

Immediate Hypersensitivity

(Bee Careful)

AN IMMUNOBIOLOGY TEACHING PACKAGE

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This is a Patient-Oriented Problem-Solving workbook designed for four students. You should have previously studied a pretest and a set of objectives designed to help prepare you for this session. Now, you each should take one of the four booklets (A through D) and follow the directions. If your group has only three students, one of you should take two booklets.

PRETEST CORRECT ANSWERS

You have the answers to some of the pretest questions, while other members of your group have the rest. This arrangement is designed to encourage all members of your group to participate actively in an exchange of ideas and concepts. First study the answers in your booklet and then EXPLAIN them to your peers. Please don't just read them to your peers, and don't let your peers read their answers to you. In explaining something to another person, most people gain a better understanding of it and often transmit a better understanding. Drawing pictures can offer aid in explaining many concepts. The pretest discussion and patient-oriented problem solving parts of this activity are "open book". Be sure to refer to textbooks, notes, and other written resources whenever questions arise within your group.

You will probably want to make notes on your pretest about questions you missed to help you review. Avoid "collecting pages" for later study and understanding. Learn the concepts now so that later you only need review them. Turn the page for your set of answers.

A Patient-Oriented Problem-Solving (POPS) System

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Pretest Correct Answers

8. **D is the correct answer.** The severity would decrease, since the mast cells would become coated with the IgE myeloma protein (IgE anti-“nothing”) rather than with the IgE anti-ragweed. Hence the pollen would not trigger histamine release from the mast cells. Since the myeloma does not react with ragweed it will not prevent IgE anti-ragweed from combining with ragweed.
9. **B is the correct answer.** The IgE that produces the symptoms of allergy is already bound to mast cells before it complexes with the allergen. **A** is therefore wrong. **C** is wrong since neither IgE nor allergen nor the complex binds to histamine receptors. **D** is incorrect. The onset of allergic symptoms (often within minutes) precludes the involvement of a step in which macrophages would have the time to process an allergen.
10. **C is correct,** but this is not the usual mechanism for anaphylaxis. Most anaphylaxis is IgE-mediated, and complement is irrelevant to this process. However, when a large dose of antigen is injected into a patient with IgG or IgM antibody to the antigen, enough anaphylotoxin can be released during complement fixation to cause anaphylaxis. Possible examples of such an event include mismatched blood transfusion, serotherapy with heterologous serum in a sensitive patient, and gamma globulin injection in an IgA-deficient patient with anti-IgA antibody. **A** is incorrect. **B** is incorrect since IgE cannot fix complement. **D** is incorrect since allergic rhinitis is IgE-mediated. **E** is incorrect. Complement is not thought to play a major role in anaphylaxis.

Do not go to the next page until you are instructed to do so.

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POSSIBLE THERAPIES: Epinephrine

Individually study the following and then consider as a group:

1. What step(s) in the pathophysiologic process does epinephrine block?
2. How does it do so?

Answer: Epinephrine relaxes smooth muscles in the lung by stimulating the β_2 -adrenergic receptors and hence can directly reverse constriction of the bronchioles and bronchi. In addition the α -adrenergic effects of epinephrine constrict peripheral blood vessels (arterioles), thereby raising blood pressure and reversing the shock (low blood pressure) that sometimes accompanies anaphylaxis. The drug is lifesaving in this situation. Epinephrine is usually given subcutaneously (SQ); in severe cases, it can be given intravenously (IV) for faster action or even into the heart if the patient has no immediately accessible veins. Epinephrine is the appropriate therapy for anaphylaxis. It can be lifesaving. All physicians and dentists should always have this drug immediately available in case of anaphylactic reactions to penicillin or other agents.

When you have finished discussing possible therapies, return to question #2 on Problem Sheet #2.

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The Better Half

Mr. Hoofit has brought his wife, Snuffy Hoofit, to you. He is so pleased with your treatment of him, he wants you to treat her. She can no longer go hiking with him in August or September since she develops burning and itching eyes, paroxysms of sneezing, runny nose, and clogged nasal passages when she is outdoors. While indoors in their air-conditioned home, these problems are markedly reduced. She seems to have little, if any, problem hiking from just after the first frost (usually in October) through July. The Hoofits have no pets. Results of your battery of skin tests appear below. You have three extra copies of this data in your booklet. Give them to the other students in your group.

ALLERGEN TEST RESULTS FOR SNUFFY HOOFIT

Allergen	Season	Skin test wheal diameter (mm)	RAST score
Histamine control		10	–
Saline control		0	–
Oak	March-May	15	3 +
Dust	Perennial	5	1 +
Bahia grass	May-September	5	2 +
Ragweed	August-September	15	3 +
Dog dander	Perennial	18	3 +
<i>Penicillium</i>	Summer	12	2 +
Johnson grass	June-September	17	3 +
Hoofit hay	August-September	5	0

Ask the group, "What is the definition for perennial?"

(Answer: Present during all seasons of the year.) Dust allergy is on the rise in the United States; does this condition contribute to Mrs. Hoofit's problems?

What does the group wish to do for Mrs. Hoofit? Please fill in Problem Sheet #4 (next page). You are the discussion leader and group secretary for this last section. The group should contrast the time, mechanism, and histology of an Arthus reaction, a delayed hypersensitivity skin test, and the immediate hypersensitivity skin test. What does a RAST score of 3+ mean? (Answer: An amount of bound radioactive anti-IgE equal to or somewhat less than a known strongly positive serum).

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Correct Answers for Problem Sheet #4

1. What is your diagnosis?

Ragweed pollenosis or allergic rhinitis, known as hay fever to the layman.

2. On what data do you base this diagnosis?

Ragweed is the allergen that gives a positive skin test and RAST score and best matches the seasonal pattern. More specifically, oak, ragweed, dog dander, Johnson grass, and perhaps *Penicillium* are possible causative agents based on the skin tests and RAST data, but Mrs. Hoofit's symptoms occur in August and September. If oak were the cause, she would have trouble in March, April, and May; therefore, oak can be ruled out. If dog dander were responsible, the symptoms would be year-round. *Penicillium* and Johnson grass can also be ruled out on the basis of season. The basic idea is to use all available data (i.e., season of occurrence as described in the patient history, skin test, and RAST).

3. What therapy will you suggest?

- (1) An antihistamine for symptomatic relief. It should be taken regularly during the ragweed season so that the drug is "there before the allergen."
- (2) Hyposensitization therapy with ragweed extract. There has always been controversy concerning the effectiveness of hyposensitization therapy for allergic rhinitis, but well-controlled, double-blind studies have shown that it is of value to the average patient. In contrast to hyposensitization for allergic rhinitis, hyposensitization for bee sting allergy is universally accepted as effective. This therapy probably acts in several ways:
 - a. Stimulates production of IgG blocking antibody
 - b. Decreases levels of IgE anti-ragweed (mechanism unknown)
 - c. Decreases release of histamine from sensitized mast cells (mechanism unknown).

The group should consider why hyposensitization for insect stings might be more effective than for allergic rhinitis. (Answer: The bee venom allergen is injected SQ and travels to the lung mast cells via the blood. It therefore has ample opportunity to combine with serum IgG blocking antibody and be removed. In contrast, ragweed pollen allergen can pass through the nasal mucosa and get to the mast cells in the submucosa with less exposure to the IgG-blocking antibody).

When you have finished discussing these answers, you have completed the final chapter in the Hoofit saga. Please complete the post-test individually.