ALLERGY TESTING AND MANAGEMENT

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ALLERGIC REACTIONS

Skin Contact
- poison plants
- animal scratches
- pollen
- Latex

Injection
- bee sting

Ingestion
- medication
- nuts & shellfish

Inhalation
- pollen
- dust
- mold & mildew
- animal dander

https://medlineplus.gov/ency/images/ency/fullsize/19150.jpg
<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
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<th>Type IV</th>
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<tbody>
<tr>
<td>IgE-Mediated Hypersensitivity</td>
<td>IgG-Mediated Cytotoxic Hypersensitivity</td>
<td>Immune Complex-Mediated Hypersensitivity</td>
<td>Cell-Mediated Hypersensitivity</td>
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<tr>
<td>Ag induces crosslinking of IgE bound to mast cells and basophils with release of vasoactive mediators</td>
<td>Ab directed against cell surface antigens mediates cell destruction via complement activation or ADCC</td>
<td>Ag-Ab complexes deposited in various tissues induce complement activation and an ensuing inflammatory response mediated by massive infiltration of neutrophils</td>
<td>Sensitized T\textsubscript{H}1 cells release cytokines that activate macrophages or T\textsubscript{C} cells which mediate direct cellular damage</td>
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<tr>
<td>Typical manifestations include systemic anaphylaxis and localized anaphylaxis such as hay fever, asthma, hives, food allergies, and eczema</td>
<td>Typical manifestations include blood transfusion reactions, erythroblastosis fetalis, and autoimmune hemolytic anemia</td>
<td>Typical manifestations include localized Arthus reaction and generalized reactions such as serum sickness, necrotizing vasculitis, glomerulonephritis, rheumatoid arthritis, and systemic lupus erythematosus</td>
<td>Typical manifestations include contact dermatitis, tubercular lesions and graft rejection</td>
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Allergy testing

- Skin test/Serum IgE to allergens
  - IgE mediated reactions
  - Allergic rhinoconjunctivitis, allergic asthma, ABPA, food allergy, drug allergy, venom allergy, latex allergy

- PATCH test
  - type IV hypersensitivity
  - contact dermatitis
Skin prick test

- For inhalant allergy, the sensitivity and specificity of the SPT are approximately 80–85%.
- For food allergy, the SPT is generally sensitive (30–70%), with high rates of false positives (30–70% specific).
- Antihistamines have to be stopped (usually 5-7 days) before testing.
- Wait 4-6 weeks after acute reaction to do skin testing.
Skin prick test

A number of suspected allergens are tested on the arm at the same time. If the test is positive, the area becomes red and swollen.
Intradermal skin test

- Performed with a 100- to 1000-fold dilution of the SPT concentration
- More sensitive but less specific than the SPT
  - high false-positive rate
- Clinical utility:
  - Aeroallergens, Venom hypersensitivity, Drug hypersensitivity
- NOT used in the diagnosis of food or latex allergy due to a high rate of systemic reactions
- Systemic reaction rate:
  - <0.02–3.6% in prospective studies
  - fatality exceedingly rare
Intradermal allergy test reactions
Serum IgE to allergens

- Generally less sensitive than skin prick test
  - sensitivity ranges 60–95%
  - specificity 30–95%
- Helpful in the following situations:
  - Antihistamines can not be stopped
  - Poor pulmonary function
  - Severe eczema
  - Dermatographism
  - Highly sensitive patient
  - Major food allergens in children
PATCH test
**Extreme positive**
Coalescing vesicles; bulla

**Strong positive**
Erythema; papules; infiltration; discrete vesicles

**Weak positive**
Erythema; infiltration; discrete papules

**Doubtful**
Faint or homogenous erythema; no infiltration

**Irritant**
Discrete, patchy or homogenous erythema; no infiltration
Question

- A 42-year-old man is evaluated for a 3-month history of cough. He describes the cough as nonproductive and associated with sinus congestion. He also notes increased mucus production with frequent throat clearing. He has no shortness of breath, wheezing, hemoptysis, or chest pain. He does not notice any change in cough with exercise. He reports that he has had similar extended periods of cough in the past, usually in either the fall or spring. He has tried over-the-counter dextromethorphan and decongestants, alone and in combination, without noticeable improvement. Medical history is otherwise unremarkable. He is a never-smoker and takes no medications.

- On physical examination, the patient is afebrile, blood pressure is 124/84 mm Hg, pulse rate is 68/min, and respiration rate is 15/min. Nasal turbinates are boggy. The lungs are clear to auscultation. The remainder of the examination is normal.
Which of the following is the most appropriate treatment?

- A  Antibiotic therapy
- B  Antihistamine-decongestant
- C  Inhaled bronchodilator
- D  Intranasal glucocorticoid
Answer

- D  Intranasal glucocorticoid
**Allergic rhinoconjunctivitis**

- **DX:**
  - Skin prick test to Aeroallergens
  - Intradermal test to Aeroallergens
  - Serum IgE to Aeroallergens

- **Treatment:**
  - Avoidance measures
  - Medical treatment (*nasal steroids*, antihistamines, leukotriene antagonist)
  - Immunotherapy
A 36-year-old woman is evaluated for a 5-year history of multiple symptoms, including back pain, food intolerances, headaches, pelvic pain, nausea, myalgia, joint stiffness, lightheadedness, and fatigue. She reports that her most bothersome symptom is mid/low back pain. She reports no trauma, fever, weight loss, rash, or bladder or bowel incontinence. She notes that if she removes highly processed foods from her diet, her symptoms seem to improve, especially the fatigue.

During the past 3 years, the patient has been evaluated by an orthopedic surgeon, allergist, neurologist, gastroenterologist, gynecologist, and rheumatologist, along with three different internists. She is married with no history of intimate partner violence. She does not smoke, drink alcohol, or use illicit drugs. Medications are citalopram, gabapentin, tramadol, and several herbal preparations.
On physical examination, vital signs are normal. BMI is 21. Back examination shows mild tenderness to palpation along the paraspinal muscles. Straight-leg raise test is negative for radicular symptoms but does reproduce her low back discomfort. The remainder of the examination is unremarkable.

Previous records show a normal comprehensive metabolic profile, creatine kinase level, complete blood count, and thyroid-stimulating hormone level within the past year. An erythrocyte sedimentation rate measured 1 month ago was 25 mm/h, and Lyme serology performed at the same time was negative. A lumbosacral spine radiograph 6 months ago was normal.
Which is the most appropriate diagnostic step?

A  Food allergy testing

B  MRI of the lumbosacral spine

C  Repeat Lyme serology

D  No additional testing
☐ D  No additional testing
Food allergy

- **DX:**
  - Skin prick test
  - NO INTRADERMAL skin test to foods due to risk of systemic reaction
  - Serum IgE

- **Treatment:**
  - Avoidance of foods
  - EPIIPEN prn
Drug allergy

- Useful for penicillin, chemotherapeutic agents, muscle relaxants, insulin, and heparin skin testing.
- Value of drug skin testing to other agents is variable:
  - patients may be allergic to a metabolite
  - lack of standardization
  - non-IgE mediated mechanism may be involved
- DX:
  - Skin prick test
  - Intradermal skin test
  - Serum IgE to drugs: NOT helpful
- Treatment:
  - Avoidance of drug
  - Use of alternative drug
  - Desensitization (if there is no alternative and drug is medically necessary)
72-year-old man sustains a laceration on his left index finger while preparing chicken. He immediately washes the area and applies neomycin and an occlusive bandage. He changes the bandage and reapplies the medication twice daily. Two days later, he develops itching and redness at the wound site. He has had no fever or other systemic symptoms. Medical history is significant for well-controlled type 2 diabetes mellitus. His only medication is metformin.

On physical examination, vital signs are normal. The left index finger shows a 1.0-cm superficial wound with well-approximated margins without purulence or drainage, and no pain on palpation. There are pinpoint papules and vesicles in an area extending 0.5 cm around the laceration site in a rectangular pattern approximating the bandage. There is no lymphangitic streaking. The remainder of the physical examination is unremarkable.
Which of the following is the most likely diagnosis?

- A  Allergic contact dermatitis
- B  Group A streptococcal infection
- C  Herpes simplex virus infection
- D  Staph aureus infection
Answer

- A  Allergic contact dermatitis
Contact dermatitis

- Reaction to metal in (A) belly-button ring, (B) earring, (C) belt buckle, (D) pant closure.

- DX: PATCH test

- Treatment:
  - Avoidance of allergens
  - Topical steroids

A 62-year-old man is evaluated during a new patient visit. He reports never having received influenza vaccination because of an egg allergy. The allergy was diagnosed many years ago after he developed hives upon eating eggs. His medical history is otherwise unremarkable. He currently feels well and takes no medications.

Physical examination, including vital signs, is normal.
Which of the following is the most appropriate management of this patient's influenza vaccination?

A  Administer inactivated influenza vaccine
B  Administer live attenuated influenza vaccine
C  Perform influenza vaccine skin testing
D  Do not vaccinate against influenza
Answer

- A  Administer inactivated influenza vaccine
Egg allergy and Influenza vaccine

Can the person eat lightly cooked egg (e.g., scrambled egg) without reaction?*

YES → Administer vaccine per usual protocol.

NO → After eating eggs or egg-containing foods, does the person experience ONLY hives?

YES → Administer TIV. Observe for reaction for at least 30 minutes after vaccination.

NO → Does the person experience other symptoms such as
- Cardiovascular changes (e.g., hypotension)
- Respiratory distress (e.g., wheezing)
- Gastrointestinal (e.g., nausea/vomiting)
- Reaction requiring epinephrine
- Reaction requiring emergency medical attention

YES → Refer to a physician with expertise in management of allergic conditions for further evaluation.

NO →

* Persons with egg allergy might tolerate egg in baked products (e.g., bread or cake). Tolerance to egg-containing foods does not exclude the possibility of egg allergy.
A 44-year-old woman is evaluated in follow-up after multiple recent emergency department visits for worsening asthma. She has had asthma since childhood, but her asthma symptoms have progressively worsened recently. Over the past 2 years, she has had twice-yearly visits to the emergency department requiring treatment with prolonged glucocorticoid tapers. She has required hospitalization twice within the last 4 months. She has no symptoms of gastroesophageal reflux, sinus disease, or other symptoms, and she diligently avoids environmental exposures and likely triggers. Medical history is significant for multiple allergies; skin testing has been positive for allergy to dust mites, cats, and ragweed. She is a never-smoker.
Medications are a high-dose inhaled glucocorticoid, a long-acting \( \beta_2 \)-agonist, a leukotriene antagonist, a long-acting anticholinergic agent, and an as-needed short-acting \( \beta_2 \)-agonist.

On physical examination, vital signs are normal. BMI is 26. Slightly puffy facies are noted. The lungs reveal decreased air movement and mild, diffuse wheezes. Skin fragility is observed on the arms. The remainder of the examination is unremarkable.

Laboratory studies show a serum IgE level of 362 U/mL (362 kU/L) and 6% eosinophils on peripheral blood smear.
Which of the following is the most appropriate treatment?

A  Allergen immunotherapy
B  Daily prednisone
C  Infliximab
D  Omalizumab
Answer

- D  Omalizumab
Omalizumab in allergic asthma

Severe asthma?
  yes
  Patient ≥12 years?
    yes
    Controlled with ICS plus LABA?
      yes
      Multiple documented severe exacerbations?
        no
        yes
        Frequent daytime and nocturnal symptoms?
          no
          yes
          FEV1 <80% predicted
            no
            yes
            Skin-prick test positive?
              no
              yes
              RAST test positive?
                no
                yes
                Bodyweight 20–150 kg and total IgE 30–700 IU/mL?
                  no
                  yes
                  Consider treating with omalizumab

Patient not suitable for omalizumab
35-year-old woman is evaluated in follow-up for worsening asthma. Medical history is significant for environmental and food allergies, allergic rhinitis, and asthma diagnosed at age 10 years. Although her asthma had been previously well controlled, her symptoms have worsened over the past year with increased wheezing and a cough productive of dark-colored mucus. She was admitted to the hospital 2 weeks ago for her asthma symptoms and was diagnosed with pneumonia. She was treated with antibiotics and a tapering course of glucocorticoids. Her respiratory symptoms have recurred following completion of therapy. Medical history is otherwise unremarkable. Medications are fluticasone/salmeterol and as-needed albuterol metered-dose inhalers. She works as a school teacher.
On physical examination, temperature is 37.1 °C (98.7 °F), blood pressure is 110/70 mm Hg, pulse rate is 92/min, and respiration rate is 16/min; BMI is 23. Diffuse wheezing is noted on expiration with diminished airflow across the upper right lung field. The remainder of the examination is unremarkable.

Laboratory studies show a leukocyte count of 10,500/µL (10.5 × 10⁹/L) with 15% eosinophils. Chest radiograph shows a right upper lobe infiltrate and diffusely increased lung markings.
Which of the following is the most likely diagnosis?

- A  Allergic bronchopulmonary aspergillosis
- B  Cystic fibrosis
- C  Eosinophilic granulomatosis with polyangiitis (Churg-Strauss syndrome)
- D  Hypersensitivity pneumonitis
Answer

- Allergic bronchopulmonary aspergillosis
Allergic bronchopulmonary aspergillosis

- Chronic hypersensitivity reaction that occurs in response to colonization of the lower airways with Aspergillus species
- Symptoms typically include severe and uncontrolled asthma, cough with expectoration of mucus plugs, and systemic symptoms such as low-grade fever and fatigue.
- Testing: Skin test to Aspergillus fumigatus(AF), serum IgE, serum IgE and IgG to AF, imaging
- Treatment: steroids, antifungal, omalizumab
63-year-old woman is evaluated in the emergency department following multiple wasp stings that occurred when she was working in her garden. She is in respiratory distress with wheezing and is confused.

On physical examination after receiving a normal saline fluid bolus, temperature is 37.1 °C (98.8 °F), blood pressure is 76/44 mm Hg, pulse rate is 114/min, and respiration rate is 28/min. Oxygen saturation is 93% breathing 3 L of oxygen per minute by nasal cannula. She appears confused and can follow only simple commands. The skin is flushed, and urticaria is noted. Chest examination reveals diffuse bilateral expiratory wheezes. Cardiac examination reveals regular tachycardic rhythm. The extremities are cool to the touch.
Which of the following is the most appropriate next step in treatment?

- A  Diphenhydramine
- B  Epinephrine
- C  Glucagon
- D  Methylprednisolone
Answer

□ B  Epinephrine
Anaphylaxis is highly likely when any one of the following three criteria is fulfilled:

**1.** Sudden onset of an illness (minutes to several hours), with involvement of the skin, mucosal tissue, or both (e.g. generalized hives, itching or flushing, swollen lips-tongue-uvula)

**AND AT LEAST ONE OF THE FOLLOWING:**
- Sudden respiratory symptoms and signs (e.g. shortness of breath, wheeze, cough, stridor, hypoxemia)
- Sudden reduced BP or symptoms of end-organ dysfunction (e.g. hypotonia [collapse], incontinence)

**OR 2.** Two or more of the following that occur suddenly after exposure to a likely allergen or other trigger* for that patient (minutes to several hours):
- Sudden skin or mucosal symptoms and signs (e.g. generalized hives, itch-flush, swollen lips-tongue-uvula)
- Sudden respiratory symptoms and signs (e.g. shortness of breath, wheeze, cough, stridor, hypoxemia)
- Sudden reduced BP or symptoms of end-organ dysfunction (e.g. hypotonia [collapse], incontinence)
- Sudden gastrointestinal symptoms (e.g. crampy abdominal pain, vomiting)

**OR 3.** Reduced blood pressure (BP) after exposure to a known allergen** for that patient (minutes to several hours):
- Infants and children: low systolic BP (age-specific) or greater than 30% decrease in systolic BP***
- Adults: systolic BP of less than 90 mm Hg or greater than 30% decrease from that person’s baseline
1. **Have a written emergency protocol** for recognition and treatment of anaphylaxis and rehearse it regularly.

2. **Remove exposure to the trigger** if possible, e.g., discontinue an intravenous diagnostic or therapeutic agent that seems to be triggering symptoms.

3. **Assess the patient’s circulation, airway, breathing, mental status, skin, and body weight (mass).**

4. **Promptly and simultaneously, perform steps 4, 5 and 6.**

5. **Call for help:** resuscitation team [hospital] or emergency medical services [community] if available.

6. **Inject epinephrine (adrenaline) intramuscularly in the mid-anteroscutaneous aspect of the thigh, 0.01 mg/kg of a 1:1,000 (1 mg/mL) solution, maximum of 0.5 mg (adult) or 0.3 mg (child); record the time of the dose and repeat it in 5-15 minutes, if needed. Most patients respond to 1 or 2 doses.**

7. **Place patient on the back or in a position of comfort if there is respiratory distress and/or vomiting; elevate the lower extremities; fatality can occur within seconds if patient stands or sits suddenly.**

8. **When indicated, give high-flow supplemental oxygen (6-8 L/minute), by face mask or oropharyngeal airway.**

9. **Establish intravenous access using needles or catheters with wide-bore cannulae (14-16 gauge). When indicated, give 1-2 litres of 0.9% (isotonic) saline rapidly (e.g., 5-10 mL/kg in the first 5-10 minutes to an adult; 10 mL/kg to a child).**

10. **When indicated at any time, perform cardiopulmonary resuscitation with continuous chest compressions.**

In addition,

- At frequent, regular intervals, monitor patient’s blood pressure, cardiac rate and function, respiratory status, and oxygenation (monitor continuously, if possible).
Anaphylaxis

- First-line treatment: **EPINEPHRINE**
  - EPI 0.3mg IM x1 (repeat dose in 3-5 minutes if needed)

- Additional treatments: steroids, antihistamines, beta agonist, fluids, glucagon (if on beta blocker and refractory to EPI)

- Evaluate trigger: medications (most likely trigger in a hospitalized patient), food allergies, insect stings

- Testing: serum tryptase during acute reaction, skin testing 4-6 weeks after acute reaction
Questions?