EDUCATIONAL COMMENTARY – DIAGNOSTIC TESTING FOR FOOD ALLERGIES

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LEARNING OUTCOMES

On completion of this exercise, the participant should be able to

- define food allergy.
- differentiate food allergy from food intolerance.
- discuss in vivo and in vitro testing for allergies.
- list the most common food allergens.
- discuss anaphylaxis and its causes.

Introduction

An allergy is defined as an abnormal immune response or hypersensitivity to a substance in the environment that is normally harmless. Allergic reactions can range from uncomfortable to life-threatening. In most cases, allergies to food and insect stings are responsible for the more serious reactions.

A food allergy is an immune reaction to a specific food. Allergic reactions usually follow the ingestion of the offending food within a few minutes to two hours. Severe reactions usually occur more rapidly. Symptoms of allergy include gastroenteritis, esophagitis, urticaria (hives), angioedema, dermatitis, and respiratory distress. Although the gastrointestinal (GI) symptoms are often similar, a food allergy should be distinguished from a food intolerance or sensitivity. In most cases, a food allergy is systemic, strikes quickly and suddenly, can be triggered by very small amounts of the food involved, occurs every time the food is ingested, and is potentially life-threatening. Food intolerance, on the other hand, affects only the GI tract, transpires gradually, usually occurs only when a large amount of the food is consumed, and is not life-threatening. Food intolerance is much more common than food allergy. Although an immune reaction that produces antibodies to gluten occurs in celiac disease, it is not considered a food allergy. Symptoms are confined to the GI tract and anaphylactic reactions do not occur in celiac disease.

Anaphylaxis, also called anaphylactic shock, is a rapidly occurring, severe, life-threatening, systemic immune reaction that can result in rash, swelling of the airways, lowered blood pressure, fainting, loss of consciousness, and possibly death due to cardiovascular collapse. Allergies to drugs, foods, and insect stings are responsible for most cases of anaphylaxis. In children, anaphylaxis is most often caused by allergies to foods. Inhaled allergens such as pollen rarely cause anaphylactic reactions. In the United
States, anaphylactic reactions are responsible for approximately 1500 deaths annually. Between 2.8 million to 42.7 million Americans are at risk for an anaphylactic reaction during their lifetimes.\(^1\)

**Mechanism of Immediate Hypersensitivity**

The substance that causes an allergic reaction is known as an **allergen**. Protein is the most likely component of a food to cause an allergy. Protein or fragments of proteins are more resistant to digestion in the GI tract and enter the blood circulation. At this point, the immune system recognizes the protein as foreign and forms antibodies that attach to the allergen. Most food allergies are categorized as type I (immediate) hypersensitivities. In a type I hypersensitivity, immunoglobulin E (IgE) antibodies are produced on the first exposure to the allergen. Mast cells have receptors on their surface with a strong affinity for IgE. The attachment of IgE antibodies to mast cells is called **allergic sensitization**. No symptoms accompany sensitization to an allergen. Symptoms do not occur until the second exposure to the same allergen. Then, the allergen attaches to the IgE that is bound to the surface of the mast cells. When the allergen binds to the antigen-binding sites of two or more IgE molecules, the IgE antibodies are cross-linked and the mast cell releases its granules. The granules contain potent immune mediators, including histamine and cytokines. These substances are responsible for the symptoms that occur in the allergic response. Blood vessels dilate and vascular permeability increases, resulting in edema (swelling), redness, heat, and movement of immune cells to the area. On the skin, signs of histamine release are inflammatory reactions called **wheal** (induration or thickening) and **flare** (redness). In skin testing, this reaction is measured and used as an indicator of allergic response to a specific allergen.

**Common Food Allergens**

The most common culprits in food allergy are shellfish, fish, milk, eggs, soy, wheat, peanuts, and tree nuts. According to the Centers for Disease Control and Prevention, these eight foods are responsible for 90% of all food allergies.\(^2,3\) Symptoms vary according to the location in the body in which the histamines are released. Histamines released in the skin produce hives, rash and/or itching. Those released in the GI tract cause stomach pain, nausea, bloating, cramps, or diarrhea.

**Prevalence**

Food allergies affect 1% to 4% of adults and approximately 7% of children in the United States. Children of parents with allergies have a greater risk for allergy. In most cases, children outgrow most food allergies by the age of 5, except for allergies to peanuts, tree nuts, and shellfish. The National Health Interview Survey of 2007 found that food allergies in children under 18 years of age increased by 18% in the previous decade.\(^4\) Research is under way to determine the cause of this rise in food allergies. One leading theory, the “hygiene hypothesis,” proposes that excessive cleanliness interferes with the normal maturation of the immune system. Lack of exposure to germs changes the focus of the immune system.
from preventing infections to attacking substances not normally recognized by the immune system as foreign. Some factors observed at the same time as the rise of allergies include the following:

- More children without older siblings
- Delayed introduction of potentially allergenic foods
- More urbanization and lack of exposure to farming environment
- Sterile environment resulting in lack of exposure to microbes
- Use of antibiotics
- Reduction of helminth infections

**In Vivo Testing**

Testing for allergies may occur in the physician’s office or in the laboratory. In the physician’s office, skin testing may be performed. A small amount of a suspected allergen is introduced by pricking or scraping the skin, injecting the allergen under the skin, or applying a patch impregnated with the allergen to the patient’s skin. The type of skin testing administered is determined by the types of allergens suspected of causing the patient’s hypersensitivity. Prick tests and scrape tests are most commonly used for food, dust, and pollen allergies. Extreme care is taken when skin testing is performed, as anaphylaxis may occur at any time. A patient with suspected food allergies may be put on an elimination diet, which omits the foods most likely to cause the allergic reactions. Over the course of several weeks, these foods are systematically reintroduced to the diet. Often, this technique can identify the offending food(s).

**In Vitro Testing**

Laboratory testing may also be performed to identify the cause of allergic reactions. After a history and physical examination by a physician, a total IgE assay and a complete blood cell count including a white blood cell differential may be ordered. Persons with allergies usually have elevations in white blood cell count, eosinophil count, and total IgE concentration. To determine the allergen responsible for the hypersensitivity, a radioallergosorbent test (RAST) or an enzyme-linked immunosorbent assay (ELISA) may be performed. These tests detect allergen-specific IgE. In 2010, the National Institute of Allergy and Infectious Diseases recommended that ELISA testing replace RAST because of its increased sensitivity. ELISA testing is also preferable because it eliminates the dangers associated with the use of radioactive reagents. A positive result does not guarantee that the patient will ever react to that particular allergen, but it does indicate the possibility of a reaction. The concentration of IgE does not correlate with the severity of the allergic reaction.
Prevention and Treatment

Preventing allergic reactions to food involves avoiding the offending food. Food labels should be carefully inspected. When dining in restaurants, the allergic individual should confer with the chef about the ingredients used to prepare each dish ordered. Patients with severe allergies may be prescribed antihistamines, steroids, or immunotherapy. Immunotherapy, or allergic desensitization, may be used to induce immune tolerance to a specific allergen. The patient is exposed to increasing doses of the allergen over a long period of time. Antibodies of a class different from IgE, usually IgG, are produced to the allergen. The specific IgG antibodies can then react with the allergen before the allergen causes cross-linking of the IgE antibodies on mast cells, thus preventing the release of immune mediators. The result is a long-term tolerance for that specific allergen. Patients with severe allergies usually carry antihistamines or injectable epinephrine in case of unavoidable exposure. Patients experiencing anaphylactic shock should be treated with injectable epinephrine if available and rushed to the nearest hospital for emergency treatment.

Conclusion

The prevalence of food allergies has significantly risen in recent years. The cause of this rise is speculated to be excessive cleanliness. It is thought that our preoccupation with cleanliness interferes with the normal maturation of the immune system, causing immune mechanisms to be redirected and to interact with innocuous substances.

References


