

Therapeutic approaches to allergic rhinitis: Treating the child

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Allergic rhinitis is currently the most common of all chronic diseases in children. However, children frequently lack the ability to verbalize their symptoms, with the result that the condition may go undiagnosed and untreated. Unfortunately, untreated allergic rhinitis not only detrimentally affects children's physical and psychosocial well-being, quality of life, and capacity to function and learn, but it is also associated with and may contribute to potentially serious sequelae, including asthma, sinusitis, and otitis media. Because children may not accurately describe their symptoms, the classic signs of allergic rhinitis in the pediatric population, including the allergic shiner, the allergic crease, and the allergic salute, are particularly important in enabling the clinician to recognize those children who may have this condition; other significant signs include mouth breathing, snoring, chronic cough, and continual throat clearing. The options for treating allergic rhinitis in the child are the same as those for the adult, and the clinician can expect the same level of efficacy. Environmental control for allergen avoidance is an important goal, but the clinician must prescribe it within the context of the family's lifestyle to obtain compliance. Complete avoidance of inhalant allergens is not always feasible, and medications are necessary. Oral antihistamines remain the mainstay of initial treatment for allergies. Given evidence of the significant deleterious effects of the sedating antihistamines on learning, the clinician should prescribe nonsedating second-generation agents whenever possible. Decongestants may be needed. Intranasal corticosteroids are a most effective option, and these agents lack the systemic side effects associated with orally administered steroids. In persistent disease, allergen immunotherapy injections may be considered. In all cases, the clinician should consider issues that are likely to influence compliance in the pediatric population. (*J Allergy Clin Immunol* 2000;105:S616-21.)

Key words: Allergens, allergic rhinitis, antihistamines, asthma, atopy, corticosteroids, otitis media with effusion, sinusitis

Allergic rhinitis is an extremely common condition in children, and, just as is the case in adults, it is responsible for far more debilitation and interference with daily life than even patients themselves recognize. Because children are typically unable to verbalize the impact of their symptoms, these symptoms often go unnoticed or inadequately treated. This unintentional benign neglect leaves children vulnerable not only to the discomfort and

disability of allergic rhinitis itself but also to the sequelae that often accompany this disorder.

Allergic rhinitis can be subdivided into seasonal and perennial categories, depending on when the child appears to have the symptoms most prominently. Those children with seasonal allergic rhinitis have periodic exacerbations of symptoms that occur primarily during plant-pollinating seasons, specifically in temperate climates (spring for trees, spring and summer for grasses, and autumn for weeds). Children with perennial allergic rhinitis, on the other hand, have persistent symptoms and react to allergens that are present year-round (indoor allergens [eg, dust mites], animal dander, and mold). However, the 2 conditions may coexist and are not different diseases; the diagnosis and treatment are the same.

CAUSE OF ALLERGIC RHINITIS

Allergic rhinitis and atopy, in general, are caused by the interaction of a genetically predisposed patient and the environment. Genetics clearly plays an important role. Approximately 20% to 30% of the general population and 10% to 15% of children are atopic.¹ When both parents are atopic, however, this risk more than quadruples, reaching 50%; and the risk increases even further, to nearly 72%, when both parents have the same atopic manifestation (whether allergic rhinitis, asthma, or atopic dermatitis).¹

The role of the environment is essential because allergens, which are ubiquitous in virtually all environments, initiate and then, on subsequent exposure, trigger the genetically predetermined immune response. When an allergen comes into contact with a nasal mucosa that has been previously sensitized by that allergen, it binds to specific IgE antibodies on the cell surface of the nasal mucosal mast cells and basophils, which then degranulate.¹ In the early, or immediate, phase of the allergic reaction, re-exposure to the allergen will cause mast cells and eosinophils to release and generate inflammatory mediators (such as histamine, leukotrienes, and prostaglandins), which increases vascular permeability, tissue edema, and cellular recruitment and produces the localized symptoms of rhinorrhea, sneezing, and congestion. The late-phase response usually occurs 4 to 8 hours after initial exposure, during which time symptoms recur.

PREVALENCE OF ALLERGIC RHINITIS IN CHILDREN

Allergic rhinitis is currently the most common of all chronic conditions in children.² According to an analysis of the 1988 National Health Interview Survey on Child

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Health, which included data from a total of 17,110 children under the age of 18 years, allergic rhinitis was present in 59.7 cases per 1000 children. Asthma, at 42.5 cases per 1000 children, was the second most common condition (Table I).² Notably, however, the figure for allergic rhinitis likely represents a substantial underestimate because it includes only children with hay fever or seasonal allergic rhinitis, thus probably omitting children with perennial allergic rhinitis.

A prospective study of 747 children in Tucson, Ariz, further demonstrates the extraordinary frequency of allergic rhinitis in children.³ In this study, which evaluated the natural history of physician-diagnosed allergic rhinitis in the early years of life, 42% of all children had this condition by age 6 years. Fully one half of these children had experienced the development of the condition in the first year of life. Those children who experienced the development of allergic rhinitis before the age of 1 year had more respiratory symptoms at age 6 years and were more likely to have a diagnosis of asthma. Risk factors for the early development of allergic rhinitis, as ascertained by a questionnaire study of the children's parents and physician assessments, included early introduction of foods or formula, heavy maternal cigarette smoking (≥ 1 pack/day) in the first year of life, parental allergic disorders, higher serum IgE levels at 9 months and 6 years, and the presence of dogs in the home.³

IMPACT OF ALLERGIC RHINITIS IN CHILDREN

In and of itself, allergic rhinitis can have a significant impact on children's quality of life, psychologic well-being, and capacity to function in activities of daily living. Individuals with allergic rhinitis are more likely to exhibit shyness, depression, anxiety, fearfulness, and fatigue than are those without the condition.^{4,5} Furthermore, children with allergic rhinitis miss 2 million school days each year,⁶ and, even when they are at school, their ability to learn and to process cognitive input has been found to be significantly impaired ($P < .02$) relative to the abilities of their nonallergic peers.⁷

In addition to these psychosocial and performance problems, allergic rhinitis, when left untreated, may exacerbate and contribute to the symptoms of several comorbid conditions, including asthma, sinusitis, and otitis media with effusion.

Allergic rhinitis and asthma

Of all the chronic conditions that may occur concurrently in children, the comorbidity of allergic rhinitis and asthma is by far the most frequent. The 2 conditions have been recognized as genetically linked "atopic" conditions since the 1920s. In the National Health Interview Survey on Child Health,² the combination of asthma and hay fever occurred with an observed frequency of 10.1 cases per 1000 children, which represents a 4-fold increase over the expected frequency of 2.5 cases per 1000 children ($P < .001$). Not surprisingly, other atopic

TABLE I. Prevalence of chronic illnesses in US children under 18 years of age*

Condition	Cases per 1000	SE
Hay fever	59.7	2.5
Asthma	42.5	1.6
Other respiratory allergy	37.1	1.9
Eczema or other skin allergy	32.9	1.7
Digestive allergy	25.1	1.2
Heart conditions	15.2	1.2
Arthritis or other joint problems	4.6	0.6
Diabetes mellitus	1.0	0.2

*Original tabulations of the 1988 National Health Interview Survey (US Bureau of the Census for the National Center for Health Statistics). Adapted from Newacheck PW, Stoddard JJ. Prevalence and impact of multiple childhood chronic illnesses. *J Pediatr* 1994;124:40-8. With permission.

TABLE II. Signs and symptoms of seasonal and perennial allergic rhinitis

- Itching of the nose, ears, palate, or throat
- During the pollen season, sneezing episodes triggered by non-specific stimuli, such as dust and other irritants
- Thin, clear rhinorrhea, which may be profuse and continuous
- Irritation of the skin of the lower external nose and upper lip because of excessive nasal discharge
- Nasal congestion that increases with progression of the pollen season (may be the only symptom present in children)
- Blockage of the paranasal sinuses or eustachian tube, causing sinus headache or earache
- Worsening of asthma symptoms
- Worsening of symptoms on arising in the morning, even when pollen exposure occurred on the previous day
- Altered hearing, smell, and/or taste
- Mouth breathing
- Dry, irritated, or sore throat
- Snoring
- Chronic postnasal drip
- Chronic or nonproductive cough
- Continual throat clearing
- Frontal headaches
- Eustachian tube dysfunction
- Sleep disturbance, with or without daytime fatigue

Adapted from American Academy of Allergy, Asthma, and Immunology (AAAAI). Task force on allergic disorders: promoting best practice. Raising the standard of care for patients with allergic disorders: executive summary report. AAAAI, Milwaukee, Wis, November, 1998. With permission.

conditions, including eczema, digestive allergy, and other respiratory allergy, also tended to co-occur frequently with hay fever, but no comorbidity was more common than that of allergic rhinitis and asthma.²

The recent Executive Summary Report from the Task Force on Allergic Disorders⁶ refers to atopy as "the strongest identifiable predisposing factor for the development of asthma." Several connecting factors have been noted, including the following:

Asthma and allergic rhinitis share a genetic predisposition.⁸ Rhinitis and asthma share a common respiratory mucosa.⁶ Inflammation plays a key role in the pathogenesis of both allergic rhinitis and asthma.⁶

Patients with allergic rhinitis often report exacerbation of asthma symptoms during the pollen seasons.⁶

Allergic reactions in the nasal mucosa can aggravate asthma symptoms.⁶

Effective treatment of allergic rhinitis also tends to improve asthma symptoms.⁶

Several studies have confirmed the latter association. Two studies were done by Corren et al⁹ and Watson et al.¹⁰ These studies showed a marked improvement in the symptoms of asthma when patients with allergic rhinitis were treated with intranasal corticosteroids. In another study, cetirizine, a sedating antihistamine, was administered to 186 patients who were 12 years of age or older and who were allergic to pollen and had asthma.¹¹ Patients receiving cetirizine therapy experienced an improvement in rhinitis symptoms, as expected, but they also experienced an improvement in asthma symptoms. The regimen was well tolerated, except for headache and some fatigue and somnolence, which was also not surprising because cetirizine, although a second-generation antihistamine, is known to be sedating.

Loratadine (another second-generation antihistamine, but 1 that lacks sedation as a side effect) has also been shown to have beneficial effects on asthma symptoms. In 1 study, the agent improved asthma symptoms and lung function and reduced bronchodilator use.¹² In another study, the combination of loratadine plus pseudoephedrine, when administered to patients with both allergic rhinitis and asthma, improved pulmonary function and had a beneficial effect on quality of life.¹³ However, patients with asthma, in general, require asthma-specific treatment; treatment of rhinitis alone is not sufficient.

Allergic rhinitis and sinusitis

The incidence of sinusitis tends to increase as children age, and it is especially common in children who experience frequent upper respiratory tract infections and allergic rhinitis, both of which have been implicated in the pathogenesis of sinus disease.¹⁴ Indeed, it is unusual to have sinusitis inflammation in the absence of nasal disease.⁵ In addition, sinusitis and allergic rhinitis share the pathologic features of mucociliary dysfunction, tissue edema, and increased mucus production.⁵

The frequent comorbidity of allergic rhinitis and sinusitis has been documented in several studies. In 1 study, more than 53% of children with allergic rhinitis also had abnormal sinus radiographs.¹⁵ In another study, up to 70% of children with allergic and chronic rhinitis were found to have abnormal findings on sinus radiograph studies.¹⁶ Finally, in a trial of patients with recurrent sinusitis, 92% were also found to be allergic.¹⁷ Although antibiotics are key to the treatment of bacterial sinusitis, clinical experience also amply demonstrates that treatment of underlying allergic rhinitis is useful in ameliorating sinusitis.

Allergic rhinitis and otitis media

It is the rare child who is spared the pain of otitis media and the otitis media with effusion that frequently

results. More than 80% of all children have at least 1 episode of acute otitis media by the time they reach 3 years of age.¹⁸ Atopic children are known to be more susceptible to both acute otitis media and chronic otitis media with effusion, and the allergic response links the comorbidity of allergic rhinitis and otitis media.⁵ Although it is true that a basic eustachian tube dysfunction may be present in many infants and young children, it is also true that tubal function is further compromised in the setting of allergic rhinitis⁵ and that this exacerbated dysfunction may increase both the frequency and the severity of otitis media.

SIGNS AND SYMPTOMS OF ALLERGIC RHINITIS IN CHILDREN

Allergic rhinitis may be seen with a wide range of signs and symptoms (Table II). Unfortunately, however, many of the symptoms of allergic rhinitis may go unrecognized in children because of their inability to verbalize and describe their symptoms. Therefore the signs of the condition are particularly important in recognizing this condition in the pediatric population. Some characteristic signs of allergic rhinitis in children include the "allergic shiner," a darkening of the lower eyelid because of chronic nasal obstruction and suborbital edema, the "allergic crease," visible as a transverse skin line above the tip and below the bridge of the nose caused by constant rubbing, and the "allergic salute," characterized by upward rubbing of the nose with the palm of the hand as a means of trying to reduce itching and temporarily open the nasal passages.¹⁹

In addition to these more localized signs and symptoms, many children with allergic rhinitis experience systemic symptoms, including weakness, malaise, fatigue, irritability, and poor appetite.⁶ Children are often unable to express these symptoms, however, or they may tend to attribute them to other causes. Therefore the presence of these symptoms will likely not be recognized unless they are specifically elicited. In addition, children and adolescents with allergic rhinitis often do not sleep soundly, do not feel well, and do not look well, a combination that may have deleterious effects on both school performance and self-esteem.¹⁹

EVALUATING AND DIAGNOSING ALLERGIC RHINITIS IN CHILDREN

The diagnosis of allergic rhinitis is highly dependent on a comprehensive history. Children, particularly older ones, may be able to provide accurate information in this regard if skillfully questioned. When evaluating younger children, however, the clinician will need to depend primarily on information provided by parents or other caretakers. In addition to questioning about the aforementioned signs and symptoms, the clinician may find it useful to ask about the presence of allergens in the home environment (Table III).⁶

Although the presence of the signs of allergic rhinitis in a child is a vital diagnostic clue, it is also a nonspecific-

TABLE III. Questions to ask parents about allergens in the home

- Does your home feel moist or damp?
- What is the usual temperature inside the house?
- Is your basement wet or damp?
- Have you ever seen cockroaches in your home?
- Do you use air conditioners and/or humidifiers?
- Do you have pets?
- Do you have a fireplace or wood-burning stove?
- Does anyone smoke in your home?
- What kind of cleaning agents and/or air sprays do you use?
- Do your child's allergy symptoms disappear when you leave home and come back when you return?

Adapted from American Academy of Allergy, Asthma, and Immunology (AAAAI). Task force on allergic disorders: promoting best practice. Raising the standard of care for patients with allergic disorders: executive summary report. AAAAI, Milwaukee, Wis, November 1998. With permission.

ic 1. The classic signs of allergic shiners and an allergic crease (with or without the physical findings of a high, arched palate and a constantly open mouth) only identify children with nasal obstruction; they do not necessarily indicate an underlying allergic cause.²⁰

To establish the diagnosis of allergic rhinitis with certainty, allergy testing is recommended. As in adults, inhalant allergens are the most frequent trigger of allergic rhinitis in children; however, food allergy should not be ignored in infancy or early childhood. Foods are a significant source of allergic reactions until about the age of 2 years.²⁰ Because two or more seasons of pollen exposure are required for sensitization, allergy testing for seasonal allergens such as trees, grasses, and weeds is typically requested after 2 or 3 years of age. However, allergy to perennial inhalant allergens such as house dust mite, dog, cat, cockroach, and feathers can manifest after several months or even weeks of daily exposure. In these instances, allergy testing to perennial inhalant allergens as well as potential food allergens may be performed in children less than 2 years of age if clinically indicated. However, these children will exhibit a smaller wheal-and-flare in the event of a positive allergy skin test than will older children and adults.^{20,21}

TREATING ALLERGIC RHINITIS IN THE CHILD

The management scheme for the treatment of allergic rhinitis in the child is similar to that in the adult. Specifically, treatment options include environmental control for allergen avoidance, pharmacotherapy, and immunotherapy. In all cases, the primary goal of treatment is to control the symptoms without altering the child's ability to function; a second but equally important goal is to prevent the development of the sequelae of allergic rhinitis.

Environmental control for allergen avoidance

Educating families about avoiding exposure to allergens is an essential part of the treatment of allergic rhinitis (Table IV). Unfortunately, it is also often highly

TABLE IV. Environmental control of allergen exposure

Allergens	Control measures
Indoor	
Dust mites	Encase bedding in airtight covers Wash bedding in water >130°F Remove wall-to-wall carpeting Remove upholstered furniture Do not use fans
Animal dander	Avoid furred pets Keep animals out of child's bedroom
Cockroaches	Control available food supply Keep kitchen/bathroom surfaces dry and free of standing water Professionally exterminate
Mold	Destroy moisture-prone areas Avoid high humidity in child's bedroom Repair water leaks Check basements, attics, and crawl spaces for standing water and mold
Outdoor	
Pollen	Keep car and house windows closed Control timing of outdoor exposure Restrict camping, hiking, and raking leaves Drive in air-conditioned car Air-condition the home Install portable high-efficiency particulate air filters

impractical; moreover, it may negate psychosocial ramifications for children that should not be ignored. Avoiding outdoor sports in the springtime and banishing furred pets from the home, for example, may have effects on children that range beyond allergen control. Nevertheless, families should be taught about the importance of environmental control measures and advised to adhere to them to the extent possible.

Oral antihistamines

Despite the addition of new agents to the antiallergy armamentarium, oral antihistamines continue to serve as the mainstay of the treatment for allergic disorders. These agents can be expected to be as efficacious in children as they are in adults.

Two generations of antihistamines are currently available: the first-generation (sedating) antihistamines, which are available without prescription; and the second-generation (nonsedating) agents, which require a prescription (Table V). The problems of sedation and frequent dosing that limited treatment with many of the first-generation antihistamines have been largely obviated by the second-generation agents. The second-generation agents have several advantages over the first-generation agents, including preferential binding to peripheral H₁ receptors (minimal penetration of the central nervous system; minimal antiserotonin, anticholinergic, and α -adrenergic blocking activity; and minimal sedative effects).⁶

The absence of sedative and cognitive effects is at least as crucial in children as it is in adults. In a study of 52 primary school children with a history of seasonal

TABLE V. Second-generation antihistamines and antihistamine/decongestant combinations

Medication	Onset of action (h)	Sedation	Possible cardiac side effects	Formulations	Recommended dosing schedule
Astemizole*	2-4	No	Yes	Tablets, 10 mg	≥12 y: 10 mg, qd
Azelastine	3	Yes	No	Nasal spray	≥12 y: 2 sprays per nostril, bid
Cetirizine	1-2	Yes	No	Tablets, 10 mg Syrup, 5 mg/5 ml	≥12 y: 5-10 mg, qd 6-11 y: 5-10 mg, qd 2-5 y: 5 mg, qd
Fexofenadine	1-2	No	No	Tablets, 60 mg	≥12 y: 60 mg, bid
Fexofenadine/pseudoephedrine	1-2	No	No	Tablets, 60 mg/120 mg	≥12 y: bid
Loratadine	1-2	No	No	Tablets, (Reditabs), 10 mg Syrup, 5 mg/5 ml	≥6 y: 10 mg, qd
Loratadine/pseudoephedrine	1-2	No	No	Tablets (12 h), 5 mg/120 mg Tablets (24 h), 10 mg/240 mg	≥12 y: bid ≥12 y: qd

qd, Daily; bid, twice daily.

*No longer available in the United States.

TABLE VI. Available intranasal corticosteroid sprays

Medication	Dose per actuation (μg)	Formulation (Aqueous/ Metered-dose inhaler)	Pediatric dosage
Beclomethasone	42	+/+	≥6
dipropionate	84	+/0	≥6
Budesonide	32	+/+	≥6
Flunisolide	25	+/0	≥6
Fluticasone propionate	50	+/0	≥4
Mometasone furoate	50	+/0	≥12
Triamcinolone acetonide	55	+/+	≥6 (metered-dose inhaler) >12 (aqueous)

+, Available; 0, not available.

allergic rhinitis and 21 children with no allergic history, Vuurman et al found⁷ that children with allergy performed significantly less well ($P < .01$) than their contemporaries who had no allergy on all learning measures, including factual knowledge, conceptual knowledge, and knowledge application. Importantly, however, although the children with allergic rhinitis never scored as well on learning measures as did nonallergic children, those children treated with the second-generation antihistamine loratadine scored substantially better on all measures than did children with allergy who were treated with the first-generation agent diphenhydramine. The children treated with diphenhydramine consistently had the worst scores on all measures of learning. The magnitude of this difference in performance led the study's investigators to conclude that nonsedating antihistamines should be prescribed to school children with allergic rhinitis whenever possible.⁷

Decongestants

Decongestants produce vasoconstriction within the nasal mucosa through α -adrenergic receptor activation and are thus effective in relieving the symptoms of nasal obstruction. However, these agents have no effect on other symptoms, such as rhinorrhea, pruritus, or sneez-

ing.¹⁹ Therefore they may be most effective when used in combination with other agents, such as antihistamines. It is important to note, however, that ephedrine, β -phenylethylamine derivatives, and pseudoephedrine are considered "doping" products and that their use should therefore be restricted in older children who participate in organized sports programs.²²

Intranasal corticosteroids

Intranasal corticosteroids are highly effective in relieving a range of allergic rhinitis symptoms that includes nasal congestion, rhinorrhea, itching, and sneezing.¹⁹ With the current exceptions of fluticasone propionate (4 years of age) and mometasone furoate (12 years of age), intranasal corticosteroid sprays are approved for use in children as young as 6 years of age (Table VI). There has been some concern about the serious side effects associated with systemic corticosteroids, such as growth retardation, hypothalamic-pituitary-adrenal suppression, and behavioral disturbances. However, the intranasal corticosteroids, which act locally on the nasal mucosa, are rapidly metabolized, have a long duration of action, are not associated with the same side effects as the systemic agents, and do not produce clinically important side effects.¹⁹ In fact, a review of more than 200 studies demonstrates that beclomethasone, 1 of these agents, does not produce systemic side effects, even with prolonged use of up to 6 years.²³

There have been several case reports of children who were treated with systemic corticosteroids or with inhaled corticosteroids and pulse systemic corticosteroids who had poor clinical outcomes after contracting chicken pox. Therefore current thinking is that children who are on low-dose corticosteroids and/or receiving inhaled corticosteroids should be vaccinated against the varicella virus.²⁴

Mast cell stabilizers

Mast cell stabilizers, such as cromolyn sodium, can be useful in relieving nasal pruritus, rhinorrhea, sneezing, and obstruction; however, they have minimal effect on congestion. Cromolyn sodium is generally well tolerated and is

most efficacious when taken prophylactically, well in advance of allergen exposure. In addition, because of its short duration of action, it should be taken 4 times a day; as a result, compliance is difficult for many families.¹⁹

Immunotherapy

Allergen immunotherapy is another proven treatment for children with allergic rhinitis and should be considered when other treatments are inadequate in controlling symptoms. However, in making the decision to prescribe this therapy, the clinician should consider the positive and potentially negative effects of regular office visits for the administration of injections.²⁰ If the decision is made to prescribe immunotherapy, it must be administered by a physician who is experienced in its use and whose office is set up for dealing with the management of adverse allergic reactions, including anaphylaxis should this rare untoward event occur.

Adherence issues in children

Nonadherence is a significant potential problem in the treatment of children. Most children are extremely reluctant to take medication, and medication refusal may compromise the effectiveness of therapy. The clinician can help alleviate this problem by prescribing medications with characteristics that may influence adherence, including taste, consistency, tablet/capsule size, and dosing frequency.²⁰ It is also helpful to explain to children the rationale behind each of the medications they are expected to take, emphasizing desired effects and also noting potential side effects.

CONCLUSIONS

Allergic rhinitis is currently the most common chronic disease in the pediatric population. This condition not only has significant deleterious effects in and of itself on well-being, quality of life, and capacity to learn, but it also increases the risk for several potentially serious comorbid conditions, including asthma, sinusitis, and otitis media. Fortunately, a broad range of options is currently available for the treatment of this condition, and the clinician can expect any of the available categories of agents to be as efficacious in children as they are in adults. It is important, however, to be cognizant of pediatric dosing recommendations and to prescribe therapy with an awareness of the unique issues that are likely to influence adherence in young patients.

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