Ministry of Education and Science of Ukraine
V. N. Karazin Kharkiv National University

BRONCHIAL ASTHMA IN CHILDREN

Methodical recommendations
for students of the 4th course of the medical school for discipline
"Pediatrics"

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CONTENTS

LIST OF ABBREVIATIONS

ARI – acute respiratory infection
ICS – Inhaled corticosteroids
IgE – Immunoglobulin E
IL – Interleukin
LABA – Long action betta2 agonist
LAMA – Long-acting muscarinic antagonist
LTRA – Leucotrien reseptor agonist
OKS – Oral corticosteroids
PEF – Peak exhaled flow
SABA – Short action betta2 agonist
Th – T-helpers
FEV1 – Forced expiratory volume-one second
FVC – Forced vital capacity

INTRODUCTION

Bronchial asthma is one of the most common chronic diseases and there are about 334 million patients worldwide, and 14 % of them are children. The incidence of bronchial asthma varies in different countries and populations and ranges from 1 to 18 %. In children, this figure ranges from 5–10 % in the population and depends on gender and age characteristics.

According to the Global Initiative for Asthma (GINA), bronchial asthma is a heterogeneous disease that is usually characterized by chronic inflammation of the airways. It is determined by the presence of symptoms such as wheezing, shortness of breath, dryness, and cough, which change over time and intensity along with restricted airflow. Airflow obstruction can be completely or partially reversed with or without specific therapy.

RISK FACTORS AND PATHOGENESIS

Factors that may increase the risk of developing asthma or worsen symptoms:

- The effects of cigarette smoke in the womb,
- The impact of various microbes in the environment
- Allergens that can cause asthma:

house dust mites that live in carpets, mattresses and upholstered furniture;
saliva, excrement, hair and epidermis of domestic animals, plant pollen;

- food components (stabilizers, genetically modified products);
- pharmacological agents (enzymes, antibiotics, vaccines, serums).
- Physical factors that can cause asthma:
- meteorological factors (cold air, changes in atmospheric temperature, barometric pressure, humidity, etc.);
- exercise and hyperventilation;
- emotional stress;
- A history of allergic rhinitis or eczema or a family history of asthma or allergies increases the likelihood that respiratory symptoms are caused by asthma.

Pathogenesis

After involvement of allergens in the respiratory tract, immunocompetent cells are activated. T-lymphocytes present in increased amounts in the airways release specific cytokines (IL-4, IL-5, IL-9, IL-13). As a result, B-lymphocytes produce IgE antibodies. Inflammation of the airways in asthma can mean a loss of normal balance between Th lymphocytes.

The current "hygienic hypothesis" of asthma illustrates how this cytokine imbalance may explain some of the sharp increases in asthma prevalence in Western countries.

This hypothesis is based on the concept that the newborn's immune system is skewed to the generation of cytokines Th2 (mediators of allergic inflammation). Over time, environmental stimulants such as infections activate Th1 responses and bring the Th1 / Th2 relationship into balance.

As a result of the antigen-antibody reaction there is a kind of "explosion". Activated mucosal mast cells basophils and eosinophils release bronchoconstrictor mediators and other biologically active substances (histamine, serotonin, chemotaxis factors, heparin, proteases, thromboxane, leukotrienes, prostaglandins), which induce the formation of myocardial infarction in the lumen of the bronchi.

Pathophysiological phases. Inflammation of the airways leads to

structural changes (bronchoconstriction, mucosal edema, mucous plugs)

functional changes (airway reconstruction: smooth muscle hypertrophy and hyperplasia, angiogenesis, subepithelial fibrosis)

CLINICAL FEATURES AND DIAGNOSTIC CRITERIA

The main clinical phenotypes of asthma (GINA 2020) are following:

Allergic – most common in childhood and associated with a past and / or family history of allergic diseases such as eczema, allergic rhinitis, or food or drug allergies.

Non-allergic – asthma that is not related to allergies.

Asthma, which begins in adulthood.

Asthma with persistent airflow limitation – Some patients with long-standing asthma develop airflow limitation that is persistent or not completely reversible. It is believed that this is due to the reconstruction of the walls of the respiratory tract.

Asthma with obesity – some obese asthmatics have severe respiratory symptoms and mild eosinophilic airway inflammation.

The children complain of periodic paroxysms of expiratory dyspnea, cough (especially at night or during exercise), shortness of breath or rapid breathing, chest tightness.

History includes information about other allergic diseases (eczema or allergic rhinitis) or asthma in first-degree relatives

Clinical improvement occurs within 2–3 months of treatment with control drugs and worsening – after their weaning.

Objectively, the patient's position during the attack is sitting, he is anxious, sweating, inability to speak. Cyanosis, chest retraction is present.

Infants have difficulty in feeding and have a softer, weaker cry. The anteroposterior diameter of the thorax may be increased due to hyperventilation.

Percussion reveals tympanic sound, auscultation- whistling rales on exhalation. Tachycardia is noted.

Diagnosis

Spirometry (assessment of lung function) is performed in children older than 5–6 years. In clinical practice, when an obstructive defect is confirmed, variation in airflow limitation is usually estimated based on variation in FEV1 or PEF.

"*Variability*" means improvement and / or deterioration of symptoms and lung function. Excessive variability can be detected during one day (daily variability), from day to day, from visit to visit, or seasonally,

Reversibility test (rapid improvement of FEV1 (or PEF), measured within minutes after inhalation of short-acting betta 2 agonists.

Spirometry indicators:

- Reduced forced exhalation in 1 second (FEV1),
- Reduced forced expiratory flow over 25–75 % of FVC (FEF 25-75).

- FEV1 / FVC ratio decreased (normally more than 0.9 in children and 0.75–0.8 in adults)
- Increase in FEV1 by more than 12 % after inhalation of salbutamol or after 4 weeks of treatment
- Reduction of FEV1 by 10–12 % or more after exercise

Skin testing. Allergens for skin testing are selected on the basis of suspected or known allergens identified from a detailed environmental history. Antihistamines may suppress skin test results and should be discontinued for an appropriate period (according to the duration of action of a particular agent) before allergy testing. Topical or systemic corticosteroids do not affect the skin reaction. Testing should not be performed during exacerbations of wheezing.

The level of specific IgE in the serum.

Bronchial provocation test. These tests are performed to determine airway hyperresponsiveness to substances (eg, methacholine, histamine). Patients are given increasing doses of provocative agents and measured FEV1. The end point is a 20 % reduction in FEV1.

The number of eosinophils in the blood and nasal mucosa.

X-ray examination. If there is any doubt about the diagnosis of asthma in a child who is wheezing or coughing, a regular chest x-ray may help rule out structural abnormalities (such as congenital lobar emphysema, a vascular ring), chronic infections such as tuberculosis, inhaled foreign body, or others. Depending on the condition under consideration, other studies of the image may be appropriate

Testing of nitric oxide exhalation fraction.

Diagnostic criteria

- The presence of respiratory disorders (wheezing, shortness of breath, chest tightness and coughing or shortness of breath);
- Restriction of air flow on exhalation;
- Positive test with bronchodilators: when using a short-acting bronchodilator for ≥4 hours, and long-acting – for ≥15 hours in children, an increase in FEV1> 12 % is predicted;
- Excessive variability of PEF twice a day for 2 weeks – the average daily variability of PEF daily> 13 %;
- Positive exercise test – FEV1> 12 % is predicted, or PEF> 15 %;
- Excessive difference in lung function – FEV1 variation> 12 % or> 15 % in PEF between visits.

Differential diagnosis of bronchial asthma should be performed with the following diseases:

- Chronic cough syndrome of the upper respiratory tract
- Inhalation foreign body

- Bronchiectasis
- Cystic fibrosis
- Primary ciliary dyskinesia
- Congenital heart disease
- Bronchopulmonary dysplasia
- Incapable laryngeal obstruction
- Hyperventilation dysfunctional breathing
- Alpha1-antitrypsin deficiency
- Tuberculosis

TREATMENT

The purpose of asthma treatment:

- the long-term goals of asthma treatment are to achieve good symptom control;
- minimize the future risk of death from asthma, exacerbations, persistent airflow limitation and treatment side effects.

The following categories of drugs are used for long-term therapy

Asthma control medications: are used to reduce airway inflammation, control symptoms, and reduce future risks such as exacerbation and decreased lung function. In patients with mild asthma, treatment with the controller may be performed as needed with low doses of ICS – formoterol taken at the onset of symptoms and before exercise.

Therapeutic (rescue) drugs: are used to all patients to relieve symptoms of exacerbation of asthma, are recommended for short-term prevention of bronchoconstriction caused by exercise. This group includes short-acting betta 2 agonists. Reducing and, ideally, eliminating the need for SABA is both an important goal in the treatment of asthma and a measure of the success of asthma treatment.

Additional therapies are used in patients with severe asthma can be considered when patients have persistent symptoms and / or exacerbations, despite optimized drug treatment.

Asthma medications should be used with the minimum dose and frequency needed to maintain acceptable asthma control. Asthma medications are safe for many years if used properly.

The following categories of drugs are used for long-term therapy

Corticosteroids

Inhaled corticosteroids strongly suppress airway inflammation and play an important role in the long-term control of asthma: beclomethasone (beclazone), budesonide (pulmicort, turbuhaler), fluticasone (flixotide).

Oral corticosteroids (prednisolone ≤7.5 mg / day) can be prescribed to patients with uncontrolled asthma with frequent exacerbations.

Formoterol is a selective stimulant of β2-adrenoceptors. In patients with reversible airway obstruction, it has a bronchodilator effect. This effect develops rapidly (within 1–3 minutes) and remains quite pronounced through 12 hours after inhalation of the drug.

Bronchodilators

Salmeterol is a selective long-acting β 2-adrenoceptor agonist (12 h). Salmeterol is more effective in preventing histamine-induced bronchospasm and causes longer bronchodilation than conventional short-acting β 2-receptor agonists;

effectively and long-term inhibits the release in the lung tissues of mediators of mast cells, such as histamine, leukotrienes; suppresses early and late stage of allergic reaction.

Salbutamol (albuterol) is a selective beta 2-adrenoceptor agonist. At therapeutic doses, it acts on beta2-adrenoceptors of bronchial smooth muscle, providing rapid (within 5 minutes) and short-term (4–6 hours) bronchodilation in patients with reversible airway obstruction.

Ipratropium (Atrovent) blocks muscarinic receptors of tracheobronchial tree smooth muscle and inhibits reflex bronchoconstriction; has both a pronounced bronchodilator and prophylactic effect; causes a decrease in the secretion of the glands of the nasal mucosa and bronchial glands; bronchodilator effect occurs after 5–10 minutes after inhalation, reaches a maximum by the end of the first hour, and persists for an average of 5–6 hours after inhalation.

Tiotropium bromide

Theophylline – bronchodilator action; alkaloid; the mechanism of action is caused mainly by blocking of adenosine receptors, suppression of phosphodiesterases; increase in the content of intracellular cAMP; decrease in intracellular concentration of calcium ions; as a result the smooth muscles of bronchial tubes relax. Moderate to moderate bronchodilator used as an adjunct in the treatment of stable asthma and the prevention of nocturnal asthma symptoms.

Leukotriene receptor antagonists

Montelukast is an active compound that binds to CysLT1 receptors with high selectivity and chemical affinity. Montelukast causes significant airway cysteine-leukotriene receptor blockade, as evidenced by its ability to inhibit bronchoconstriction in asthmatic patients.

Direct antagonist of mediators responsible for airway inflammation in asthma. Used for long-term treatment of asthma as an alternative to low doses of inhaled corticosteroids. Preparations like montelukast (Singular).

Mast cell stabilizers

Cromolyn (Intal) – inhibits the degranulation of mast cells, prevents the release of mediators from mast cells, which cause inflammation of the respiratory tract and bronchospasm. It is used in the form of inhalations. Application in the form of inhalations. It is intended for maintenance therapy of easy and average asthma.

Immunotherapy therapy

Anti-immunoglobulin E is *omalizumab* for patients ≥6 years of age with moderate to severe asthma.

Biological agents

Anti-interleukin 5 / 5R (*mepolizumab* for subcutaneous use for patients ≥6 years or *Anti-interleukin 5 receptor* (*benzalizumab* for subcutaneous use for children ≥12 years with eosinophilic uncontrolled asthma)

Anti-interleukin 4R (*dupulumab* for subcutaneous administration for patients ≥12 years with severe asthma requiring oral corticosteroids).

According to the recommendations of GINA experts, the tactics and types of treatment of bronchial asthma are divided into levels (steps), each of which corresponds to the severity of the disease and how asthma symptoms respond to therapy. The choice of the amount of therapy appropriate to one degree or another depends on the severity of clinical manifestations of bronchial asthma.

Table 1

Initial treatment of asthma – recommended options for adults and adolescents and children 6–11 years

Asthma symptoms	Preferred initial treatment
Uncommon asthma symptoms for example, less than twice a month and the absence of risk factors for exacerbations	As needs SABA Other options include taking ICS when taking SABA, in combination or individual inhalers
Asthma symptoms or need for medication twice a month or more	Low doses of ICS and SABA. Other options include daily LTRA or ICS administration when SABA is taken in combination or separate inhalers.
Anxious asthma symptoms most days; or waking up due to asthma once a week or more, especially if there are any risk factors	Low dose ICS and LABA, on demand SABA ICS medium doses and, if necessary -SABA. Other options include low-dose ICS with daily LRTA, as need SABA.
The initial course of asthma occurs with very uncontrolled asthma or acute exacerbation	Medium doses of ICS and LABA, if necessary – SABA. You may also need a short OCS course. Other options include daily high-dose ICS and LABA, or the addition of tiotropium or the addition of LRTA, as need SABA

The level (step) of treatment the doctor chooses based on the severity of the condition. If the treatment is ineffective or the response to it is insufficient, it is necessary to check the inhalation technique, adherence to prescriptions, clarify the diagnosis and assess comorbidities, and so on. Then, based on the results of how the manifestations and course of the disease have changed in response to therapy, the doctor can move the patient either to a higher level (step) or to a lower level. In all cases, the physician should try to keep the patient on the minimum effective doses of drugs on which good control has been achieved.

Table 2

Low, medium, high daily doses of inhaled corticosteroids for adults, adolescents and children aged 1–6 years

Inhaled corticosteroids	**Adults and adolescents**		
	Low	**Medium**	**High**
Beclomethasone dipropionate (CFC) *	200–500	>500–1000	>1000
Beclomethasone dipropionate (HFA)	100–200	>200 –400	>400
Budesonide (DPI)	200–400	>400 –800	>800
Budesonide (nebules)			
Ciclesonide (HFA)	80–160	>160 –320	>320
Fluticasone foorate	100	n.a.	200
Fluticasone Propionate (DPI)	100–250	>250 –500	>500
Fluticasone propionate (HFA)	100–250	>250 –500	>500
Mometasone	110–220	>220 –440	>440
Triamcinolone acetonide	400–1000	>1000–2000	>2000
Inhaled corticosteroids	**Children aged 6-11 years**		
	Low	**Medium**	**High**
Beclomethasone dipropionate (CFC) *	100–200	>200–400	>400
Beclomethasone dipropionate (HFA)	50–100	>100–200	>200
Budesonide (DPI)	110–200	>200–400	>400
Budesonide (nebules)	250–500	>500–1000	>1000
Ciclesonide (HFA)	80	>80–160	>160
Fluticasone foorate	n.a.	n.a.	n.a.
Fluticasone Propionate (DPI)	100–200	>200–400	>400
Fluticasone propionate (HFA)	100–200	>200–500	>500
Mometasone	110	≥220 –<440	≥440
Triamcinolone acetonide	400–800	>800–1200	>1200

Notes: CFC – chlorofluorocarbon propellant, DPI – dry powder inhaler; HFA – hydrofluoroalkane propellant

Table 3

Assessment of asthma control in adults, adolescents and children aged 6-11 years

	Well controlled	**Partially controlled**	**Uncontrolled**
Has been observed in the last 4 weeks:			
Asthma symptoms are more common twice a week during the day	Does not have	1–2 of these symptoms	3–4 of these symptoms
Were there nocturnal awakenings due to asthma?			
Relief of symptoms * more than twice a week?			
Any restriction of activity due to asthma?			

If a child's asthma is well controlled, it is possible to try to ease the therapy. For all patients, rapid relief agents, use SABA. The intensity of treatment depends on the severity of the symptoms.

If SABA are used more than 2 days a week to relieve symptoms (not including the use SABA to prevent exercise-induced symptoms), it is advisable to increase therapy.

Table 4

Personalized approach to asthma treatment for adults and adolescents (12+ years)

Selection of controllers	Step1 If necessary Low doses of ICS – formoterol	Step 2 Low doses daily ICS, if necessary, low doses of ICS – formoterol	Step 3 Low doses of ICS / LABA	Step 4 Medium doses of ICS / LABA	Step 5 High doses of ICS – LABA Phenotype determination and tiotropium anti-IgE, anti-IL5 / 5R1
Other controllers	Low doses of ICS when taking SABA	LTRA Low doses of theophylline	Average doses of ICS, + LTRA	High doses of ICS Add tiotropium or LTRA	Low doses of OKS, but consider a side effect
Drugs that improve the condition	If necessary, ICS – formoterol		If necessary, low doses of ICS / formoterol in patients receiving maintenance therapy and relief drugs		

Table 5

A personalized approach to the treatment of asthma for children aged 6-11 years

Selection of controllers	Step1	Step 2 Low doses daily ICS	Step 3 Low doses of ICS / LABA or average doses of ICS	Step 4 Medium doses of ICS-LABA Refer to Expert Advice	Step 5 Send for phenotypic evaluation ± anti-IgE
Other controllers	Low-dose ICS when taking SABA	LTRA Low doses of theophylline if taking SABA	Low doses of ICS, + LTRA	High doses of ICS -LABA Add tiotropium or LTRA	anti-IL 5 or low doses OCS, but consider a side effect
Drugs that improve the condition	SABA are required				

The severity of asthma can be assessed when the patient is on control treatment for several months:

Mild asthma is asthma that is well controlled during treatment in step 1 or step 2, i.e. if necessary only ICS formoterol, or at low dose ICS, LTRA .

Moderate asthma is asthma that is well controlled with step 3, such as low-dose ICS and LABA.

Severe asthma is asthma that requires step 4 or 5 treatment, high doses of ICS, and LABA. ICS-LABA or asthma, which remains "uncontrolled" despite such treatment.

Treatment of exacerbation of asthma

Exacerbation of asthma is an episode characterized by progressive shortness of breath, cough, wheezing, chest tightness, progressive decrease in lung function.

Clinical picture:

In mild and moderate form, the patient speaks phrases, position – sitting, increased respiration rate, but additional muscles do not participate in respiration, tachycardia above 100 beats / min, PEF> 50 %, O2 saturation – 90–95 %, on auscultation – whistling rales.

In severe form, the patient can speak only a few words. Sitting hunched over, agitated, increase in respiratory rate involving additional muscles, tachycardia more than 120 beats / minute, O2 saturation <90 %, PEF ≤ 50 %, on auscultation loud wheezing

In a life-threatening condition – lack of consciousness, "dumb lungs"

Emergency aid

In mild to moderate exacerbations, SABA are prescribed (up to 4 doses every 20 minutes for the first hour).

When the condition worsens, systemic corticosteroids are administered. The recommended dose for adults and adolescents is 1 mg *prednisolone* / kg / day or equivalent to a maximum of 50 mg / day and 1–2 mg / kg / day for children 6–11 years to a maximum of 40 mg / day).

After the first hour, the dose of SABA is changed to 4–10 doses every 20 minutes for the next 1–2 hours.

Oxygen therapy is performed to maintain oxygen saturation – 93–95 %.

In severe form, the patient is transferred to an emergency room.

Prescribe SABA, oxygen therapy, systemic corticosteroids, thioptropia bromide.

With the ineffectiveness of therapy, artificial ventilation is performed.

PECULIARITIES OF BRONCHIAL ASTHMA IN CHILDREN UNDER 5 YEARS OLD

Wheezing in this age group is a very heterogeneous condition, and not all wheezing indicates asthma. Most episodes of wheezing in young children are virally induced, regardless of whether the child has asthma or not. Therefore, it can be difficult to decide when wheezing in a respiratory infection is a truly isolated phenomenon or a recurrent clinical manifestation of childhood asthma. In the past, two main classifications of rales have been proposed (called "rales phenotypes"):

Classification based on symptoms:

• *episodic wheezing (*wheezing in discrete periods of time, often in combination with IRT, with no symptoms between episodes) or

• *repeated wheezing* (episodic wheezing with symptoms that also occur between these episodes, such as during sleep or with activators such as activity, laughter or crying). •

Classification based on time trends:

• temporary wheezing (symptoms began and ended before the age of 3 years);

• persistent wheezing (symptoms began before age 3 and continued after age 6),

• late-onset wheezing (symptoms started after reaching 3 years of age).

The clinical utility of these and other asthma classification and prediction systems remains the subject of active research

If the symptoms (cough, wheezing, shortness of breath) occur during an acute respiratory infection, disappear in less than 10 days and are absent between episodes, which should be no more than 2–3 per year, the likelihood of bronchial asthma in a child is low (few of which has asthma).

If symptoms occur during an acute respiratory infection and persist for more than 10 days, episodes occur more than 3 times a year (or a severe episode / nocturnal worsening), between which the child also occasionally has coughing, wheezing, and shortness of breath, the likelihood increases (some children have asthma)

If symptoms that occur during an acute respiratory infection do not go away in 10 days, episodes occur more than 3 times a year (or a severe episode / nocturnal worsening), between episodes the child has a cough, wheezing, and shortness of breath while playing or laughing. If you have allergic reactions, atopic dermatitis, food allergies, or a family history of asthma, the likelihood of asthma is high (most of these children have asthma).

Clinic and Diagnosis

*Cough i*s repeated or constant unproductive, which may increase at night or be accompanied by wheezing and difficulty breathing. Cough that occurs during exercise, laughter, crying, or exposure to tobacco smoke in the absence of a clear respiratory infection

Wheezing. Recurrent wheezing, including during sleep or with stimuli such as activity, laughter, crying, or exposure to tobacco smoke or air pollution

Decreased activity – the child does not run, does not heal like other children, gets tired quickly, begs for arms

History: relatives of atopy – allergic rhinitis, atopic dermatitis, asthma in first-line relatives.

Diagnostic tests

Although no tests specifically and definitively diagnose asthma, children 5 years of age and younger have the following useful aids.

Therapeutic trial. A trial of at least 2–3 months, if necessary, with a short-acting beta2-agonist and regular low-dose inhaled corticosteroids may provide some guidance in the diagnosis of asthma.

The response should be assessed by monitoring symptoms (day and night) as well as the frequency of episodes of wheezing and exacerbations. Significant clinical improvement during treatment and deterioration after discontinuation of treatment confirm the diagnosis of asthma.

X-ray examination to rule out structural abnormalities (congenital lobe emphysema, vascular ring, etc.).

Table 6

Differential diagnosis of bronchial asthma in children under 5 years of age

Conditions	Characteristic signs
Recurrent viral respiratory infections	Cough, runny nose, nasal congestion <10 days; wheezing is minor, no symptoms between infections
Gastroesophageal reflux	Cough during feeding. Vomiting after overeating. Poor response to asthma medication.
Foreign body aspiration	The episode begins abruptly with a severe cough and / or stridor while eating or playing;
Tracheomalacia	Noisy breathing during crying or eating, or during upper respiratory tract infections (noisy inhalation if thoracic or exhalation if intrathoracic); severe cough; inhalation or exhalation; symptoms are often observed from birth; poor response to asthma medication
Tuberculosis	Constant noisy breathing and cough; fever that does not respond to normal antibiotics; enlarged lymph nodes; poor response to bronchodilators or inhaled corticosteroids; contact with those who have tuberculosis
Congenital heart disease	Heart murmur; cyanosis when eating, delayed physical development; tachycardia; tachypnea or hepatomegaly; poor response to asthma medication
Cystic fibrosis	Cough begins shortly after birth; recurrent respiratory infections; delayed physical development due to malabsorption; liquid fat bulky stool
Vascular ring	Breathing is often constantly noisy; poor response to asthma medication
Primary ciliary dyskinesia	Cough and relapses, mild chest infections; chronic ear infections and purulent discharge from the nose; poor response to asthma medication; situs inversus occurs in approximately 50% of children with this condition
Bronchopulmonary dysplasia	Infant born prematurely; very low birth weight; long-term mechanical ventilation or oxygen supplementation is required; breathing difficulties present from birth
Immunodeficiency	Recurrent fever and infections (including non-respiratory); inability to achieve prosperity

Step-by-step therapy of bronchial asthma in children under 5 years of age

Step 1. If necessary, SABA. If their use is more than 2 times a week, it ndicates the need for treatment by controllers. Other options. In children who are not helped by SABA inhalations, intermittent high doses of ICS may be considered.

Step 2. Daily low-dose ICS and, as needed SABA. Other options. LTRA (montelukast), but parents should be warned of possible side effects

Step 3. Medium doses of ICS (double low daily doses). Evaluation of treatment should be carried out in 3 months. The child should be referred to experts if there is a weak response to treatment. Other options. LTRA and low doses of ICS

Step 4. Refer the child to a specialist. Other options.

Further increase the dose of ICS for several weeks to improve asthma control.

Add LTRA.

Add LABA in combination with ICS (for children older than 4 years)

Add low doses of OCS (for a few weeks only) to improve asthma control.

Add intermittent high doses of ICS at the beginning of ARI, followed by regular daily ICS if asthma exacerbation is a major problem.

Table 7

Low doses of inhaled corticosteroids for children 5 years and younger

Inhaled corticosteroids	Low daily doses (age-group with adequate safety and effectiveness data)
BDP (pMDI standard particle, HFA)	100 (5 years and older)
BDP (pMDI extrafine particle, HFA)	50 (5 years and older)
Budesonide nebulized	500 (1 year and older)
Fluticasone propionate (pMDI standard particle, HFA)	50 (4 years and older)
Fluticasone furoate (DPI)	Not sufficiently studied in children 5 years and younger
Mometasone furoate (pMDI standard particle, HFA)	100 (5 years and older)
Ciclesonide (pMDI, extrafine particle, HFA)	Not sufficiently studied in children 5 years and younger

For children aged 0–3 years, use an inhaler with a metered dose under pressure with a face mask or a nebulizer with a face mask.

For children 4–5 years use a inhaler with a dosed dose under pressure plus with a mouthpiece, an inhaler with a dosed dose under pressure and a special one with a face mask, or a nebulizer with a mouthpiece or face mask.

Asthma control is carried out according to the following criteria (table 8)

Table 8

Asthma control in children 5 years and younger

	Well controlled	Partially controlled	Uncontrolled
Has been observed in the last 4 weeks:			
Asthma symptoms during the day for a few minutes more often than once a week	Does not have	1–2 of these symptoms	3–4 of these symptoms
Is reduced activity due to asthma (running, playing less than other children, gets tired quickly while playing, walking)			
Do rescuers need drugs more than twice a week?			
Nocturnal awakening or cough due to asthma			

Table 9

Personalized treatment of asthma in children under 5 years

Choice of controllers	Step1	Step 2 Daily low doses of ICS	Step 3 Double dose of ICS	Step 4 Continue controllers Refer to expert advice
Other controllers		LTRA Low doses of ICS at the beginning of ARI	Low doses of ICS + LTRA Refer to a specialist	Add LTRA or increase the frequency of ICS or intermittent ICS
Drugs that improve the condition	SABA are required			
Consider this step for children	Uncommon viral wheezing or symptoms	Frequent wheezing requiring the use of SABA more than 3 times a year.	Not well-controlled asthma, exacerbation more than 3 times a year Asthma is not well controlled at low doses of ICS	Asthma is not well controlled at double doses of corticosteroids

Treatment of exacerbations

Primary care

Salbutamol 2 doses 2 times (100 g) after 20 minutes. When using a nebulizer, a dose of 2.5 mg of salbutamol solution is recommended.

Indications for hospitalization

- The child cannot talk or drink
- Cyanosis
- Respiration rate> 40 per minute
- Oxygen saturation <92 % when inhaling indoor air
- No respiratory noise during auscultation
- Lack of response to initial treatment with bronchodilators
- No reaction to 6 puffs of inhaled SABA (2 separate puffs, repeated 3 times) for 1–2 hours
- Persistent tachypnea, despite three doses of inhaled SABA, even if the child has other clinical signs of improvement

o Social environment that restricts the provision of acute treatment, or parents / guardians who cannot cope with acute asthma at home

During hospitalization, continue to give SABA for inhalation, oxygen (if available) to maintain a saturation of 94–98 % and give *systemic corticosteroids*. Enter the initial dose of oral prednisolone (1–2 mg / kg to a maximum of 20 mg for children under 2 years; 30 mg for children 2–5 years), or intravenous methylprednisolone 1 mg / kg 6 hours per day

Children with moderate exacerbations and poor response to initial SABA may be given *ipratropium bromide* as 2 puffs of 80 mcg (or 250 mcg using a nebulizer) every 20 minutes for 1 hour.

QUESTIONS FOR SELF – CONTROL

1. Determination of bronchial asthma in children.
2. Risk factors for bronchial asthma
3. Pathophysiological mechanisms of bronchial asthma.
4. Classification and clinical symptoms of bronchial asthma.
5. Criteria for the diagnosis of bronchial asthma
6. Treatment of bronchial asthma in children.
7. Severe asthma in children. Etiology, pathogenesis, clinical symptoms, diagnosis and emergency care.

Control tests

1. What is the normal respiratory rate in a child 1 year?

A. 50–60

B. 20–30
C. 30–40
D. 16–20

2. Which of the following cells is a source of allergic inflammation?
A. Erythrocytes
B. Leukocytes
C. Neutrophils
D. Eosinophil
E. May cells

3. All of the following are signs of atopy INITIAL:
A. Hereditary predisposition
B. IgE overproduction
C. Eosinophilia
D. Leukocytosis

4. What is the type of immune response to anaphylactic shock and atopic bronchial asthma?
A. Type I
B. Type II
C. Type III
D. Type IV
E. Types III and IV

Answers: 1) C, 2) E, 3) D, 4) A

Situational tasks

1. An 11-year-old girl suffers from bronchial asthma for 4 years with exacerbation at the time of ragweed and poplar flowering. Diseases of the upper respiratory tract are rare. These symptoms appear in the spring (April, May). The father suffers from bronchial asthma. What is the main pathogenic mechanism of the disease?
A. Autoimmune
B. Microbial inflammatory
C. Neurogenic
D. IgE reagents
E. Immune complexes

2. An 8-year-old girl suffers from recurrent hay fever and bronchial asthma. Shortness of breath after indomethacin attack of dry cough. Physical

examination reveals BH-26 `, tympanic percussion sound, wheezing, prolonged exhalation. Which diagnosis is most likely?

A. Pneumonia
B. Acute bronchiolitis
C. Obstructive bronchitis
D. Medical allergy
E. Aspirin asthma

3. A 10-year-old boy has been suffering from bronchial asthma for 7 years. Frequent exacerbations, 1-2 attacks per week, weekly night symptoms, physical activity decreases. PEF, FEV1 <60%, daily bronchial lability> 30%. Determine the stage of bronchial asthma.

A. Status asthmaticus stage I.
B. Moderate bronchial asthma
C. Mild persistent bronchial asthma
D. Severe bronchial asthma
E. Status asthmaticus stage II

Answers: 1 – E, 2 – E, 3 – D

LITERATURE

The main sources of information

1. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention, 2020. https://www.ginasthma.org
2. Nelson textbook of Pediatrics 19th ed. / Kliegman RM, Behrman RE, Jenson HB, Stanton BF. Philadelphia, Pa: Saunders Elsevier; 2011. – 2615 p.
3. Pediatrics. Textbook / O. V. Tiazhka, T.V. Pochinok, A.N.Antoshkina and al. /edited by O. Tiazhka – Vinnytsia: Nova Knyha Publishers, 2011. – 584 p.

Additional sources of information

1. Capitan T. Propaedeutics of children's diseases and nursing of the child. – Vinnisa, 2010, – 807 p.
2. Propedeutics of paediatrics /V. A. Fjoklin, V. A. Klymenko and all – Kharkiv, 2010. – 346 p.
3. Contemporary Pediatrics/ O. Ozdemir – Croatia. – 2012, 432 p.
4. The Harriet Lane handbook: a manual for pediatric house officers/ the Harriet Lane Service. Children's Medical and Surgical center of the Johns Hopkins Hospital. – 19th ed. /editors, Megan M. Tschudi, Kristin M. Acara. 2012. – 1132 p.

5. Pediatrics /H. Bauchner, R.Vinci, M. Kim, Cambridge University Press. 2010 - http://ebooks.cambridge.org

6. American Academy of Allergy, Asthma and Immunology: http://www.aaaai.org

7. National Heart, Lung, and Blood Institute https://www.nhlbi.nih.gov/health-topics/asthma

8. Papadopoulos NG, Arakawa H, Carlsen KH, Custovic A, Gern J, Lemanske R, et al. International consensus on (ICON) pediatric asthma. Allergy. 2012; 67:976–97. doi: 10.1111/j.1398-9995.2012.02865.x.

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