

Bronchial Asthma in Children

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Asthma in childhood is usually a preventable disorder caused by inhaled substances or food or a combination of the two. It often masquerades as respiratory tract infection and may pass for many months as bronchitis, pneumonia, or repeated "chest colds." The fact that such episodes are actually manifestations of asthma may be suggested by a history of one or more minor symptoms such as coughing at night, cough on exertion, increased sneezing, or nasal itching.

Food is the usual cause of asthma in patients under the age of 14 months, but after age two inhalant allergy becomes more common. Food, however, continues to be a frequent cause, and not uncommonly food and inhalant allergy coexist. When this is the case, inhalant allergy is likely to receive all the attention and food allergy is likely to remain unrecognized. Foods that cause asthma may also cause one or more components of the Allergic Tension-Fatigue Syndrome: recurrent headaches, stomachaches, musculoskeletal discomfort ("growing pains"), pallor, tiredness and difficult behavior.

Bronchial asthma is one of the leading chronic diseases of childhood, causing 23 percent of grade and high school absenteeism according to Children's Bureau figures.¹ It constitutes an important part of the practice of every pediatrician and family physician and is an area in which the physician is not likely to be well-prepared. Unfortunately, it is not widely recognized that bronchial asthma is a preventable disease in the majority of cases. The purpose of this paper is to highlight current perspectives related to the causes, symptoms, diagnosis, treatment, and prevention of asthma in children.

Causes of Asthma

Inhalant and food allergy together

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account for over 90 percent of childhood asthma. Except in infants, inhalant allergy is the more common; it is usually caused by house dust, pollens, molds, or animal epidermals, especially cat and dog danders. In our experience, inhalants alone are the etiological agents in about 60 percent of asthmatic children, inhalants plus food in about 25 percent, and foods alone in about ten percent. Bacterial, psychogenic, and forms of intrinsic allergy together account for the remaining five percent. Figure 1 shows the relative frequency of these major causes of asthma in childhood.

Since inhalant allergy is most common, this is what the physician is likely to investigate first. However, treatment of an inhalant allergy sometimes gives less than expected results, and when this occurs it is often because of an unrecognized concomitant food allergy. When inhalant allergy and food allergy coexist, inhalant allergy is apt to receive all the attention and food allergy is likely to



remain unrecognized and untreated. One reason is that the positive inhalant skin tests overshadow the negative food tests.

It is important to remember that what seems to cause an asthma attack is often only what triggers it. Figure 2 illustrates this point in terms of a gun analogy. The actual cause is the frequently unrecognized bullet or bullets (ie, items to which the patient is sensitive). Proof of this concept comes when, following removal of the bullets, the trigger-movers no longer bring on an attack.

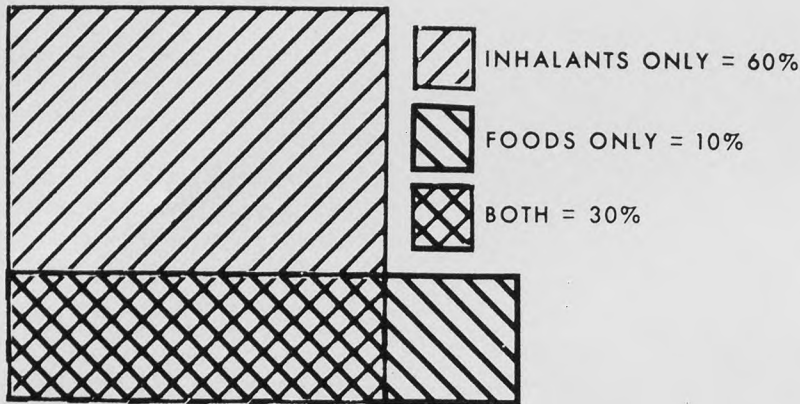
Bacterial allergy, ie, specific sensitization to bacteria or their products, although a valid concept, does not occur, in our opinion, as frequently as is generally supposed. More often, no such specific effect is demonstrable, but an upper respiratory tract infection acting as a trigger for asthma is mistaken for evidence of bacterial allergy. Further confusion results when upper respiratory tract *allergy* is mistaken for upper respiratory tract *infection*. This frequently happens when attacks of asthma are interpreted as "colds" and "bronchitis," while the continuity symptoms of allergic rhinitis and subclinical asthma are interpreted as the aftereffects of these so-called "infections." (Fig 3)

Bacterial allergy, when it does occur, appears more often in infants and runabouts than in older children. Continuity symptoms and a family history of allergy are often lacking and bacterial and other skin tests are negative. Bacterial allergy is said to be more common in the eastern United States than on the west coast.²

Psychogenic factors may play a role in some cases of asthma in childhood. In the majority of such cases, they play a secondary role as trigger factors. Occasionally, however, they are a primary cause and the chief factor, able to cause asthma without the participation of any allergic factor.

Figure 1. Inhalants and foods, alone or jointly, are the chief causes of asthma in childhood. The small percentage of cases in which psychogenic ("intrinsic" factors) or bacterial allergy are chiefly responsible is not shown in this diagram.

ETIOLOGY OF ASTHMA IN CHILDHOOD estimated



INHALANTS A FACTOR IN 90%
FOOD A FACTOR IN 40%

Fortunately, only a small number – less than four percent of asthmatics – fall into this category. In children sent to asthma convalescent hospitals, however, a much higher percentage are of this type because the usually-successful approach to asthma as an antigen-antibody disorder often fails with this group.

Symptoms of Asthma

Asthma may be defined as a recurrent reaction in the lung characterized by dyspnea, wheezing, and coughing due to narrowing of the lumen of the bronchi and bronchioles. It is usually due to specific sensitization, and is caused by smooth muscle spasm, edema of the mucus membrane lining, increased mucus production, or any combination of these obstructive factors. (Fig. 4)

Cough is one of the important symptoms of asthma and at times the only one. Wheezing may be so slight as to be detected only intermittently by stethoscope. Dyspnea may be apparent only during exercise or if an "attack" occurs. A child with intermittent mild asthma without any recognized "attacks" may manifest his asthma chiefly by coughing on exertion or at night.

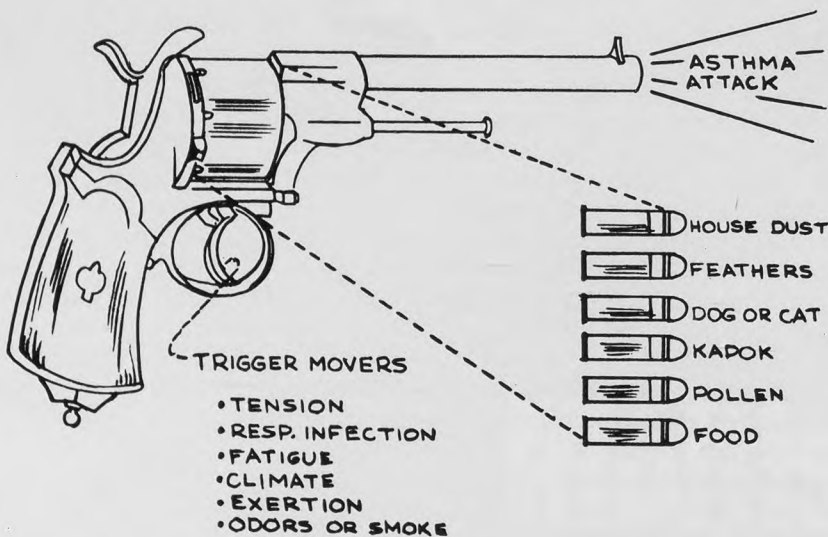
While several nonspecific factors may, on occasion, induce bronchospasm, mucus secretion, and edema of the mucus membrane (bringing on the symptom-complex called asthma), there is usually an underlying antigen-antibody reaction as well. This releases chemical mediators, the most important of which is probably slow-reacting substance. Such chemical mediators are responsible for the pathology described. The term "asthma" usually refers to this type of "allergic asthma." It is also used to describe the entire disease complex rather than just one of its symptoms.

"Continuity" or interval symptoms are those symptoms likely to be more or less continually present in the intervals between attacks of asthma or between occasions when audible wheezing is heard. In the case of allergic rhinitis they are excessive sneezing and nasal itching (rubbing), and in the case of asthma they are coughing at night and coughing on exertion. (Fig. 5)

Since the allergic rhinitis which so often accompanies asthma is usually

Figure 2.

CAUSES OF ASTHMA ASSUMED VERSUS ACTUAL



caused by the same allergens, lessening of sneezing and of nose rubbing can be used as a guide in treating associated asthma. And, since coughing at night and coughing on exertion are likely to be caused by the same allergens as are responsible for more overt episodes of asthma, they can serve also as a useful guide in treating a patient with asthma. Thus, one does not usually have to wait for weeks to evaluate therapy for asthma. Minor "continuity" or interval symptoms may be present almost daily and can serve as an ongoing index of therapy.

Diagnosis of Asthma

There are all degrees of asthma from the mildest of symptoms to status asthmaticus. In the severe forms the over-inflated chest, prolonged expiration, and severe dyspnea may make the diagnosis obvious. More often such symptoms are lacking and there is only a cough accompanied by bilateral squeaks, groans and musical sounds heard by stethoscope, and occasional audible wheezing. If an "attack" does occur, rales and low-grade fever may also be present and do not necessarily indicate the presence of infection. In minimal asthma, the characteristic squeaks and groans may not be heard by stethoscope unless the patient is instructed to take a deep breath. The patient may not be aware of dyspnea until he exerts himself.

Between episodes of asthma, the physical examination may be entirely normal. However, it is not usually necessary to postpone diagnosis until the patient becomes symptomatic. *The fact that he is an asthmatic can usually be established through the history alone.* If this is done, investigation of etiology can begin immediately. This may save much time and spare the patient subsequent attacks. The history, for example, will usually reveal one or more previous episodes suggestive of asthma, although they may have been diagnosed as "bronchitis" at the time. Between such episodes the patient is likely to have an occasional night cough and a tendency to cough on exertion. Such patterns of cough are frequently associated with mild or subclinical asthma and by themselves should suggest the diagnosis. Equally helpful in diagnosis is a history of allergic rhinitis, since upper respiratory tract allergy usually accompanies

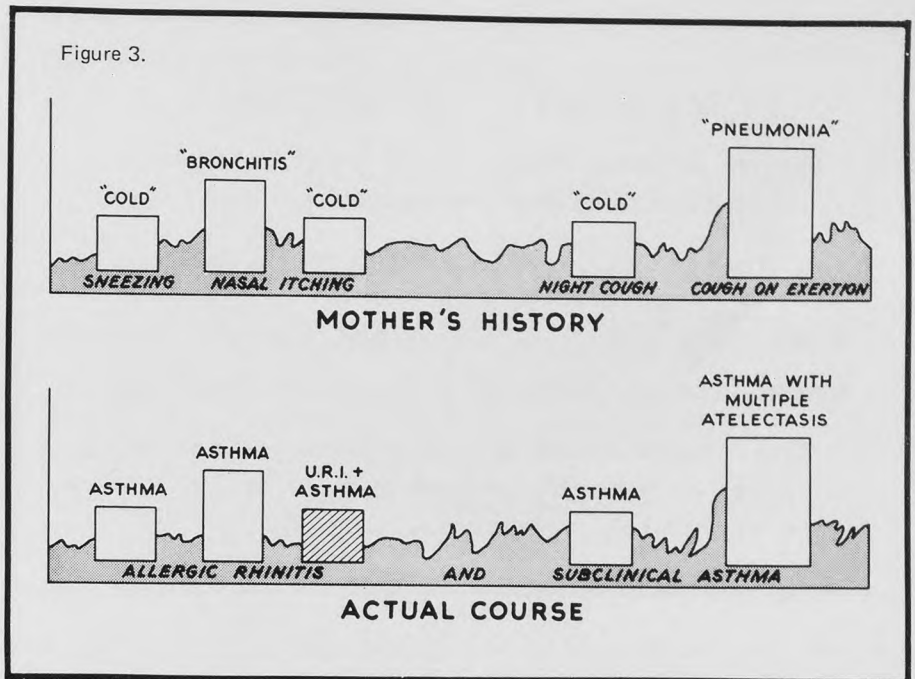


Figure 4. The likelihood that asthma will cause complete obstruction of an air passage decreases as the infant grows older.

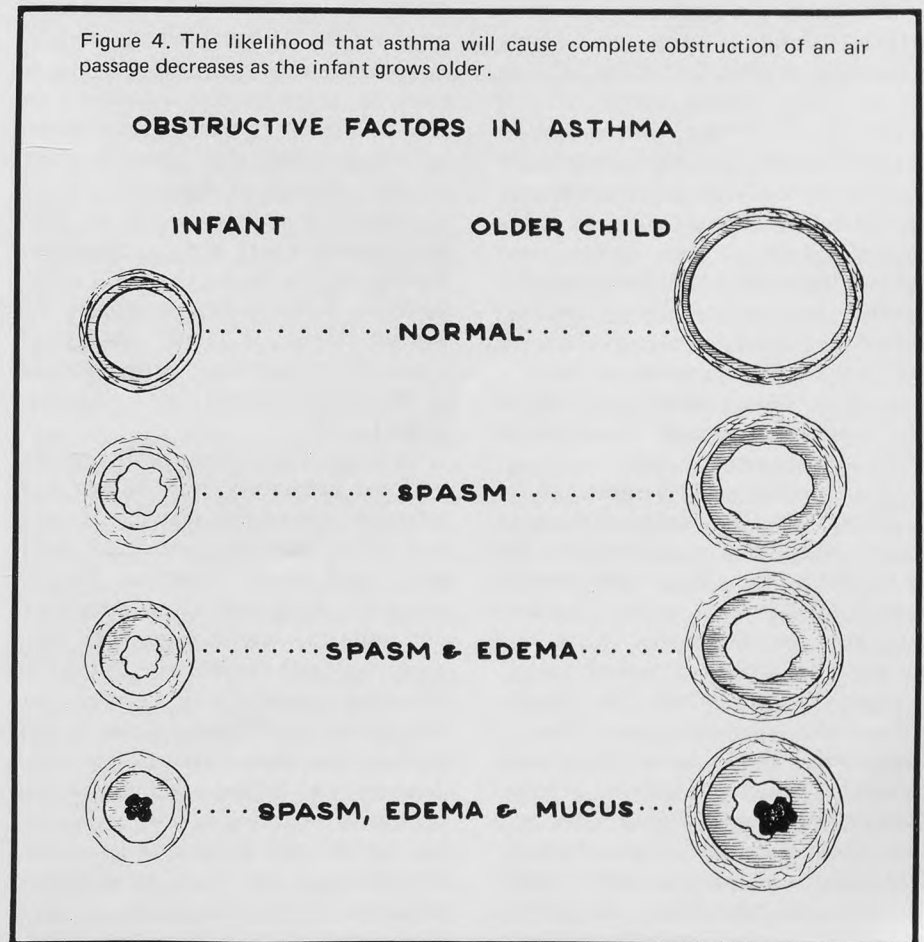


Figure 5.

"CONTINUITY" SYMPTOMS

(When present these are of great value as diagnostic aids and therapeutic guides)

ALLERGIC RHINITIS

Sneezing
Nasal Itching (rubbing)

ASTHMA

Night Cough
Cough on Exertion

The effectiveness of a program to prevent asthma can often be promptly judged by its effect on one or more "continuity" symptom.

lower tract allergy and is caused by the same allergens. A history, therefore, of more than an average amount of sneezing and frequent nasal rubbing (itching) goes far to confirm a suspicion of asthma. The association of nasal allergy (allergic rhinitis) with pulmonary allergy (asthma) is a much-neglected diagnostic aid.

The patient's previous history is often helpful in diagnosis. Atopy frequently appears first as food allergy in infancy causing gastrointestinal symptoms or eczema, then as allergic rhinitis due to inhalants in early childhood, and finally as asthma. A history of unusually severe colic or of a symmetrical, flexural puritic rash (atopic dermatitis) in infancy helps to identify as possibly allergic (atopic) respiratory tract symptoms later in childhood. The presence of such a history in infancy should alert one to the possible subsequent development of respiratory tract allergy.

Asthma may easily be mistaken for a number of other conditions. Foreign body, spasmodic croup, acute bronchitis, Middle Lobe Syndrome, snoring, congenital laryngeal stridor, tracheal vascular rings, and cystic fibrosis may all present a superficial resemblance to asthma. Factors which help in the differential diagnosis are an increase of eosinophiles in the blood or on nasal smear, a positive family or personal history for atopic disease, the non-contagious nature of asthma, frequent association of asthma with allergic rhinitis, the bilaterality of physical signs in asthma, asthma's probably

normal appearance by chest x-ray, and frequent association of asthma with positive skin tests for inhalants.

Asthma is the great masquerader of respiratory tract infection. It may simulate, to at least some degree, almost any respiratory tract infection: bronchitis, pneumonia, bronchopneumonia, sinusitis with cough, croup, the common cold, and a virus pneumonitis. Although allergy may be suspected in such situations, the idea is often discarded because infection is so well simulated. In our Pediatric Allergy Clinic when the patient's chart reveals a history of repeated episodes of bronchitis or pneumonia, we consider asthma a very likely explanation. Further search in the chart will often disclose eosinophilia, symptoms of allergic rhinitis, a family history of atopy and other supporting evidence of the role allergy has played all along. (Fig 6)

It is not always easy to distinguish between respiratory tract allergy and infection since both may be present and both may be associated with cough and nasal congestion. Even a low-grade fever and a few rales may not settle the matter since both may occur with asthma. We have found the following points helpful. Allergy is not contagious; simultaneous illness in the home, therefore, favors infection. Asthma and allergic rhinitis occur bilaterally; infection may be unilateral. The chest x-ray in asthma is usually negative or, at the most, shows hyperinflation. If the chest x-ray or sinus films show unilateral pathology, infec-

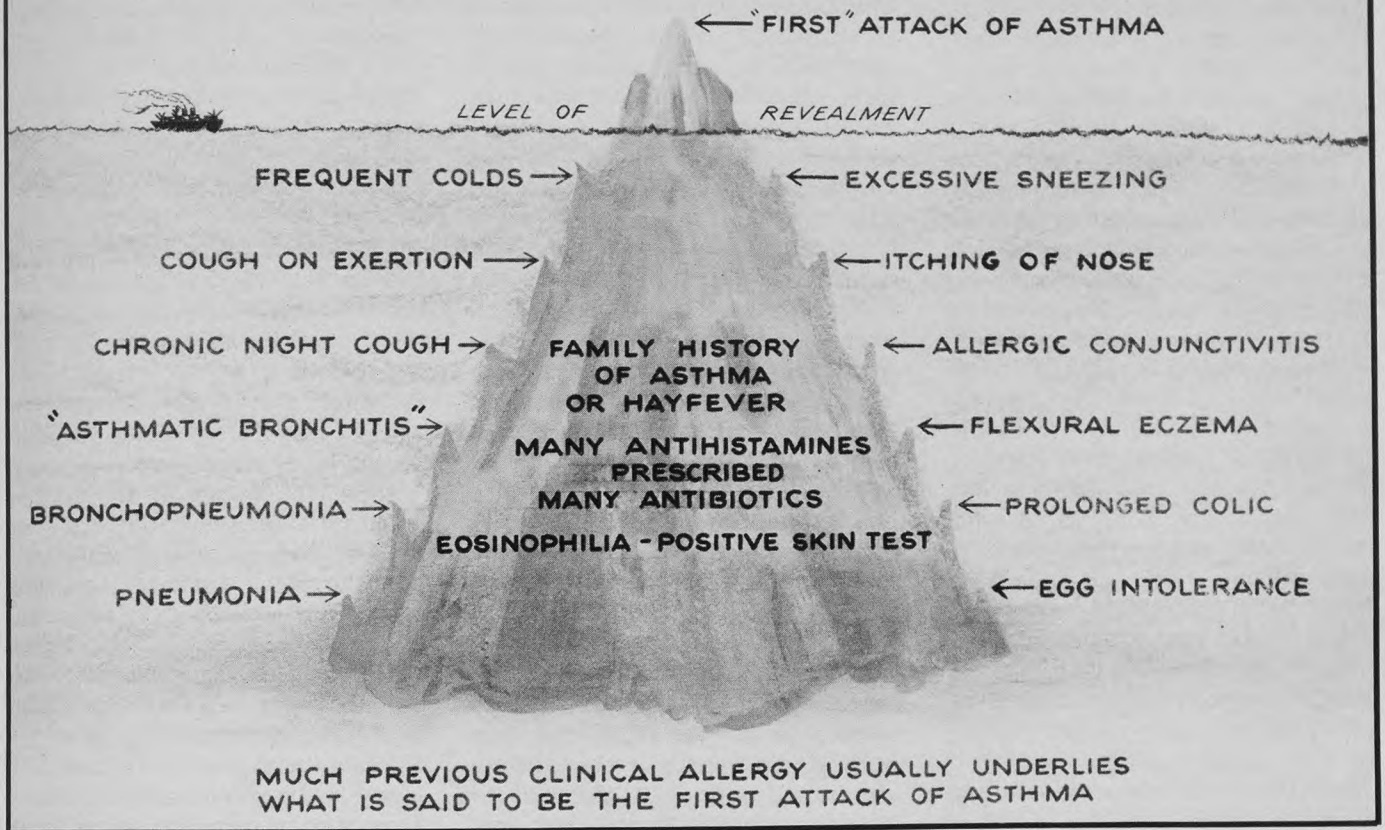
tion is more likely. Cultures for pathogens are negative in allergy but may be positive with infection. Increased eosinophilia in the blood or on nasal smear favors allergy. High or persistent fever favors infection. When in doubt the patient should be treated for infection and an allergy investigation initiated as well. Pending the outcome of this, he should not have contact with cats, dogs, or feather pillows since they are such well-known potential causes of respiratory tract allergy. The most convincing evidence that respiratory allergy masquerades as infection comes when, following the removal of a cat, dog, feather pillow, or the elimination of other allergens, "bronchitis" or "colds" which were previously recurrent no longer occur.

House dust allergy is the most important single cause of childhood asthma and it deserves major consideration. The house dust-sensitive patient tends to have early morning itching of his nose, sneezing and nasal congestion soon after awakening. His scratch test is almost always clearly positive to house dust; an intradermal test to house dust should not be necessary. If the scratch test to a full-strength extract of house dust is negative and only the intradermal test is positive, house dust sensitivity is not likely to be of major importance.

Many different foods may cause asthma but milk, chocolate, corn, and wheat are probably the most common unrecognized causes of food-related asthma. Milk and chocolate together are responsible for so many cases that their removal from the diet for three weeks is a useful initial approach when conducting an investigation of food allergy. Ice cream, sherbert, and cheese must also be excluded as well as cola drinks, which contain a chocolate derivative. If a more restrictive diet, such as corn or wheat elimination, is to be used in conducting an investigation of food allergy, it is necessary to give the parent detailed written instructions on foods which contain corn or wheat. The average patient has no idea of the numerous ways in which these foods enter the diet. Corn elimination, for example, includes dextrose, corn syrup, corn starch, and corn oil. At times an even more comprehensive diet restriction is needed before relief of symptoms occurs. Conducting such a "basic" diet

Figure 6.

THE HIDDEN ICEBERG OF ALLERGY



requires experience on the physician's part and willing cooperation on the patient's and parents' part. Written instructions are essential.

While food allergy in a patient frequently causes respiratory tract symptoms including asthma, it frequently causes a variety of other symptoms as well. These include intermittent abdominal discomfort ("stomachaches"), headaches, musculoskeletal pain ("growing pains"), pallor and dark circles under the eyes, fatigability and tiredness, nervous tension and difficult behavior. These are such diffuse and nonspecific signs and symptoms that it is no wonder they are usually dismissed as having nothing to do with allergy. Pediatric allergists, however, recognize that such symptoms are often signs of a general allergic toxemia due to systemic effects of histamine, slow-reacting substance and possibly the kinins or other mediators of the allergic reaction. Together they are referred to as the Allergic Tension-Fatigue Syn-

drome.^{3,4} The presence of these signs and symptoms along with asthma or nasal allergy should suggest food allergy as a possible cause of the entire syndrome. While this is especially true if all skin tests are negative, it also applies to a patient whose skin tests for inhalants are positive, but whose inhalant-oriented therapy has not given a completely satisfactory result.

Food allergy should especially be considered in asthma where there is any combination of: (1) onset of symptoms in infancy, (2) a family history of probable food allergy, especially to milk, (3) winter predominance of symptoms, (4) signs and symptoms of the Tension-Fatigue Syndrome, and (5) negative skin tests for inhalants as well as for foods.

It is beyond the scope of this paper to discuss skin testing in depth, but several points can be highlighted. Properly done, skin tests for *inhalant* allergens have a high correlation with clinical symptoms. For reasons not yet fully apparent, skin tests for foods

have a very poor correlation, so poor that some allergists dispense with food tests entirely. Tests for pollen allergy, on the other hand, are among the most reliable, thus greatly simplifying the recognition and treatment of seasonal hay fever and pollen asthma.

Skin tests, like clinical symptoms, may change over the years; old sensitivities may be lost and new ones acquired. Tests which are said to have changed after a *short* interval may instead involve nonspecific skin irritability or actual dermographism, resulting in falsely positive tests.

Some antiallergic drugs taken prior to testing are capable of suppressing a skin reaction and thus account for falsely negative reactions. Hydroxyzine in preparations such as Atarax and Marax is especially likely to do this⁵ and should be avoided 48 hours prior to testing. Other antihistamines or ephedrine, on the other hand, cause little or no suppression. Steroids do not interfere with skin testing.

House dust skin tests are equally as

reliable as pollen tests and are almost always positive in the house dust-sensitive patient. House dusts from different sources contain one or more common factors, chief of which is the house dust mite; its importance in house dust allergy has only recently been established.⁶

Skin tests can be done at any age, including infancy. Infants a few months old usually have not had time to acquire inhalant sensitivity but may be sensitized in utero to a food the mother has eaten. Such sensitization may be of the immediate anaphylactic type in which case the skin test will be positive, or of the delayed-onset type of food allergy, in which case it will probably be negative. In any case, passive sensitization acquired from the mother is *not* involved, since maternal reagins (skin test antibodies) do not cross the placenta. A mother does not pass her positive allergy skin tests on to her baby.

In infants under one, where food allergy is more common than inhalant allergy, only a few tests may be worth doing, but rapidly thereafter inhalant sensitivity becomes more common and a larger number of tests must be considered. Fully established inhalant allergy — asthma or allergic rhinitis — may be revealed by skin tests in a child who is less than two years of age.

Treatment of Asthma

Current symptoms should, of course, be treated symptomatically. But more important, the physician's objective should be to discover, through history and skin tests, what the patient is allergic to, and then to take an active part in seeing that such allergens are avoided as completely as possible. Where complete removal or avoidance is not possible, injection therapy may also be indicated. Such is often the case in house dust, pollen, and mold sensitivity. We also employ injection therapy with diluted stock vaccine in the few cases of bacterial allergy we see. Injection therapy is not used for food allergy. Removal of known allergens gives much better results than can be obtained by immunizing injections and is therefore the treatment of choice. It is the only satisfactory way of dealing with allergy to cats or dogs.

Once it is established that a child is

house dust-sensitive, *it becomes essential* to institute dust control procedures in his bedroom. Elimination of dust sources in this one room alone, where he spends about half his life, will take care of about 80 percent of his exposure to house dust. Much of the remaining half of his life is spent either outdoors or at school. In neither of these areas will he encounter house dust. Road dust and soil are not allergenic and have nothing to do with house dust allergy. It is household lint, from mattresses, box springs, upholstered furnishings, and stuffed toys, with its mite antigen component that is the chief offender. Written directions should be given to the child's parents on how to eliminate the major sources of house dust in his bedroom, and an appointment should be made to inspect the room after this has been done. Once the room has been properly prepared, the child should not sleep or nap in other rooms unless they are similarly prepared.

Control of bedroom dust, if taken seriously by both the physician and the parent and properly carried out, can be one of the most rewarding procedures in the care of a house dust-sensitive asthmatic child. As an important prophylactic measure, encasings are likely to be more effective than a drug prescription which affords only temporary symptomatic relief. Insistence on proper mattress and box spring encasings* where they are indicated and *avoidance of plastic encasings* that soon develop cracks and splits is an important feature of bedroom dust control. The physician should have an order blank for such encasings in his office to give to the patient.

Once steps to eliminate house dust in the bedroom have been taken — and not until then — consideration can be given to further measures such as use of a portable air filter or house dust injection therapy. The best air filters are those of the electrostatic type or the recently developed HEPA (high-efficiency particulate air) filter. Other filters which depend on the use of a disposable fiberglass trap are much less effective.

Failure to remove a cat or dog from the home of a child who is sensitive to

them is one of the *most frequent* causes for failure in treating asthma. Logical as it is to identify and remove the allergen, it is often difficult to accomplish where a pet is concerned. All sorts of compromises may be proposed in order to avoid the only really effective measure. These include keeping the pet out of the child's bedroom or away from certain areas of the house, instructing the child to avoid contact with the animal, spraying the dog with "Dust-Seal," exchanging him for a Chihuahua or a poodle, or giving the child immunizing injections against cat or dog dander. None of these measures is likely to succeed⁷ and they all fail to take a realistic attitude toward the problem.

Injection therapy is an effective approach to pollen sensitivity and is fortunately successful in giving a practical level of protection in most cases.^{8,9} Properly carried out, it has been shown to bring about production of a blocking antibody,¹⁰ decreased histamine release for leucocytes^{11,12} and a reduction in reagin¹³ — the trouble-making, skin-sensitizing antibody (specific Gamma E).

While the physician's chief concern should be the prevention of asthma, he must provide symptomatic treatment when it occurs. First in line and most useful for this purpose is a combination of aminophylline and ephedrine which is the basis of most proprietary asthma medications, such as Tedral, Marax, Quadrinal, and many others. Half of the suggested adult dose will suffice for most children, even older ones. If this is given more than three times in 24 hours, excessive nervousness may result. Aminophylline suppositories are also useful but aminophylline is excreted slowly and may be dangerous and even fatal *if administered too often or in too high dosage*. Next in line are Adrenalin or Susphrine which are particularly useful in early treatment but cannot be expected to be effective in removing the mucus plugs characteristic of long-standing asthma. Finally, in the hope of avoiding hospitalization, intravenous aminophylline given slowly and oral steroids in decreasing dosage over a period of several days, may also be helpful. Both should be physician-directed. To be avoided, if possible, are long-term use of steroids with resultant retardation of growth, and

*Obtainable at Allergen-Proof Encasings, Inc., 1450 East 363rd Street, Eastlake, Ohio 44094.

frequent use of pocket nebulizers. The Locked-Lung Syndrome¹⁴ and death have been reported in patients who, because of free access to such nebulizers, have grossly over-used them. A new drug, disodium cromoglycate (Intal or Aarane) has become available in the United States after extensive clinical trials in this country and abroad. It is beneficial as an adjunct in the prevention of future attacks in chronic asthmatics, although it has no effect during an existing attack or in status asthmaticus.¹⁵

There is no evidence that pooled gamma globulin is useful in the treatment of asthma even where bacterial allergy is suspected. The great majority of supposedly low levels of immunoglobulins in pediatric practice are actually within the wide range of normal for children, or examples of physiological hypogammaglobulinemia of early life.^{16,17} Giving gamma globulin may actually cause an allergic reaction in patients who do not have agammaglobulinemia.

Although asthma may spontaneously improve at any time and especially at puberty, it may also worsen at any time or not change, even at puberty. Waiting, possibly years, to see whether spontaneous improvement will occur — meanwhile trying to get along with drugs rather than determining the cause of asthma — is not likely to prove satisfactory to the parent or helpful to the child. Even when no asthma is present, treatment of a patient with hay fever or chronic allergic nose symptoms will often do much to improve his general health and may prevent asthma from developing in the future.⁹

Prevention of Asthma

Childhood asthma should be looked upon as a preventable disease. A number of important reasons can be identified for failure to prevent it.

1. Treating asthma symptomatically rather than looking for and removing the allergen(s).

2. Not removing an allergen after determining that the patient is allergic to it. *Example:* (a) Giving house dust injections without first obtaining proper mattress and box spring encasings and employing other dust control measures in the bedroom, (b) Permitting a cat or dog to remain in

the house of a cat or dog sensitive patient.

3. Failure to recognize repeated respiratory tract illnesses as allergy masquerading as infection. Repeated episodes of "bronchitis" and "pneumonia" may have an allergic rather than infectious basis and may be asthma in disguise. Adenotonsillectomy and administration of gamma globulin or cold vaccine may reflect respiratory tract allergy being mistaken for infection.

4. Accepting "trigger" factors such as climate or respiratory tract infections as the cause of asthma instead of searching for "bullet" factors such as house dust, animal danders, pollens, or food. Change of climate and correction of emotional factors often prove to be blind alleys in treating the average case of asthma.

5. Failure to appreciate that skin tests for foods, whether positive or negative, seldom help in treating food allergy. Test diets based on skin tests are, on the whole, less likely to succeed than elimination diets based on history and knowledge of what foods are statistically the most frequent offenders. Milk, chocolate, and corn head the list.

6. Not recognizing that the Allergic Tension-Fatigue Syndrome may accompany asthma, especially if it is caused by food. The Allergic Tension-Fatigue Syndrome due to food is probably the least known common syndrome in pediatric practice.

7. Not appreciating that milk allergy is often hereditary and frequently persists into childhood and even adult life.

8. Failing to explore food allergy as a reason for failure of an "inhalant" case to do well. When both are present there is a tendency on the physician's part to recognize the inhalant allergy and overlook the food allergy. This may result in a satisfactory outcome if the total allergic load is thereby reduced. Often, however, it will be necessary to recognize and treat both allergies.

9. Unnecessary delay in diagnosing asthma by history alone and failure to use "continuity symptoms" as an aid in such diagnosis. A "second history" (subsequent review of statements made at the first visit) is well worth getting. Sneezing, nasal itching or coughing on exertion denied on the

first occasion are often subsequently noticed and acknowledged the second time around.

10. Treating the patient on the basis of skin tests of doubtful significance and questionable reliability. Some experience on the physician's part in interpreting skin tests is desirable. Doubtful tests should be repeated rather than debated. Skin tests can be very useful but in inexperienced hands may prove more confusing than helpful. Positive skin tests to an allergen, whether an inhalant or a food, suggest, but do not prove, that the allergen involved has a roll in causing clinical symptoms.

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