To prevent the accelerated development of pulmonary fibrosis, the use of non-steroids that inhibit the activity of inflammatory mediators and enhance the therapeutic effect of antibiotics is indicated.

Breathing exercises include the elements of training the mechanisms or components of the respiratory act. The set of exercises should include static respiratory sound exercises for training an elongated exhale. In addition to static exercises, it includes dynamic respiratory exercises, when the physical exercises are combined with breathing exercises. Sputum removal is best achieved in the drainage position with the lowered upper part of the body, facilitated by vibratokry massage (manual or with the help of a vibrator).

In case the therapy of catarrhal-purulent and purulent endobronchitis turned to be ineffective, bronchoscopy sanitation is indicated.

BRONCHIECTATIC DISEASES

Bronchiectasis is an acquired disease with chronic local suppurative process (purulent endobronchitis) in irrevocably modified (extended, deformed) and usually functionally defected bronchi, which is manifested mainly in the lower parts of the lungs.

There is primary bronchiectasis as an independent nosological form (bronchiectasis) and secondary bronchiectasis as a complication of manifestations of other diseases (tuberculosis, abscesses, staphylococcal destruction of the lungs, etc.).

The following classification of bronchiectasis is the most modern one:

1. Origin: congenital, dysontogenetic acquired (atelectatic, emphysematous, mixed).

2. Form: cylindrical, bag-shaped, cystic.

3. Distribution: unilateral, bilateral (extensive, non-extensive) — with indication of the segments.

4. Severity: localized, diffuse.

5. Course: with exacerbations (frequent, rare).

Clinical symptoms

The cough is characterized by a constant character with purulent sputum, especially in the morning. Shortness of breath with limited bronchiectasis at rest usually does not bother, in bilateral lesions severe shortness of breath is pronounced on slight exertion and even at rest.

During the examination of a child, a doctor should pay attention to his/her developmental delay, and pale skin. Change of the fingers (drum sticks or "watch glasses") is found in patients with congenital bronchiectasis and in advanced cases.

Chest deformity is most pronounced in atelectatic bronchiectasis. Asymmetric deformations — retraction of the chest on the background of the disease, its lagging during respiration, shoulder blade lowering, rib convergence and intercostal space narrowing, scoliosis — are most common.

On percussion the most pronounced change determined in atelectatic bronchiectasis is shortening of percussion sound. In emphysematous bronchiectasis, percussion sound has an empty boxed tone.

Auscultation reveals various moist rales and crepitation, which decrease after sputum expectoration. Wheeze is usually heard in the morning. In the periods of exacerbation, auscultative changes are characterized by increased number of short and medium moist vesicular crepitation; dry wheezing can also be heard. Breathing over the lesion is usually weakened. Listening to the constant wheezing, and their stable localization in the period of remission may indicate bronchiectasis.

Methods of bronchiectasis diagnosis

Bronchiectasis is characterized by such rentgenologic features as the presence of atelectasis, and ring-like shadows. In cylindrical bronchiectasis without atelectasis a slight deformation of lung pattern, "heaviness" of lung roots can be detected. The accessory signs include a different contour of the heart in atelectatic bronchiectasis of the lower lobe of the left lung. In case the middle or lingular segments are suspected to be involved, the corresponding lateral radiograph is necessary.

In bronchoscopy of children, catarrhal, purulent, fibrinous-ulcerative bronchitis are more common; in case of foreign bodies — hemorrhagic and granulating bronchitis.

Bronchography is a contrast examination of the bronchial tree allowing to determine the localization of bronchiectasis, its extension, and form. Acquired bronchiectasis can be cylindrical, bag-like, mixed, accompanied with deforming bronchitis.

Angiopulmonography is of great importance in case of extensive bronchiectatic lesions (more than 9 segments). The lack of blood flow in the affected areas of the lung indicates their inability to function and requires the removal of those areas that are completely intoxicated.

Treatment

The treatment of bronchiectasis is surgical. The disease itself is an indication for surgical treatment. But it is not limited only to surgery. Conservative treatment is used as a preoperative preparation as well as in postoperative period. Later, rehabilitation and sanatorium-resort treatment is necessary.

CYSTIC FIBROSIS

Cystic fibrosis (CF) is a chronic, progressive genetic (congenital) disease of the mucous glands of the body. It primarily affects the respiratory and digestive systems of children and young people. As a rule, the sweat glands and reproductive system, can also be affected. On average, people with CF have a life expectancy of about 30 years.

Etiology and CF pathogenesis

It is known that cystic fibrosis is a consequence of gene mutations (in the middle of the long arm of chromosome 7), which is responsible for the molecular structure of the protein located in the membrane of the glandular cells lining the excretory ducts of the pancreas, intestine, respiratory system, urogenital tract and regulates electrolyte (mainly chloride) transport between these cells and intercellular fluid. The defective protein is destroyed, which leads to dehydration of the secretions, that is the secretions have increased viscosity. It results in the development of clinical symptoms and syndromes of the organs and systems mentioned above. The total number of mutations can exceed 500. There is mixed pulmonary intestinal form — 76.5%, primarily pulmonary — 21%, and predominantly intestinal — 2.5% of the patients. Bronchopulmonary changes dominate in the clinical picture, it determines its course and prognosis in 90-95% of patients with cystic fibrosis. Children can

inherit the changed genes from one or both parents. In CF, each parent carries one abnormal CF gene and one CF normal gene but shows no symptoms of the disease because the normal CF gene dominates or "slows down" the abnormal CF gene. To develop CF, a child must inherit two abnormal genes — one from each parent.

Most of the damage in CF is due to blockage of the narrow ducts of the affected organs with thick secretions.

Clinical manifestations

Increased sweating (in hyperthermia, significant physical exertion, high ambient temperatures) may lead to massive loss of electrolytes, hypochloremia, hyponatremia and development of collaptoid state with cellular hypotonic dehydration.

Gastrointestinal manifestations are intestinal obstruction, abdominal distention, exocrine pancreatic insufficiency, protein and fat malabsorption; frequent, large, bulky, foul-smelling stools and flatus, steatorrhea, vitamin A, D, E, K malabsorption, recurrent abdominal pain (RLQ may be confused with appendicitis), jaundice (cholestatic), GI bleeding.

Genitourinary manifestations: undescended testicles or hydrocele; late onset puberty due to chronic lung disease and inadequate nutrition; amenorrhea (20% of female patients are infertile); azospermia (more than 95% of male patients) due to obliteration of the vas deferens.

Respiratory syndrome most often begins to manifest itself at the age of 2 months to 1 year, or irrespective of intestinal syndrome, or concurrently. Pulmonary syndrome can start either with pneumonia or bronchial obstructive syndrome, or with a combination of these syndromes.

The disease begins with non-productive cough, painful like in whooping cough. Sputum, saliva, mucus in the nose in children is usually viscous, sticky, thick. The genesis of bronchial obstruction in cystic fibrosis is caused by impaired mucociliary clearance in connection with the phenomena of dyscrinia, dyskinesia, edema and hyperplastic processes.

Broncho-obstructive syndrome can be of protracted or recurrent nature. Purulent endobronchitis increases obstruction, which develops as a result of the accumulation of infection. The process involves small bronchi and bronchioles. As a result of persistent airway obstruction patients develop swelling of the lungs. The prolonged course of bronchopulmonary process results in bronchiectasis and pulmonary fibrosis. In cystic fibrosis patients often suffer atelectasis. Most children with cystic fibrosis lag in physical development due to chronic hypoxia and chronic intoxication as a result of bronchopulmonary changes.

Fingers and toes become deformed (drumsticks, "watch glass" nails). Percussion of the lungs reveals alternation of areas of shortening of pulmonary

sound with the sound of empty box. The presence of different-sized moist rales, which are heard constantly, is typical of cystic fibrosis. In some children, especially in the period of exacerbation, rales can be heard, and breathing is significantly weakened, mainly in the basal parts of the lungs due to accumulation of a large number of viscous sputum. During exacerbation of bronchopulmonary process, obstructive syndrome, shortness of breath, acrocyanosis tachycardia occurs or increases.

Potential complications of CF

Pneumothorax (~10% of CF patients), atelectasis, hemoptysis, bronchiectasis, cor pulmonale, respiratory failure, nasal polyps, chronic sinusitis with mucopyocele formation, hypertrophic pulmonary osteoarthropathy, allergic bronchopulmonary aspergillosis (ABPA), pulmonary hypertension and formation «cor pulmonare».

Gastrointestinal complications include gastroesophageal reflux, pancreatitis, cystic fibrosis–related diabetes mellitus, meconium ileus, distal intestinal obstruction syndrome, rectal prolapse, vitamin deficiency (especially fat-soluble vitamins), fatty liver, focal biliary cirrhosis, portal hypertension, liver failure, cholecystitis and cholelithiasis.

CF Diagnosis

1. Sweat test, a "gold standard" confirmation of CF diagnosis, is considered to determine the content of chlorides in sweat (Gibson-Cooke sweat test). The content of chloride in sweat higher 60 mEq/L corresponds to the diagnostic criteria of CF. The content of chloride in sweat from 40 to 60 mEq/L (in children of 6 to 29 months —30 to 60 mEq/L) is considered to be a questionable result of the sweat test. The concentration of sweat chloride is to be equal to 60 mmol/L or higher.

2. Molecular-genetic diagnostics of CF, analysis of the TMRP (transmembrane regulatory protein) gene mutation of cystic fibrosis.

3. Diagnostics of exocrine pancreatic insufficiency (maldigestion syndrome, malabsorption); determination of the level of neutral fat in feces; determination of the activity of fecal pancreatic elastase-1. Criteria for evaluating the results of determination of fecal pancreatic elastase-1 activity: normal — more than 200 μg / g of feces; moderate pancreatic insufficiency — 100 - 200 μg / g of feces; severe pancreatic insufficiency — less than 100 μg / g of feces.

4. Modern methods of screening: the method of radial immunodiffusion for the quantitative determination of albumin in meconium is sensitive when albumin concentration in meconium is greater than 20 mg /g of dry matter.

5. Test to determine the level of trypsin in a dry spot of blood by the method of radionuclide evaluation of trypsin-like immune reactivity.

Basic principles of CF treatment.

CF is a genetic disorder, so gene therapy at an early age is the only way to prevent or cure it. Ideally, gene therapy can restore or replace a defective gene. Today, the purpose of CF treating is to reduce the number and severity of exacerbations, maintain the function of the lungs and other internal organs and systems, extend the duration and improve the quality of life.

Children with a distinct malabsorption syndrome are prescribed a high-calorie diet, including the use of food for special medical purposes based on hydrolyzed proteins and medium chain fatty acids, supportive therapy, and physical therapy.

Some drugs should be used continuously during lifetime: enzymes for substitution therapy of exocrine pancreatic insufficiency (pancreatin), mucolytic drugs (alpha dornaza and hypertonic sodium chloride solution (3%), acetylcystine or carbocysteine (7%), bronchodilators for liquefying thick sputum, and fat soluble vitamins to overcome their deficiency. If necessary, antibiotic therapy is used. Bronchial tree drainage using special breathing exercises, vibration massage, coughing up, various methods of kinesiotherapy, should be performed daily, with special care, otherwise all the efforts and medications will not be effective.

Monitoring of CF patients

1. Assessment of physical development
2. Checking the function of the lungs (FZHEL, FEV1, pulmonary purification index, plethysmography), determination of saturated oxygen.
3. X-ray of the chest organs in the front and right side projections (computed tomography, if necessary).
4. Determination of the activity of fecal pancreatic elastase-1 (only in patients with the lack of clinical manifestations of pancreatic insufficiency).
5. Ultrasound examination of the abdominal cavity.
6. Glucose tolerance test in patients aged 12 years and older.

PULMONARY HEMOSIDEROSIS

Idiopathic Pulmonary Hemosiderosis

Idiopathic Pulmonary Hemosiderosis (IPH) is a disorder of unknown etiology that is characterized by recurrent or chronic hemorrhage in the alveoli and accumulation of hemosiderin pigment in the lungs.

IPH is still a rare disorder with an estimated incidence of 0.242 and 1.233 cases per million in selected populations. Pulmonary hemosiderosis is a condition seen more frequently in children than in adults. Only 20% are adult patients.

Clinically, it manifests as a triad of hemoptysis, diffuse parenchymal infiltrates on chest radiographs and iron deficiency anemia. Nonspecific recurrent or chronic pulmonary symptoms are cough (dry or productive), dyspnea, tachypnea, wheezing. Symptoms of chronic fatigue, severe exercise limitation, growth failure, pallor, finger clubbing, hepatosplenomegaly.

Goodpasteur's Syndrome

Goodpasteur's syndrome is characterized by hemoptysis, iron deficiency anemia, and glomerulonephritis. Patients most often have progressive renal disease with hypertension and eventual renal failure and death.

Heiner's Syndrome

It occurs in children aged 6 months to 2 years with hypersensitivity to cow's milk. Presenting symptoms may include hemoptysis, iron deficiency anemia, and pulmonary infiltrates. Patients may have prolonged exposure to cow's milk and a history of chronic rhinitis, recurrent otitis media, persistent cough, or failure to thrive.

Broncho-obstructive syndrome and diarrhea are possible.

Laboratory investigations. The full blood count will reveal variable degrees of sideropenic anaemia (transferrin saturation <40%), microcytic (MCV <80fL) anemia, sudden decrease in hematocrit levels. Plasma ferritin level can be normal or elevated because of the alveolar synthesis and release into the circulation and do not reflect the iron deposits of the body.

Bone marrow biopsy typically shows hyperplastic erythropoiesis, and low intramedullary iron deposits (decreased quantity of sideroblasts).

Imaging studies. First, there is no pathognomonic findings for pulmonary hemosiderosis. During the acute phase (IPH exacerbations) the chest radiographs show diffuse alveolar-type infiltrates, predominantly in the lower lung area. Further signs of fibrosis are detected.

Broncho-alveolar lavage or sputum examination shows the predominant cellular types are the alveolar macrophages filled with haemosiderrin, intact erythrocytes and occasionally neutrophils.

Video assisted thoracoscopic biopsy of the lung is a gold standard test for the diagnosis of IPH that reveals aggregates of haemosiderin-laden macrophages in the alveolar spaces along with fresh intra-alveolar haemorrhage. The inter-alveolar septae showed fibrous thickening, focal lymphocytic infiltrate and giant cell reaction.

Immunological studies — anti-nuclear antibody, rheumatoid factor, antineutrophil cytoplasmic antibodies (ANCA), anti-glomerular basement membrane (anti-GBM) antibodies for differential diagnosis of Goodpascher's syndrome, IgG and IgE, cow's milk antibodies for differential diagnosis Heiner's syndrome.

Treatment of Pulmonary Hemosiderosis

The recommended starting dose is immunosuppressant agents of systemic corticosteroids like prednisolon 1,5-3 mg/kg a day.

Inhaled corticosteroids, such as budesonide or flunisolide, are used in IPH as systemic corticosteroid-sparing agents due to the need for prolonged corticosteroid treatment for the remission of the disease with varying results.

Other immunosuppressant agents like azathioprine (3 mg/kg a day), chloroquine, methotrexate and cyclophosphamide (2 mg/kg a day).

Supportive care is given to the patient with oxygen administration for periods of hypoxemia and intubation and mechanical ventilation if the patient develops respiratory failure. Blood transfusions are indicated in case of severe anemia. Other treatment consists of plasmapheresis and plasma exchange for basement membrane antibody (IgG) removal.

In severe cases splenectomy is indicated to treat pulmonary hemosiderosis as it has an immunosuppressive effect.

Lung transplantation is the best option in case of deterioration after treatment. However, recurrence has been reported in only one case after transplantation. Some cases showed a good response to treatment with steroids.

Treatment options are limited in IPH with the long-term prognosis.

Heiner's syndrome treatment consists primarily of strict avoidance of the offending food, in this case — cow’s milk. Substitute formulas may be given, such as soya formula.

IDIOPATHIC FIBROSING ALVEOLITIS

Idiopathic fibrosing alveolitis **(**Hamman-Rich syndrome) (IFA) is a progressive inflammatory lung lesion of unknown nature, which leads to the development of diffuse fibrosis, chronic respiratory and cardiopulmonary failure. It is a rare disease characterized by rapidly progressive diffuse pulmonary fibrosis with the development of respiratory failure, pulmonary hypertension and cor pulmonale. It is a hereditary disease with autosomal dominant type of inheritance. The disease manifests itself mainly in school age children and adolescents, but the first signs of it (on history) almost half of the patients are detected in pre-school age. The disease begins gradually after an attack of influenza, repeated pneumonia, bronchitis and often measles. Morphological substrate is perialveolar fibrosis which reduces the elasticity and pliability of lung tissue and thus worsens the excursion of the lungs. Due to the thickening of the interalveolar septa diffusion of gases in the blood is damaged, which leads to hypoxemia and hypoxia, hypercapnia.

Clinical symptoms

Patients usually complain of a spastic, dry cough, shortness of breath exertion and cyanosis during physical training, sometimes chest pain, feeling of tightness in the chest. Percussion defines an insignificant shortening of sound in the basal zones or no change, decrease of excursion of lungs. Auscultation reveals inconstant fine bubbling or crepitation moist rales, sometimes may be weakening of breathing in the lower areas. There can be increasing cyanosis around the mouth, acrocyanosis, fingers take the form "drumsticks". A child retards in weight and growth. The thorax is flattened; circumference of the neck disproportionately increases (due to increased contractility of the neck muscles that perform the role of auxiliary respiratory muscles during difficult breathing). Pulmonary heart syndrome is developing with the expansion of the cardiac dullness, signs of cardiovascular failure.

The study of respiratory function reveals the decline of lung volumes, reduced lung compliance and difficulty in passing the oxygen through the alveolar-capillary membrane, and therefore change in the gas composition of the blood (hypoxemia, then hypercapnia) and indicators of acid-base status.

Radiological investigation in the initial period reveals that the interstitial pattern is enhanced and later nodular formation appears on its background. In periods of exacerbations there is determined multiple shadowing, alternating with areas of particularly clear lung fields. Shadowing is usually localized in the roots and lower parts. Pneumothorax may be possible complication. Father radiological investigation reveals diffuse fibrosis.

The disease is undulating with periods of exacerbation and remission. However, remission time zone fibrotic changes do not disappear, and rates of respiratory still significantly reduced. Depending on the frequency and duration of periods of exacerbation, some authors distinguish subacute and chronic forms of course. In subacute form periods of exacerbation are more frequent, accompanied by fever reaction. At chronic progression pulmonary fibrosis occurs gradually and manifests the growth of respiratory failure.

There are two clinical forms of idiopathic diffuse pulmonary fibrosis depending on diffusion of gases in the lungs. In most cases diffusion capacity is decreased, but in 10-15% of patients it is within normal limits. In such patients the process is easier, retarded growth and weight are insignificant or absent.

Treatment of Idiopatic Fibrosing Alveolitis

Corticosteroid therapy is usually used. Originally prednisolone is prescribed at a dose of 1 mg / kg per day. The dose is gradually reduced, but maintenance therapy (5-10 mg prednisolone per day) has to be continued for many months. In severe progressive course corticosteroids are combined with cytostatic drugs (azathioprine, etc.). In case the condition is exacerbated by

pneumonia or bronchitis, corticosteroids are combined with antibiotics. In addition, antihistamines and vitamins are used in symptomatic treatment.

The prognosis of this disease is poor. The survival of patients with pulmonary fibrosis is less than 5 years.

CONGENITAL DISEASES OF THE RESPIRATORY SYSTEM

Congenital malformations are anomalies, which in most cases lead to gross changes in the structure and function of the organs or tissue.

ICD-10 (International classification of diseases)

(Q30-Q34) Q32 Congenital anomalies [developmental defects] of the trachea and bronchi

Q32.0 Congenital tracheomalacia

Q32.1 Other defects of trachea development

Q32.2 Congenital bronchomalacia

Q32.3 Congenital bronchial stenosis

Q32.4 Other congenital anomalies of the bronchi

Q33 Congenital anomalies [developmental defects] of the lungs

Q33.0 Congenital cyst of the lungs

Q33.2 Sequestration of the lungs

Q33.8 Other congenital anomalies of the lungs

Q33.9 Congenital anomaly of the lungs is not specified

Q34 Other congenital anomalies [developmental defects] of the respiratory organs

Congenital malformations of the trachea and bronchi.

Tracheobronchomegaly (TBM) (Mounier-Kuhn syndrome) is a congenital excessive expansion of the trachea and large bronchi. Thinning of the cartilage of the trachea and main bronchi is combined with a quantitative and qualitative deficiency of elastic and muscle fibers in the membrane part of the trachea. The disorder is often combined with other abnormalities, more often in men.

At early age the disease is characterized with productive cough, repeated exacerbations of broncho-pulmonary disease, an increase in respiratory failure during exacerbation, which can also occur in older age. Children have a strong vibration when coughing with purulent sputum, and a loud "purring" breathing.

X-ray examination reveals deformation of the pulmonary pattern with thickening areas, enlargement of the lumen of the trachea and large bronchi, bronchiectasis in the lower-lobe segments.

Bronchoscopy can reveal enlargement of the lumen of the trachea (bronchi), thickening of the walls protruding to the lumen of the interstitial spaces.

The course of the disease can be asymptomatic, so diagnosis is made at random examination, as well as a progressive process with development of inflammatory changes and respiratory failure. Patients often have attacks of strangulation, which are regarded as bronchial asthma.

Bronchoscopy can reveal an unusually large size of the trachea and bronchi, sometimes sac-like bulging in the membrane part. The lumen of the trachea can take a crescent shape and change when breathing.

Tracheomalacia is a common disorder in neonates and infants, which can lead to life-threatening airway occlusion, because of external pressure or intrinsic defect of tracheobronchial cartilage. In tracheomalacia the trachea lacks firmness, causing the anterior and posterior walls to come together during respiration, decreasing the tracheal lumen.

Tracheomalacia occurs in 2 forms: primary and secondary. Primary tracheomalacia is rare and is caused by a congenital deformity of the supporting tracheal rings. Secondary tracheomalacia is due to external compression from lesions such as vascular anomalies (e.g., vascular ring), tumors or hemangiomas. It can also result from surgical intervention such as tracheoesophageal fistula repair.

Patients with tracheomalacia can present with inspiratory or expiratory stridor, wheezing, and a barking cough. Dramatic "dying spells", in which the patient undergoes reflex apnea progressing to cardiac arrest, can also occur.

Patients can also present with recurrent pneumonitis secondary to chronic obstruction and difficulty clearing bronchial secretions.

Tracheomalacia is typically self-limited, but in severe cases tracheostomy may be needed to stent the trachea during development.

Tracheal stenosis is a rare pathology. There are functional forms, which are associated with excessively soft cartilage, and local forms of tracheomalacia.

Among the organic stenosis, there are primary, which are associated with the change in the trachea wall, and secondary (or compressive), in which the trachea is compressed from the outside.

The cause of the primary organic stenosis is the defect of the membrane part of the trachea, as a result of which the cartilaginous rings are completely or partially closed, and the lumen is narrowed. A stenosis can also be associated with an increased number of cartilaginous rings or with their large thickness. Stenoses are usually localized in the middle and lower thirds of the trachea and are often combined with other lung deficiencies.

The cause of the secondary organic stenosis is compression of the trachea in children, abnormally located vessels: double or right artery of the aorta (back type) and abnormal branching of the subclavian arteries from the arch of the aorta.

Clinically, tracheal stenosis is manifested by the symptoms of an expiratory stridor, which often manifests itself immediately after the birth.

In pronounced stenosis, expiration can also be difficult. Stridor is exacerbated by physical activity, anxiety, feeding, and especially in acute respiratory infections. Some children have a loud breath, which is described as "hoarse", "cracking", "scratching", sometimes — persistent, resistant to the treatment "spastic bronchitis" with an appropriate physical picture in the lungs. Expiratory stridor can be combined with often recurrent obstructive bronchitis, with attacks of strangulation or less pronounced episodes of difficult breathing like in croup.

Diagnosis is verified with CT, bronchography, bronchoscopy. X-ray contrast study of the esophagus is used to exclude compression from the outside. Differential diagnostics is made with congenital stridor on the basis of laringomalacia, and aspiration syndrome. The prognosis of organic stenosis of the trachea is serious. The treatment is surgical. In case of compression of the trachea from outside, the operation on the vessels is performed, in case of tracheomalacia — stents to strengthen the framework of the trachea are used, in rigid stenoses —tracheoplasty is performed.

Williams-Campbell Syndrome is a rare congenital syndrome characterized by defective or completely absent bronchial wall cartilage in subsegmental bronchi, leading to distal airway collapse, producing a mechanical abnormality that may contribute to the formation of bronchiectasis distal to the collapsed bronchi. The defect usually is between the fourth and sixth order bronchial divisions, but it may extend between first to eight generations of proximal bronchi. The deficiency in cartilage occurs early in life when the lungs are still developing and growing. The exact mechanism is still not well understood. There is no evidence suggesting that cartilage deficiency occurs outside of the lung. Affected patients have normal caliber trachea and central bronchi. The symptoms and prognosis ultimately depend on the extent of cartilage maldevelopment of the bronchi.

The clinical picture is the bronchial obstruction and bronchopulmonary infection. Usually in the first year of life an acute pneumonia occurs, and then eventually a chronic bronchopulmonary process develops.

X-ray examination reveals intense and rough deformation of the pulmonary pattern; ring-shaped or oval clarifications with thickened walls (enlargement of the bronchi). Pneumosclerotic changes are localized both in the upper and lower lung portions.

Bronchography reveals local extensions, mainly, of segmental or subsegmental bronchi. When using a contrast medium that is retained on the walls of the bronchi, it is possible to detect their narrowing on inhalation and expanding on exhalation.

Bronchoscopy in the period of exacerbation can reveal sudden hyperemia of the bronchial mucosa and a large amount of viscous purulent secretion, obturating segmental and subsegmental bronchi.

There is no specific treatment of Williams-Campbell Syndrome. Prophylaxis of exacerbations remains the basis of treatment. Prophylaxis can be achieved if an oral or intravenous antibiotic is given for 7-10 days or until sputum production decreases. For severe cases, several different antibiotics may be used sequentially in a continuous regimen to minimize bacterial resistance.

Congenital bronchial asthma resembles Williams-Campbell syndrome, but the bronchial enlargement is less pronounced. There are two types of bronchomalacia— of proximal and mixed type.

Bronchography reveals the widening of the particular parts of the bronchi.

The disease has an early onset, severe course, persistent coughing up of mucous or mucous-purulent sputum. Frequent pneumonic and bronchial episodes at the age of 2-3 years quickly lead to a chronic process. With age some patients have a positive dynamics associated with strengthening the cartilaginous bronchial framework.

Treatment can include the use of stents for endoprosthetics in children from the birth.

Congenital malformation of the lungs

Lung agenesis is a congenital pulmonary anomaly, that is rare and can vary in presentation and severity. Pulmonary agenesis implies the absence of the lungs and lung blood vessels, whereas the principal bronchus is absent.

Lung aplasia implies the absence of the lungs and lung blood vessels, whereas the principal bronchus is rudimentary.

Lung hypoplasia is a condition when the main and lobar bronchi terminate with a functionally invalid rudiment, the lung tissue being underdeveloped.

Intrathoracic or extrathoracic lesions can cause pulmonary hypoplasia. Therefore, prolonged rupture of membranes, renal dysplasia, neuromuscular diseases, and congenital diaphragmatic hernia can lead to lung hypoplasia. Reduced urine volume during fetal life may retard the lung growth. Pulmonary aplasia leads to respiratory distress, which may vary according to the degree of alveolar involvement. Pulmonary hypoplasia may be primary when the entire lung or one lobe is reduced in size.

Asymptomatic clinical picture is rare. Children have physical retardation. Respiratory failure is observed: dyspnea, cyanosis of varied severity. Cough and production of purulent phlegm are associated with the inflammatory process. Sometimes there is a pain in the chest. From the side of the affected part, the thorax is flattened, and the healthy half is convex. At the site of the lesion there can be observed shortening of percussion sounds, absent or weakened respiratory noises. The heart is shifted toward the lesion**,** which may erroneously be interpreted as dextracardia. In case of expressed hypoxia, the

nail phalanx become thickened as "drumsticks." Clinical picture of hypoplasia is less pronounced. The process proceeds by the type of chronic lung diseases, vital lung capacity, GLC are decreased.

Chest X-ray reveals the decrease of lung volume on the side of lesion, intense darkness, high position of the diaphragm. The heart and organs of the mediastinum are remote so that the spine looks bare. However, there may be a "pneumocele" when healthy lung is protruding through the anterior mediastinum in the other direction.

X-ray examination shows a decrease in the volume of the lungs on the side of the defect — deep darkening, high position of the diaphragm; shifting of the heart and mediastinum, multiple thin-walled cavity in the lung area, reduction of lung volume.

Bronchography and computer tomography can reveal deformation and expansion of the bronchi, ending with spherical enlargement. Bronchoscopy can also reveal a pronounced purulent endobronchitis.

Differential diagnosis is made with chronic pneumonia, polycystic ovary, extensive bronchial defects, cystic fibrosis. The treatment is surgical.

Congenital lobar emphysema (congenital localized emphysema, gigantic emphysema, tense emphysema) is characterized by stretching of the parenchyma of the lung lobe or a segment with manifestation mainly in early childhood. This anomaly is rare, but late diagnosis quickly leads to death of newborns.

This disease is characterized by narrowing of the bronchus, aplasia, dysplasia, and hypertrophy of the mucosa with the formation of folds which act as valves. Amount of air, which gets into the lungs is more than that which gets out (valve mechanism).

The causes of congenital lobar emphysema include bronchial cartilage deficiency, extrinsic compression by a bronchogenic cyst, a large pulmonary artery, or mucus plugs. Lobar overdistention and air trapping lead to compressive changes in the rest of the lung.

Congenital lobar emphysema primarily affects the upper lobes. The left upper lobe is involved in 41% of patients; the right middle lobe – in 34%; and the right upper lobe – in 21%. Involvement of the lower lobes is rare, occurring in fewer than 5% of patients.

Congenital cardiac anomalies may be present in as many as 10% of patients. Lesions most commonly occur in white male individuals (male-to-female ratio, 3:1) and in young infants.

Most patients with congenital lobar emphysema present at the age of not older than 6 months. Neonates may present with mild-to-moderate respiratory distress. Mediastinal shift may be present, with hyper resonance and decreased breath sounds on the involved side. Infants present with cough, wheezing, respiratory distress, and cyanosis. Older children may present with recurrent

chest infections. On images obtained in neonates, the affected lobe may be slightly opacified, rather than lucent, because it is still filled with fluid. Associated cardiac anomalies occur in as many as 10% of patients.

Differential diagnosis can include pneumothorax cysts, diaphragmatic hernia, hypoplasia of lung, aspiration syndrome.

Radiological examination reveals: hyper aeration of one lung; mediastinum and heart displaced in the opposite side; scanty or absent lung pattern; flat diaphragm; limited excursion; possible mediastinal hernia.

Lobectomy is required to manage intrapulmonary lesions. Segmentectomy can be done in a few patients. The extrapulmonary sequestration can be resected without the loss of normal lung tissue.

Congenital cystic adenomatoid malformations (CCAMs) result from an abnormality in the branching morphogenesis of the lung (the lung developed incorrectly). Different types are thought to originate at different stages and levels of development. The mechanism is unknown, but may be from imbalance during organogenesis (early organ formation). CCAMs can affect either side and any lobe, but rarely multiple lobes.

Stocker's classification:

0. Involvement of all lung lobes is incompatible with life.

1. Pneumocele is most common; it is composed of 1 or more cysts of 2-10 cm in size, larger cysts are often associated with smaller cysts; walls contain muscle, elastic, or fibrous tissue. Cyst walls occasionally produce mucin which is unique to this subtype.

2. Small cysts (0.5-2 cm) of relatively uniform size resembling bronchioles; lined with cuboid-to-columnar epithelium with a thin fibromuscular wall.

3. Predominantly solid lesions, with small (under 0.5 cm) cysts, lined with cuboidal epithelium.

4. Large air-filled cysts, lined with flattened epithelial cells.

Prenatal diagnosis is made by ultrasound examination; microcystic – < 5 mm or macrocystic – > 5 mm; fetal MRI can help to distinguish it from CDH if diagnosis is in question.

Postnatal diagnosis is usually made by X-ray. Type 1 usually appears as a single lesion, type 2 looks more bubbly, type 3 has more solid lesion.

All neonates with a prenatal diagnosis of CPAM should get a chest X-ray even if asymptomatic. Only chest CT is often done prior to surgery to confirm the lesion is still present.

Pulmonary sequestration accounts for 6% of all congenital lung malformations and mostly occurs in the lower lobes.

A sequestration is a bronchopulmonary tissue without a normal bronchial communication and with normal or anomalous vascular supply. Sequestered lung may be intralobar or extralobar.

Clinical manifestations are due to inflammatory changes: cough, fever, shortness of breath. Behind the lesions small bubbling moist rales can be heard. There are three forms of pathologic process: bronchiectasis, in which repeated inflammation leads to fusion of the lung tissue and secondary connection with bronchial tree, pseudotumoral, that is characterized by small clinical symptoms of local abscess formation or empyema.

The main distinguishing feature of sequestration of the lung is an additional large vessel which deviates from the aorta and branches in the sequestered lung tissue. This vessel can be identified at aortography, tomography and CT. Sometimes it is found during the operation accidentally.

Diagnosis of pulmonary sequestration is based on angiography. Bronchography is of much less importance.

Radiography may show darkening of the affected segment inflammation.

Surgical treatment includes resection of the sequestered area. Resection is recommended, even in asymptomatic patients, to prevent infection, hemorrhage, shunting from arteriovenous anastomoses, or compression of normal lung mass leading to respiratory distress.

Lobectomy can usually be performed. For patients with intralobar sequestration, segmentectomy may suffice. Segmentectomy is relatively difficult, but preserves additional functioning of the lung tissue. Prognosis is favorable.

Kartagener's syndrome

Kartagener's syndrome has autosomal dominant type of inheritance with 50% penetrance (frequency of 1:50 000) of the pathological gene and occurs more frequently in kinship marriages.

Patients usually present with a triad of symptoms: situs inversus (transposition of the viscera); abnormal frontal sinuses (producing sinusitis and bronchiectasis); primary ciliary dyskinesia (PCD).

In addition, the history strongly suggests infertility, which corroborates the diagnosis of Kartagener's syndrome. Investigations show moderate airway obstruction and respiratory failure of type 1 (hypoxia without hypercapnia).

Clinical symptoms include frequent respiratory infections, recurrent bronchitis, pneumonia in the first months of life. There is early occurrence of chronic bronchitis and pneumonia with the development of bronchiectasis and bronchiectasis symptoms (retard physical development, intoxication symptoms, cough with purulent sputum, deformation of terminal phalanges ("drum sticks") and nails ("watch glasses").

The differential diagnosis is made with chronic pneumonia, congenital abnormalities of bronchopulmonary system (agenesia, aplasia or hypoplasia of the right lung) in which the heart is shifted into the right half of the thorax.

The main method of treatment is a conservative therapy aimed at eliminating or reducing the activity of the inflammatory process in the bronchi and lungs, improving drainage and ventilation functions.

Prognosis depends on the nature, incidence of bronchopulmonary process, the frequency of exacerbations, severity of the disease. Proper systematic treatment and regular rehabilitation makes the prognosis relatively favorable.

QUESTIONNAIRE FOR SELF-CONTROL

1. General characteristics of chronic bronchopulmonary diseases.
2. Definition of chronic bronchitis.
3. Definition of bronchiectasis.
4. Etiology and pathogenesis, diagnosis and treatment of cystic fibrosis.
5. Etiology, pathogenesis, diagnostics and treatment of idiopathic fibrosing alveolitis.
6. Etiology and pathogenesis of pulmonary diagnostics and treatment of hemosiderosis.
7. Congenital lung deficiencies: symptoms, diagnosis, treatment.
8. Congenital defects of the trachea and bronchi: clinical picture, diagnosis, treatment.

Control tests

1. A 9-year-old boy has been suffering from bronchoectasis since he was 3. Exacerbations occur quite often, 3-4 times a year. Conservative therapy results in short periods of remission. The disease is progressing; the child has physical retardation. The child’s skin is pale, acrocyanotic, he has a "watch glass" nail deformation. Bronchography revealed saccular bronchiectases of the lower lobe of his right lung. What is the further treatment tactics?

A. Sanatorium-and-spa treatment
B. Training of the child to be fit
C. Further conservative therapy
D. Physiotherapeutic treatment
E. Surgical treatment

2. A 8-year-old boy complains of constant cough along with discharge of greenish sputum, dyspnea during physical activities. At the age of 1 year and 8 months he fell ill for the first time with bilateral pneumonia that had a protracted course. Later on there were recurrences of the disease 5-6 times a year, during the remission periods he had a constant productive cough. What examination results will be the most important for making a final diagnosis?

A. Rentgenography of thorax organs
B. Bronchoscopy
C. Spirography
D. Bronchography
E. Bacterial inoculation of sputum

3. A 5-year-old boy with chronic sinusitis and recurrent pulmonary infections has a chest X-ray demonstrating a right-sided cardiac silhouette. What is the most likely diagnosis?

A. Cystic fibrosis (CF)
B. Laryngotracheomalacia
C. Alpha-antitrypsin deficiency
D. Kartagener syndrome
E. Bronchiolitis obliterans

4. The most informative method of radiological diagnosis of bronchiectasis is:

A. Magnetic resonance tomography
B. Tomography of the lungs
C. Computer tomography.
D. Plain X-ray of the chest organs
E. Bronchography

Answer: 1

Situation task 1

A 3-year-old child with weight deficiency suffers from permanent productive cough. In case history there were some pneumonias with obstruction. On examination: distended chest, dullness on percussion over the lower parts of the lungs. On auscultation: a great number of different rales. Level of sweat chloride is 80 mmol/L.

What is the provisional diagnosis?

Answer: Mucoviscidosis (cystic fibrosis)

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