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Modern principles of allergic rhinitis therapy in children

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The article is dedicated to allergic rhinitis (AR) in children. AR is widespread among children and adolescents; it negatively affects physical and psychological condition, social life and school performance and reduces life quality of both patients and members of their families. The authors consider the most modern approaches to diagnostics and control over the disease and present evidence-based recommendations. The authors offer the relevant classification; describe classic and additional disease symptoms and list the key nosological forms of differential diagnostic search. The complex of therapeutic measures to be taken at AR is aimed at relieving devastating symptoms of the disease and involves limitation of contacts with pathogenetically significant allergens, drug therapy, specific immunotherapy and education. Preventive measures are aimed at preventing development of sensitization/manifestation/aggravation of the AR course. The information given in the article is aimed at spreading the main principles of AR therapy and increasing accessibility of the modern methods of control over allergic diseases.

Key words: allergic rhinitis, children, control, therapy.

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Allergic diseases, the prevalence rate of which continues to grow, constitute a global issue for the world healthcare. Allergic rhinitis (AR) is a disease widespread among the children and adolescents, causing extensive socio-economic load as well as negative influence on the quality of life of both the patients and the members of their families [1–5].

Moreover, according to the results of the epidemiological studies, 10-40% of AR patients also suffer from bronchial asthma (BA). At the same time, almost 100% of BA patients, at least among the children, complain of AR manifestations.

Constant sneezing, itching, rhinorrhea, nasal obstruction, cough and snoring, sleep disorders and fatigue negatively influence physical and psychological condition and social wellbeing, causing downside in school performance [6].

Despite the presence of excruciating symptoms, the proven interconnection with and the influence on bronchial asthma, the issue of AR is often paid very little attention to, sometimes no more than a usual cold [5]. As a result, most of the pediatric patients either do not receive any adequate therapy they require, or are treated sporadically, taking palliative medications, falling out of modern treatment regimens.

One of the reasons of this situation, which is not exclusively typical for our country, is the absence of guidelines on allergic rhinitis in children and its differences from the rhinitis in adults. The acute problem of choosing the correct treatment aiming at controlling the AR

symptoms in a minor patient, which is peculiar for the lack of certainty in terms of the benefits and drawbacks of certain methods, provided the ground for the topicality and the necessity to establish proven and well-based recommendations on the diagnosis and treatment of this nosology in children.

The recommendations of the European Academy of Allergy and Clinical Immunology (EAACI) workgroup studying rhinitis in children and the consensus paper from the AR and its Impact on Asthma initiative group were analyzed [1, 2, 5]. The clinical guidelines on AR diagnosis and treatment [3] in children by the professional association of the Union of Pediatricians of Russia was updated in accordance with the most state-of-the-art, evidence-based recommendations. The article quotes modern principles and the most reliable data on the epidemiology, classification, diagnosis and prophylaxis of AR in children.

DEFINITION

Allergic rhinitis — IgE-associated inflammatory disease of the nasal mucosa caused by the impact of a sensitizing (cause-significant) allergen, which is manifested with at least two of the following symptoms – sneezing, itching, rhinorrhea, or nasal obstruction [1-5].

ICD-10:

J30.1 Allergic rhinitis caused by plant pollen.

J30.2 Other types of seasonal allergic rhinitis.

J30.3 Other types of allergic rhinitis.

J30.4 Unspecified allergic rhinitis.

EPIDEMIOLOGY

Allergic rhinitis is a widespread disorder. The phase III study conducted in the framework of the International Study of Asthma and Allergy in Children (ISAAC) showed that the average spread of rhinitis is 8.5% (1.8-20.4%) in 6-7-year-old and 14.6% (1.4-33.3%) in 13-14-year-old children [7]. For the time elapsed since similar phase I study had been taken the increase in the observed prevalence of rhinitis in the world was registered. However, the data provided by different centers vary considerably [3, 7].

The prevalence of AR symptoms in the Russian Federation is ca. 18-38%. The boys develop AR more often. Children below 5 years of age have the lowest prevalence of AR; the rise in the incidence rate is registered in the primary-school age group [3].

Based on the research findings conducted according to the protocol GA2LEN (Global Allergy and Asthma European Network - Global network of allergy and asthma in Europe) in 2008-2009., the prevalence of symptoms of allergic rhinitis in adolescents of 15-18 years was 34.2%, what prevails over the official statistics considerably [4]. Girls were significantly more indicated the presence of AR in comparison with boys (38.57 and 27.27%, respectively, $p = 0.0001$). Current symptoms of allergic rhinitis were observed in 86.45% of the total number of respondents who reported having accumulated incidence of rhinitis. Over in-depth observations the diagnosis of allergic rhinitis was confirmed only in 10.4% of the adolescents, which, however, is 20 times higher than officially reported incidence rates for AP uptake in Moscow for 2008, according to the Health Ministry of the Russian Federation (599.2%).

CLASSIFICATION

The traditional approach classifies AR on the basis of length and intensity of symptoms in the presence of sensitizing [1].

In particular, the typical allergens are the house dust mites, arborescent, grain, and weed plant pollen, animal (cats' and dogs') allergens as well as mold fungi *Cladosporium*, *Penicillium*, *Alternaria* etc. [1–5].

There also are data stating that the presence of AR in adults is possible in the absence of any specific notable sensitizing; it is caused by the local accumulation of immunoglobulin (Ig) E in the nasal mucosa (so called entopy) [8]. The question of whether this effect is present in children is still in the state of open discussion [9].

Depending on the nature of the pathogenetically significant allergen allergic rhinitis may be of **seasonal** (in case of sensitizing to pollen or fungal allergens) or **perennial** type [in case of sensitizing to household (house dust mites, cockroaches) and epidermal (animal scruff) allergens]. However, the clear distinction between the seasonal and perennial rhinites is not always and everywhere possible; consequently, this terminology has been reviewed. Based on the symptoms persistence duration (ARIA classification), the following types are defined:

- **intermittent AR** (seasonal or perennial, acute, occasional; symptoms present for < 4 days per week or < 4 weeks per year);
- **persistent AR** (seasonal or perennial, chronic, long-term; symptoms present for ≥ 4 days per week or ≥ 4 weeks a year).

This approach may be conveniently used to describe the manifestations of rhinitis and its influence on the quality of life, as well as to choose a possible approach to treatment.

Based on the intensity of manifestations of rhinitis and its influence on the quality of life, AR is classified into:

- **mild AR** (minor symptoms, normal sleep, normal every-day activity, sports, rest; does not intervene with the school studies or professional activity);
- **moderate AR** (if any of the excruciating symptoms are present, resulting in the presence of at least one of the following manifestations: sleep disturbance, disruption of every-day activity, inability to do sports or have normal rest; disruption of professional activity or school studies);

Apart from that, the allergic rhinitis **exacerbation** and **remission stage** are also outlined.

CLINICAL ASPECT

The basic (classic) symptoms of allergic rhinitis are as follows [1–5]:

- rhinorrhea (transparent mucous secretion from the nasal passages);
- sneezing (often paroxysmal);
- itching, less frequently – intranasal burning sensation (sometimes accompanied by palatal and pharyngeal itching);
- nasal obstruction, distinctive oral breathing, sniffing, snoring, apnea, change and nasal twang of the voice (tb. 1).

The specific symptoms also include "allergic shadows beneath the eyes": darkening of the lower lid and the periorbital area, especially in the event of severe chronic process.

Additional symptoms develop due to profuse discharge of nasal secretion, dysfunctional drainage of paranasal sinuses and passage of auditory (Eustachian) tubes. The symptoms may include cough, weakened or absent olfaction, supralabral and alinasal skin irritation, edema and hyperemia; nasal bleeding due to forced blowing of the nose; pain in the throat, cough (manifestation of the associated allergic pharyngitis, laryngitis); pain and cracking in the ears, especially when swallowing; hearing disorders (manifestations symptoms of allergic tubootitis).

The following symptoms are mentioned among the general non-specific symptoms observed at allergic rhinitis:

- asthenia, malaise, irritability,
- headaches, increased fatigue, lowered concentration;
- sleep disorders, oppression;
- infrequent rise of body temperature.

Comorbidity, symptoms

The nose is anatomically and functionally connected with the eyes, maxillary sinuses, nasopharynx, middle ear, larynx and lower airways: thus, the symptoms may include conjunctivitis, chronic cough, oral breathing, nasal twang of the voice and snoring with or without obstructive apnea during sleep [3, 5].

Allergic conjunctivitis is considered to be the most frequent comorbidity associated with AR [10]. It is characterized by severe itching of the eyes, conjunctival hyperemia, watering of the eyes and, sometimes, periorbital edema.

Chronic allergic inflammation of the upper airway may cause **hypertrophy of the lymphoid tissue**. A considerable increase in the size of adenoids during the pollen season is often registered in children with pollinosis [11]. Polysomnography demonstrates an express correlation of the **sleep apnea syndrome** with the medical history of nasal obstruction and AR. Rhinitis is

also associated with **chronic exudates in the middle ear and the Eustachian tube dysfunction**, which have a potential to serve as a cause for lowered hearing capacity [5]. The local secretion of IgEs non-specific and specific to the environmental and staphylococcal enterotoxin antigens may also play a role in the pathogenesis of the ongoing allergic inflammation of the adenoid lymphoid tissue in atopic children [9, 12].

Allergic rhinitis is often accompanied by **asthma**, being one of the crucial risk factors of its emergence. AR is one of the reasons of exacerbation and decrease in / lack of control over bronchial asthma: its symptoms often precede the asthma manifestation [3]. AR is a major risk factor for seeking emergency medical care in the event of asthma [5].

At the same time, cough at allergic rhinitis may sometimes lead doctors to erroneously establish bronchial asthma diagnosis [5].

Constituting one of the "steps" of atopic advance, allergic rhinitis is often accompanied by **atopic dermatitis**, which sometimes precedes and often comes ahead of this form of allergy.

Allergic rhinitis caused by pollen sensitizing may be associated with the symptoms of **food allergy**. Such symptoms as itching and edema of the mouth cavity emerge due to the cross-reactivity of the air-borne allergens (birch pollen) and fruits/vegetables (e.g., apples) [13].

DIAGNOSIS

AR diagnosis is established on the basis of the medical history data, the presence of characteristic clinical symptoms and if the significant allergens are detected (by skin testing or the *in-vitro* IgE-class allergen-specific antibodies titer testing if skin testing is not possible)^D.

Medical history and physical examination

During the medical history taking, the following information is collected: the occurrence of allergic diseases in the relatives; the character, frequency, length and severity of the symptoms; the presence/absence of seasonal breakouts; response to therapy; occurrence of any other allergic diseases in the patient; initiating factors.

Rhinoscopy (visual examination of nasal passages, nasal cavity mucosa, secretion, nasal turbinates and septum) is required. AR patients usually have pale, livid-grey, edematous mucosa. The secretion is mucous and hydrous.

In the event of chronic or severe acute AR, a transverse fold is revealed on the back of the nose, which is formed in children as a result of "allergic salute" (rubbing the tip of the nose). Chronic nasal obstruction results in the formation of a typical "allergic face" (dark circles beneath the eyes, facial skull development disturbance, including malocclusion, arched palate and flattening of molars).

Detection of sensitizing allergens

Skin testing allows detecting cause-significant allergens.

If this test is impossible to hold and/or there are certain contraindications to it (age under 2 years, exacerbation of the comorbid allergic pathology, intake of medications affecting testing results etc.), the analysis of the specific IgE-class antibodies is conducted. This method is more expensive, but it is not necessary to withdraw intake of antihistamine medications before the test. Allergic sensitizing is diagnosed on the basis of positive results of skin testing or detection of the IgE-class antibodies specific to a certain allergen; quantitative parameters of the tested indicator are very important (papule size, blood serum sIgE concentration).

Additional testing methods

To rule out all the other diagnoses while performing differential diagnostic search and/or in the event of therapy inefficiency, the use of following additional testing methods is recommended^D:

- computed tomography of paranasal sinuses (to rule out chronic rhinosinusitis and polyposis)^D;
- nasopharyngeal endoscopy for the visualization of polyps^D and ruling out other possible causes of compromised nasal breathing (foreign body, nasal septum deviation etc.);
- determination of the nasal mucociliary clearance and the nasal NO concentration (to rule out primary ciliary dyskinesia)^C;
- in order to rule out bronchial asthma, it is necessary to define parameters of the external breathing function and perform a bronchial spasmolytic test of the bronchial obstruction reversibility. In dubious cases the test is performed under physical activity;
- if obstructive sleep apnea is suspected, polysomnography must be performed;
- if hearing ability affecting symptoms are present after the front rhinoscopy and otoscopy performed under ENT supervision, additional tests are conducted: tympanometry, acoustic impedancemetry; consultation with an audiologist might be required.

Additional methods **not recommended** for routine application are as follows:

- cytological examination of nasal cavity swabs: this method is aimed at the detection of eosinophils (performed in the event of disease exacerbation). Practical application of this method is limited, as eosinophils may appear in nasal secretion due to other disorders (BA, nasal polyps with/without BA, non-allergic rhinitis with eosinophilic syndrome);
- determination of the eosinophil content and the total blood IgE concentration has little diagnostic value;
- provocative allergen tests are of limited application in pediatric clinical practice^C and may only be performed by specialists (allergists) at specialized allergological medical institutions.

DIFFERENTIAL DIAGNOSTICS

Differential diagnostics of allergic rhinitis is performed on the basis of the symptoms with special regard to the age-related peculiarities^D (tb. 2). They are paid special attention to, when the treatment does not affect the symptoms [3, 4, 14].

Nasal obstruction

The nasal breathing obstruction (nasal obstruction) may result from the mucous pathology and/or anatomic abnormalities (nasal septum deviation is often observed; nasal vestibule stenosis with cleft lip, choanal atresia or piriform aperture stenosis are observed less often). AR often causes nasal obstruction accompanied by breathing through the wide-open mouth, snoring and nasal secretion discharge in children of pre-school age. However, adenoid vegetations are a rather widespread pathology as well; it is characterized by similar symptoms. Nasal polyps obstructing nasal breathing are the basis for the exclusion of mucoviscidosis and/or primary ciliary dyskinesia or, in the event of unilateral polyp, of encephalocele^D. In rare cases, nasal obstruction may be caused by a malignant neoplasm.

Nasal passage secretion color

Nasal passage secretion color is the primary diagnostic criterion used to make judgments on the character of the pathology^D. Transparent secretion is observed at the initial stages of viral rhinitis, at AR and in rare cases of cerebrospinal efflux (CSE). Viscous and often colored mucus is observed in the nasal cavity in the presence of adenoid vegetations, recurrent adenoidites and/or rhinosinusitis as well as at the later stages of viral rhinosinusitis. Sinusitis in children is always associated with the inflammation of nasal cavity; thus, the term "rhinosinusitis" is preferable.

A lengthy, chronic severe rhinosinusitis may also be associated with primary ciliary dyskinesia, mucoviscidosis and dysfunction of humoral and/or cellular immune system components^D.

Children with unilaterally colored secretion ought to be examined due to the risk of foreign objects^D.

Olfactory dysfunction

Olfactory dysfunction is a typical symptom of rhinosinusitis; the children with severe rhinosinusitis and nasal polyps may be diagnosed with hyposmia or anosmia, often without any notable subjective symptoms. A rarely diagnosed Kallmann syndrome is characterized by anosmia caused by olfactory bulb hypoplasia [15].

Nasal hemorrhage

Mild outbreaks are possible due to AR or blood congestion in the Kiesselbach's area vessels. In the event of profuse nasal hemorrhage, an endoscopic examination is prescribed, as it is necessary to rule out nasopharyngeal angiofibroma and coagulopathy^D.

Cough

Cough is an important manifestation of rhinitis caused by the mucus run down the back wall of the pharynx and irritation of cough receptors in the nasal cavity, larynx and pharynx. If no other AR symptoms are registered and the performed therapy fails to produce any effect, it is necessary to perform differential diagnostics of recurrent infections of the upper airways, pertussis, foreign bodies, aspirational bronchiectasis and tuberculosis. If no other symptoms of bronchial obstruction are present, occurrence of bronchial asthma in a patient is most probable.

Apart from the listed above, the differential diagnostics is performed in order to reveal the following forms of non-allergic rhinitis (tb. 3) [1–5, 16]:

- vasomotor (idiopathic) rhinitis is often diagnosed in the older children. It is characterized by nasal obstruction becoming severer in the event of temperature changes, air humidification and strong smells; persisting rhinorrhea, sneezing, headaches, anosmia and sinusitis. Sensitizing is not detected during the testing; hereditary allergic background is not compromised. Rhinoscopy reveals hyperemia and/or mottled mucosa and viscous secretion;
- medically induced rhinitis (including drug rhinitis) caused by the long-term use of decongestants. Characterized by constant nasal obstruction; rhinoscopy reveals bright red color of mucosa; positive response to treatment with intranasal glucocorticosteroids required to successfully withdraw the medications causing this disorder;
- non-allergic rhinitis with eosinophilic syndrome (NARES) is characterized by intense nasal eosinophilia (up to 80-90%), absence of sensitization and allergological anamnesis; sometimes is the first symptom of intolerance of nonsteroidal anti-inflammatory drugs. The symptoms also include sneezing and itching, tendency to nasal polyp formation, lack of adequate response to the treatment with antihistamines and good effect of intranasal glucocorticosteroids.

TREATMENT

The main goal of the therapy is symptomatic relief. The complex of therapeutic measures include:

- limitation of contact with pathogenetically significant allergens;
- drug therapy;
- specific immunotherapy;
- education.

Limitation of contact with allergens

It is impossible to fully escape contact with the open air-borne allergens, particularly with pollen. But even partial limitation of contact with a causative allergen relieves AR symptoms,

decreasing activity of the disease and the need in pharmacotherapy. However, all of the elimination measures should be personalized, as they are cost-effective and efficient only if a detailed preliminary allergological examination (including medical history analysis (clinical significance appraisal), skin testing and/or sIgE titer determination) has been performed.

The indoor allergens (dust mites, pets, cockroaches and mold fungi) are considered to be the major triggers and are targeted by specific interventions. Full elimination of allergens is usually impossible, and some measures entail considerable financial expenditures and inconvenience, while having limited efficiency. The external allergens are even more complicated to cope with; the only recommended approach might be staying inside during certain periods of time (in case of pollen sensitization).

- Pollen allergens. The seasonal character of symptoms in spring is caused by the dispersion of pollen from the trees (birch, alder, hazel, oak), in the first half of the summer – from graminaceous plants (three-fork-grass, timothy, rye), in the end of the summer and in the autumn – from the weeds (sage, plantain, ambrosia). In the blossoming season it is recommended to keep windows and doors closed both at home and in the car, use the air-conditioning systems when inside and limit the time spent outside in order to avoid allergen exposure. After a walk it is recommended to have a bath or a shower in order to remove pollen from the skin and prevent its staining the underwear.

- Spores of mold fungi. In order to eliminate the allergens, it is necessary to thoroughly clean air humidifiers and steam funnels, use fungicides and keep the relative humidity level inside below 50%.

- Allergens carried by house dust mites (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*). Use of special anti-mite bed linen and mattress cases impermeable to allergens helps to reduce the concentration of house dust mites, but does not result in considerable alleviation of the allergic rhinitis symptoms.

- Epidermal allergens (animal allergens from cats, dogs, horses etc.). The most efficient way is to stay away from any contact with the animal.

- Food allergens (cause AR as a result of cross-reaction during the pollen sensitization).

Despite the fact that the fungi spores and the allergens carried by house dust mites are classified as perennial, their air-borne number is usually lower during the winter months and higher during the spring-autumn period.

It ought to be mentioned that clinical improvement should be expected a considerable period of time (weeks) after elimination of the allergens.

Drug therapy

Antihistamines

The 1st generation antihistamines have an adverse therapeutic profile; they should not be used to treat AR due to acute (sedative and anticholinergic) side effects^B. The drugs belonging to this group disturb cognitive functions: attention concentration, memory and learning abilities.

The 2nd generation antihistamines constitute the basic AR therapy irrespective of the severity. Both oral and intranasal 2nd generation antihistamines are efficient for treating AR^A [5]. Oral medications feature better tolerability, while nasal preparations are characterized by a quicker effect [17].

Systemic antihistamines prevent and diminish such AR symptoms as itching, sneezing, rhinorrhea, but they are less efficient in terms of alleviating nasal obstruction. Tachyphylaxis cannot develop, if the treatment involves the 2nd generation antihistamines.

Intranasal antihistamines are an effective for intermittent and persistent AR.

In some children, the 2nd generation antihistamines may also have a mild sedative effect [18].

Intranasal corticosteroids

Intranasal glucocorticosteroids (GCSs) actively affect the AR inflammatory component, effectively decreasing acuteness of such symptoms as sneezing, itching, rhinorrhea, nasal obstruction, as well as ocular symptoms. They are recommended to children and adolescents over 2 years of age^A [1–5, 19]. It has been proven that the effect of mometasone and fluticasone application is obvious as early as within the first 24 hours from the beginning of treatment [20]. Use of intranasal GCSs alleviates manifestations of the concurrent asthma^A [21], while mometasone and fluticasone furoate are also effective against the concurrent allergic conjunctivitis^B [22].

Nasal corticosteroids are well-tolerated. Modern drugs to be used OD (e.g., mometasone, fluticasone propionate, fluticasone furoate) are preferred, as, having lower systemic bioavailability (0.5%) in comparison with beclometasone (33%), they do not reduce the growth rate (according to the treatment data for 1 year^A) [5].

A possible adverse effect of a wrong nasal corticosteroids usage is the risk of nasal septum perforation and nasal hemorrhage; however, the lack of systematic data on these adverse effects does not allow properly evaluating the possible risk.

In order to improve efficacy of intranasal GCSs, it is recommended to clear the nasal cavity off mucus before administration of the medications and use moistening agents.

Systemic corticosteroids

Given the high risk of development of adverse effects, the application of this group of drugs for treating AR in children is very limited. In the event of severe AR, schoolchildren may only be prescribed a short course of 10-15 mg of **prednisolone** per day to be taken orally for 3-7 days^D [5].

Leukotriene receptor antagonists

Montelukast has the most extensive evidence basis among the leukotriene modifiers. This drug is widely used in children all over the world. Montelukast monotherapy is efficient for both intermittent and persistent types of AR^A (the level of evidence hereinafter is quoted for the original medicine Singulair).

In children with concurrent bronchial asthma the inclusion of montelukast in the treatment schedule helps to efficiently control the AR symptoms without increase in the GCS load. Montelukast causes almost no adverse events.

Nasal decongestants

Topical decongestants may be used only for several consecutive days (3-5) in case of intense nasal obstruction, since longer usage results in the recurrent rhinodema^C.

Nasal sodium cromoglicate

Cromones are less efficient for treating AR in comparison with intranasal GCSs, antihistamines and montelukast. The required administration several times a day and low efficacy in comparison with other groups of medicines bring down the patient compliance rate.

Other drugs

Moisturizers

The use of these drugs helps to moisturize and clear the nasal mucosa; its efficacy has been proven^A. Rinsing the nasal cavity with saline is an inexpensive method of treating rhinitis with low, but proven efficacy [23, 24].

Anti-IgE-therapy

It has been established that omalizumab is an effective means of treating both asthma and the concurrent allergic rhinitis in patients with severe and moderate persistent uncontrolled asthma and AR [25, 26]. However, this drug is not used to treat AR alone.

Alternative therapies

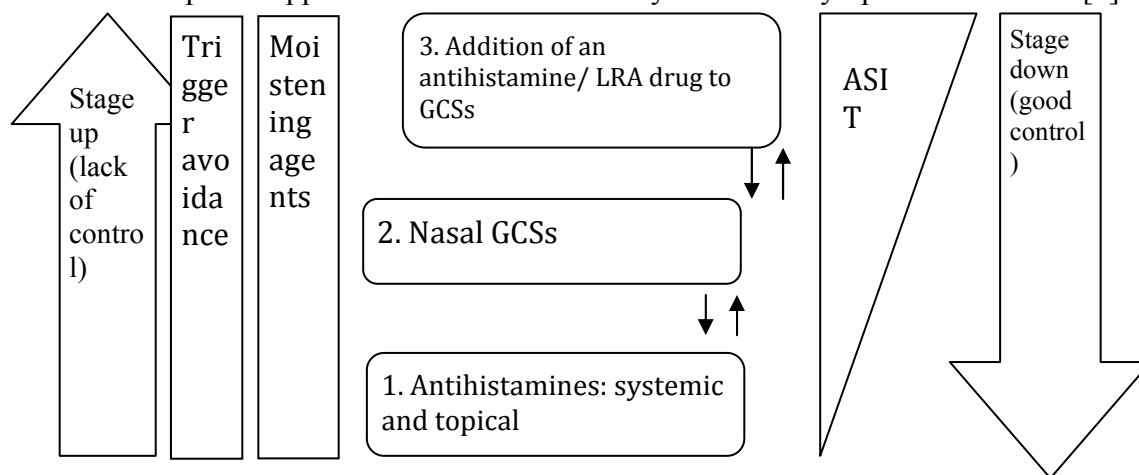
There are no convincing data on the efficacy of alternative AR therapies [27].

Principles of drug therapy

To sum up the aforementioned information on pharmacotherapeutic groups of drugs used to treat AR in children, it is important to outline several therapeutic principles (pic.).

- There are sufficient data to state that nasal corticosteroids are more efficient in terms of treating AR than antihistamines and montelukast^B [5, 28].
- The nasal obstruction symptoms are most efficiently alleviated by nasal corticosteroids^B [29].
- Antihistamines and montelukast have both proved to be equally good as complementary agents to the nasal corticosteroid therapy^B [28-30]. However, there existing comparative data are not sufficient to determine, whether antihistamines are more efficient than montelukast.
- It may be safely assumed that topical GCSs, antihistamines and montelukast are more efficient in terms of AR treatment than nasal cromones^B [5, 28].

Pic. Principles of treating allergic rhinitis in children. 1, 2, 3 – therapy stages in the framework of the therapeutic approach based on the severity of rhinitis symptoms. Modified [4]



Note. LRA – leukotriene receptor antagonists, GCSs – glucocorticosteroids, ASIT – allergen-specific immunotherapy.

- Nasal GCSs may also be used as the first-choice therapy of moderate and severe AR, especially if nasal obstruction is the object of most complaints, while the 2nd generation antihistamines / montelukast may be preferred in the event of mild AR [1-5].
- Oral antihistamines may be better tolerated, whereas intranasal antihistamines are characterized by an earlier onset of action [5].
- If control is not achieved within 1-2 weeks, the diagnosis should be reviewed [5, 14].
- For seasonal disorder, the regular treatment should begin 2 weeks prior to the expected symptom breakout [3, 5, 31].
- If the patient is under 2 years of age and antihistamines yield no effect for 1 week, the diagnosis should be reviewed before intensifying the therapy [3, 5].

- If the symptoms are not controlled and the AR is severe, a short decongestant course is prescribed; if necessary, a short emergency course of low-dose oral prednisolone may be prescribed in order to achieve control over the symptoms [5].

Immunotherapy

Allergen-specific immunotherapy (ASIT) is a pathogenetic treatment of IgE-mediated allergic disease [32], when the allergenic preparation is administered with gradual increase in dosage. Its goal is to diminish the symptoms associated with later exposure to (impact of) the causative allergen [1-5].

ASIT is prescribed when there is solid proof of interconnection between the allergen exposure, disease symptoms and the IgE-mediated mechanism [3]. ASIT induces clinical and immunological tolerance, has long-term efficiency and may prevent progression of allergic diseases: it diminishes the risk of asthma development in patients with AR and conjunctivitis and widening of the sensitization specter. ASIT has proven positive effect on the quality of life of the patients and members of their families [1-5].

Allergen-specific immunotherapy shall be performed by an allergist-immunologist. The treatment is performed only at specialized allergological rooms of outpatient-polyclinic institutions and allergological departments of in-patient and day-patient facilities. The therapy duration is usually 3-5 years. The drug and the mode of administration are selected by the specialist on an individual basis. Sublingual ASIT is more preferable for children, as it is painless and convenient in terms of the means of administration and has a more positive safety profile in comparison with the subcutaneous method. Premedication with antihistamines may lower the spread and severity of adverse effects^B [5].

The contraindications against the allergen-specific immunotherapy are severe concurrent conditions: immunopathological processes and immunodeficiencies, acute and chronic visceral diseases, severe persistent bronchial asthma, which is hardly controlled with medications, contraindications against the use of adrenaline and its analogs, low tolerance to the method [3, 5, 32].

Pharmacoeconomic models, based on the data of clinical studies and meta-analyses indicate that ASIT is also cost-effective. The results of a cohort study of children with AR, conducted in the USA, indicated decrease of expenditures in the group of children undergoing ASIT by 33% [33, 34].

Education

Education of patients and members of their families is a continuous process. The goal of such an interaction between patients and their parents/guardians and a medical professional is to achieve compliance and commitment to the established plan of therapy.

As a part of educational process, a medical professional should provide patients and members of their families with the necessary information on the nature of the disease, elimination actions, drugs for symptoms termination and specific immunotherapy, as well as to compile the personal plan in writing [1-5].

It is important to convince patients and their parents/guardians that the medications are harmless; control the technique of nasal medications administration on a regular basis; provide information on the character of rhinitis, the concurrent diseases and complications and the advantages of the effective therapy [35].

The primary education should be complemented with other educational measures (allergological courses). One of the promising alternatives, especially for older children and adolescents, is the use of educational software and Internet-resources^B [36].

PROPHYLAXIS

The primary prophylaxis is first and foremost conducted among the risk group children with compromised hereditary background in terms of atopic disorders. Primary prophylaxis includes the following measures [3, 37]:

- (for pregnant women) compliance with a rational diet; highly allergenic products are excluded from the diet in the event of allergic reactions;
- elimination of occupational hazards from the first month of pregnancy;
- intake of medications only on the basis of strong indications;
- cessation of active and passive smoking as a factor inducing early sensitization of a child;
- breast feeding is the most important component of atopic susceptibility prevention; it should be maintained until the 6th month of life at the very least (the whole cow milk should be excluded from an infant's diet; the introduction of supplemental feeding is not recommended until the age of 6 months);
- elimination procedures.

The secondary prophylaxis is aimed at prevention of AR manifestation in sensitized children and includes the following measures [3, 37]:

- control over the state of environment (neutralization of impact of the potentially sensitizing factors: pets, plants, phytotherapy, etc.);
- hypoallergenic diet with regard to the sensitizing spectrum;
- preventive antihistamine therapy;
- allergen-specific immunotherapy;
- prevention of respiratory infections as allergy triggers;
- educational programs.

The major goal of **the tertiary prophylaxis** is to prevent severe course of AR. The frequency and the length of exacerbation periods are diminished by means of the most efficient and safe medications, as well as by allergen elimination [37].

Allergic rhinitis in children is without any doubt an underestimated problem [1-4, 37]. The crucial issues of diagnostics and treatment of allergic rhinitis in children reviewed in the article are aimed at spreading the major principles of treating this nosological form, as well as at improving accessibility of the modern methods of controlling allergic diseases. The implementation of the harmonized modern evidence-based recommendations will help to improve the quality of life of children with AR.

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Table 1. Allergic rhinitis presentation in children [4]

Age	Pre-school	School	Adolescents
Symptoms			
Major symptoms	Rhinorrhea: transparent secretion Itching: nose-rubbing, "allergic salute", "allergic nasal fold"; sometimes accompanied by palatal and laryngeal itching Sneezing Nasal obstruction: oral breathing, snoring, apnea, "allergic circles beneath the eyes"		
Possible additional symptoms	Pain in the ears at change of pressure (e.g., during the flight) caused by the dysfunction of Eustachian tubes Partial loss of hearing due to chronic medium otitis		
	Cough Sleep disorders: fatigue, school underachievement, irritability Lengthy and frequent infections of airways Low control over asthma		
		Headache, facial pains, bad breath, cough, hypo- and anosmia with rhinosinusitis Symptoms of food cross-allergy, especially at allergic rhinitis caused by pollen	

Table 2. Differential characteristics of rhinitis in children ^D

Diagnosis	Pre-school age	School age	Adolescents
Infectious rhinitis	Nasal obstruction, rhinorrhea, sneezing*		
Rhinosinusitis	-	Colored secretion, headache, facial pains, olfactory deterioration, bad breath, cough	
Nasal septum deviation	-	Nasal obstruction in the absence of other symptoms of allergic rhinitis	
Choanal atresia or stenosis	Nasal obstruction in the absence of other symptoms of allergic rhinitis	-	-
Immune deficiency disorders	Mucopurulent secretion (persistent process)	-	
Encephalocele	Unilateral nasal polyp	-	-
Adenoid vegetations	Oral breathing, mucopurulent discharge, snoring in the absence of other symptoms of allergic rhinitis		-
Foreign body	Unilateral process with		

	colored secretion and stinking odor	-	-
Mucoviscidosis	Bilateral nasal polyps, olfactory deterioration, chronic bronchites, evacuation disorders, development delay		
Primary ciliary dyskinesia	Persistent mucopurulent discharge present even in between the "colds", bilateral stasis of mucus and secretion at the bottom of nasal septum, symptoms since birth		
Coagulopathy	Recurrent nasal hemorrhages caused by minimal traumas		
Systemic autoimmune disorders (Wegener's granulomatosis)	-	-	Rhinorrhea, purulent and hemorrhagic secretion, necrotic-ulcerative affection of nasal and oral mucosae, possible perforation of nasal septum, eustachitis, polyarthralgiae, myalgiae
Cerebrospinal fluid efflux	Colorless nasal secretion, often – traumas in medical history		

Note. * — more often of viral or bacterial etiology, rarely of fungal etiology. In the setting of acute respiratory viral infection the nasal symptoms prevail in the 2nd and the 3rd day and fade by the 5th day. On the average, infants might have up to 11 episodes of upper airway infections incidents per year, preschool-aged children – up to 8, schoolchildren - up to 4.

Table 3. Etiological factors causing rhinitis symptoms in children

AR	Influence of a sensitizing allergen
Infectious rhinitis	Infectious etiology: viral, bacterial, protozoan/fungal (very rarely)
Non-allergic, noninfectious rhinitis	Influence of irritants (e.g., tobacco smoke) Hormonal causes (hypothyroidism, adolescent pregnancy) Drug-induced (intake of β -blockers, NSAIDs, contraceptives) Vasomotor (idiopathic) rhinitis