

Breathe Easier: The Role of Allergy Testing in Asthma

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Recurrent episodes of cough, wheeze and shortness of breath may be due to asthma, a common and increasingly prevalent condition. Asthma is a complex disease with many triggers, including:

- viral infection,
- irritants (*i.e.*, smoke, pollution)
- exercise,
- drugs (*i.e.*, acetylsalicylic acid, non-steroidal anti-inflammatory drugs) and
- environmental allergens.

The role of allergy in asthma is supported by the observation that allergen exposure triggers asthma symptoms in sensitized individuals, whereas allergen reduction diminishes symptoms. When challenged with an allergen to which they are sensitized, allergic asthmatics experience an early phase of bronchoconstriction—the early asthmatic response, which peaks in 15 minutes to 20 minutes. Following this is a late phase of airway obstruction—the late asthmatic response (LAR), which occurs for four hours to 24 hours post-challenge. The LAR is associated with airway inflammation and an increase in bronchial hyper-responsiveness to methacholine, which can last from days to months. In this way, allergen exposure may amplify asthma symptoms and therefore, increase the need for treatment.

Just as allergens exacerbate the disease, allergen avoidance and other forms of allergy management, such as immunotherapy or anti-IgE medication (omalizumab), have been shown to decrease symptoms.^{1-2,4,6,8} These observations support the role of allergy in asthma and identify allergy as a therapeutic target.

Joanna's case:

- Joanna, an eight-year-old girl, is brought to your office by her mother
- For the past 4 months, she has experienced a nocturnal, non-productive cough, which sometimes awakens her from sleep
- She has a past history of wheezing, with respiratory infection and atopic dermatitis
- Her family history is positive for food allergy and seasonal hay fever
- Review of systems reveals persistent nasal congestion and itchy eyes
- Environmental history reveals her family has had a cat for 2 years and that her father is a smoker
- On physical exam, nasal turbinates are edematous, with moderate nasal congestion. Her chest is clear on auscultation

For more on Joanna, turn to page 100.

Allergy testing in asthma

The work-up for asthma requires:

- a detailed history,
- physical exam,
- pulmonary function testing and often
- allergy skin testing.

The patient's history should identify any relationship between symptoms and allergen exposure, whereas the physical exam should inspect for signs of allergy, such as atopic dermatitis or rhinoconjunctivitis. Pulmonary function tests, including spirometry (performed both pre- and post-bronchodilator), peak expiratory flow and methacholine

challenge, are both used to confirm diagnosis and to determine asthma severity.

Allergy skin tests are indicated in all cases of persistent or troublesome asthma and when a case of asthma is potentially related to an avoidable allergen exposure. These tests assess sensitization, namely the production of IgE, to common allergens, such as:

- animal dander (especially cat and dog),
- pollens (trees, grass and ragweed),
- house dust mites (HDM) and
- molds (indoor and outdoor).

Of the available investigations, the skin prick/puncture test (SPT) is used most often, followed by *in vitro* radioallergosorbent tests (RAST), if skin tests cannot be performed.

Skin tests

Allergy may be tested for through a SPT or intradermal test.

SPT involves placing a drop of concentrated allergen extract on the skin, typically the volar aspect of the forearm and passing a lancet through the epidermis. Various airborne allergens can be assessed at one time. Standardized extracts for allergy testing include:

- cat hair,
- cat pelt,
- short ragweed,
- Bermuda grass,
- sweet vernal grass,
- Timothy grass and
- HDM (specifically, *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*).

Histamine is used as a positive control to ensure skin reactivity and the antigen-diluent is used as a negative control to screen for skin irritability. Results are read after 15 minutes. In a sensitized patient, an immediate Type 1 hypersensitivity reaction will occur, characterized by a wheal-and-flare (erythema) reaction.

Joanna's case cont'd:

- Joanna's forced expiratory volume in 1 second is 70% predicted, with 15% reversibility
- Her skin prick test (SPT) was positive for tree, grass and ragweed pollen, cat and dog epithelium and house dust mites
- The clinical picture is consistent with allergic rhinitis and allergic asthma. She is prescribed an inhaled corticosteroid meter-dose inhaler (MDI) and aerochamber to reduce lung inflammation, along with a short acting β -2-agonist, for symptomatic relief
- In addition, she is started on a non-sedating antihistamine for her eye symptoms and an intranasal corticosteroid for her allergic rhinitis
- Joanna and her mom have been instructed on allergen-avoidance measures. A follow-up appointment is scheduled in 1 month

Table 1

Interpreting allergy SPTs

Graduated system		
Grade	Wheal (mm)	Erythema (mm)
0	< 3	< 15
2+	< 6	< 15
3+	7 to 9	16 to 30
4+	> 9	> 30

Table 2

Radioallergosorbent tests (RAST) indications

Skin abnormality that could affect skin test interpretation	<ul style="list-style-type: none"> • Dermatographism • Generalized eczema • Urticaria • Unusual skin pigmentation, tattoos, scars • Hirsutism
Medications that suppress skin sensitivity	<ul style="list-style-type: none"> • H1 antihistamines and H2 antihistamines • Tricyclic antidepressants • Prolonged or high-dose steroid use
Patient preference	<ul style="list-style-type: none"> • <i>i.e.</i>, parent of young child
Skin testing is not available	<ul style="list-style-type: none"> • <i>i.e.</i>, rural setting

Table 3
Allergen avoidance/control measures

Exposure	Intervention
House dust mite	<ul style="list-style-type: none"> • Cover pillows and mattresses with zippered, mite-proof protectors • Wash all bedding weekly in hot water (55 C/135 F) • Vacuum upholstered furniture, floors and carpets weekly, using a vacuum with a high-efficiency particulate air (HEPA) filter
Pollen	<ul style="list-style-type: none"> • Use central air conditioning with HEPA filters; keep windows shut • Use air conditioning in the car; keep windows shut • Avoid raking leaves or cutting grass
Mold	<ul style="list-style-type: none"> • Reduce humidity at home to < 50% with dehumidifier or air conditioner • Clean visible mildew with cleaners containing 5% bleach • Reduce the number of indoor plants and avoid over-watering • Keep home well ventilated and use air conditioners with HEPA filters
Pet dander	<ul style="list-style-type: none"> • Remove pets from home • Use air conditioners with HEPA filters • Keep pets out of the bedroom, if removal is not possible
Airborne irritants	<ul style="list-style-type: none"> • Avoid smoke, noxious fumes



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A number of scaling systems are available to interpret the results (Table 1). It is important to note that the size of the wheal does not necessarily correlate with the degree of hypersensitivity. Skin reactivity can be decreased in individuals taking antihistamines or long-term steroids. These medications must therefore be discontinued for at least four days in the case of antihistamines and up to several weeks for steroids, prior to the test. Advantages of SPTs are that they are sensitive, quick, relatively painless, safe and capable of assessing multiple allergens.

Intradermal skin testing is occasionally done when SPTs are negative. A very small quantity of dilute allergen extract is injected intradermally and read after 15 minutes. The disadvantages of intradermal testing include a higher rate of false positivity and a greater risk of allergic reaction.

In vitro antibody testing


RAST, an *in vitro* assay, measures the amount of allergen-specific IgE in the serum. Although RAST has been previously criticized for poor sensitivity and specificity, the ImmunoCAP[®], a particular RAST assay, can measure specific IgE over a large range of values, with excellent sensitivity and good correlation with SPT.¹⁰ RAST is indicated when SPTs are not possible (Table 2). Limitations of RAST include higher cost and lack of immediate results.

Treating asthma through allergen avoidance

By identifying allergic triggers, allergy testing enables the implementation of logical allergen reduction techniques (Table 3). The demonstration of sensitization may also be necessary to maximize compliance, since some environmental avoidance measures

may be difficult to perform. In the case of HDM and cockroach, allergen avoidance has been shown to effectively control asthma, in some cases, enabling patients to reduce medication requirements.^{3,5,7,9} Studies which have failed to show benefit have been criticized for poor study design, inadequate allergen avoidance interventions and insensitive asthma outcome measures. Overall, allergen avoidance is a safe and sensible approach to asthma management.

Final thoughts

Identification of causal allergens through allergy testing is an important part of asthma assessment and management. Identifying potential triggers through allergy testing may allow patients not only to treat their asthma, but also, to prevent it. 

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Take-home message

- Allergy skin tests are indicated in cases of asthma where symptoms may be triggered by seasonal, or perennial indoor allergens
- SPT is the quickest, most sensitive method of diagnosing specific allergen sensitization in all age groups
- Allergen identification enables the implementation of effective and rational allergen avoidance, which can improve symptoms and reduce medication needs

Frequently Asked Questions

1. What are risk factors for the development of asthma in young children?

- Risk factors include a personal or family history of allergy, a family history of asthma, prenatal exposure to tobacco smoke and allergens and a tendency to develop wheezing with respiratory infections.

2. At what age can one perform allergy skin tests?

- Allergy skin testing can be safely performed in any age group, provided that the information will be useful in patient management. Although children < 2 years of age are not generally sensitized to pollens and molds, selected skin tests can be done for relevant allergen exposures in the investigation of asthma.

3. Do all patients require RAST tests?

- No, skin testing is sufficient for diagnosis in most patients. RAST testing may be substituted if patients cannot undergo skin testing (*i.e.*, if they are highly dermatographic, cannot discontinue medications that interfere with skin testing, or are in rural centres, where there are no allergists).

4. Can an individual have positive SPT or RAST, without having a clinical allergy?

- Yes, individuals can test positively to an allergen, without reporting any allergic symptoms. However, if there is evidence of an atopic disease, such as asthma or allergic rhinitis and the individual is exposed to the allergen in question, it is likely playing a role, even if the patient is unaware.