Infection Control In Practice
Dentistry’s Newsletter for Infection Control and Safety

Immunology and Allergies

Every day, we come in to contact with potentially harmful microorganisms and chemicals. We have a variety of host defense mechanisms to prevent and contain infectious diseases and exposure to chemicals. Actually, we have three lines of defense. The first two involve non-specific host defense mechanisms. The third line is the immune response, which is very specific in the way it responds. The interaction and cooperation of these three levels of defense normally provide excellent protection.

Nonspecific host defense mechanisms are general in their activity, protecting the body from many harmful substances. This involves any barrier that blocks invasion at the point of entry and limits access to internal tissues of the body. These defense mechanisms are not truly part of the immune system because they do not involve recognition of or a response to a specific foreign substance.

The first type of nonspecific host defense mechanism occurs on the outside of our bodies. Skin and mucous membranes of the respiratory and digestive tracts have built-in defensive features. Intact, unbroken skin is a powerful physical and mechanical barrier. It is thick, tough, waterproof and produces antimicrobial chemicals. Few pathogens can penetrate intact skin. However, even the tiniest cut or abrasion in the skin can serve as a portal for microbial entry.

Although they are composed of only a single layer of cells, mucous membranes are also an effective external barrier. The mucous present helps by entrapping invaders. Like skin, defects in mucous membranes reduce the level of protection. Mucous and saliva contain antimicrobial enzymes.

Enzymes and acid present in the stomach neutralize harmful ingested materials. Microorganisms commonly populate the body (normal flora) usually causing few problems. The presence of these organisms retards the colonization by transient flora, which causes most infections.

Coughing, spitting, sneezing and vomiting all help remove pathogens. Flushing by tears, saliva, urine and perspiration help remove harmful cells and chemicals. Respiratory cilia move cells and chemicals trapped in mucous out of the lungs.

Invading microbes and chemicals that manage to penetrate our first line of defense then encounter our nonspecific cellular and chemical defense responses. This second line of defense is a slightly more sensitive system of internal protective cells and fluids. A complex sequence of events develops involving production of fever and interferons, activation of the complement system, inflammation, chemotaxis and phagocytosis. This line of defense acts rapidly at both the local and systemic levels.

Immunology is the study of the immune system and immune responses. Immune responses involve complex interactions among many different types of body cells and cellular secretions. Immune responses are specific host defense mechanisms that represent our third line of defense.

Learning Objectives

After reading this article, the reader should be able to:
- list and define the major components of the nonspecific and specific host defense systems.
- describe the four types of hypersensitivity.
- identify the steps to be taken when dealing with an occupationally-related hypersensitivity.

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Immunology and Allergies

continued from front cover

fense. There are two major components of the immune system - humoral immunity and cell-mediated immunity.

In humoral immunity, special lymphocytes called B cells produce specific glycoprotein molecules called antibodies. These molecules recognize, bind with, inactivate and destroy invading microbes and larger chemicals. Their targets are antigens, which the body considers foreign (non-self) and which could pose a threat. Once formed, humoral antibodies circulate in blood plasma and other secretions searching for the presence of a specific antigen.

Cell-mediated immunity involves the participation of several types of T cells (lymphocytes) and macrophages. Antibodies are unable to enter cells, including those containing pathogens. When cells recognize the presence of foreign antigens, a complex interactive system activates resulting in the release of highly reactive chemicals. The goal is to neutralize potentially harmful cells. Macrophages usually are first to contact foreign antigens. Macrophages ingest and digest the antigens with components parts left on their surfaces. T helper cells recognize these parts and release chemicals that stimulate function of other types of T cells as well as activating B cells to produce antibodies against these processed antigens.

The immune response is not innate, but adaptive. Acquired specific immunity arises from the dual system of B and T lymphocytes. Two features that most characterize our third line of defense are specificity and memory. Antibodies formed in response to one virus will not be effective against another type. Once formed, these “programmed” lymphocytes can recall the initial interaction with an antigen and then respond quickly to subsequent exposures.

There are four interrelated types or categories of adaptive immunity - active or passive and natural or artificial. Active immunity means that a person produces their antibodies in response to an antigen challenge. Natural active acquired immunity occurs in response to the presence of antigen within the body, a normal biologic response such as experiencing an infection. Artificial active acquired immunity involves antibody production caused by a medical procedure, such as a vaccine or use of an immune serum. Passive immunity involves reception of antibodies produced by another human or animal. Immunity is temporary, lasting about three to six weeks. Natural passive acquired immunity involves passages of antibodies from a mother’s blood across the placenta into the developing fetus. Another example is colostrum. Artificial passive acquired immunity involves transferring antibodies from an immune source to a susceptible source.

— OSAP
Compliance Corner

The Society for Healthcare Epidemiology of America

About 25% of nurses report symptoms or signs of hand dermatitis. Frequent use of hand hygiene products, particularly soaps and other detergents is the prime cause of chronic irritant contact dermatitis. SHEA suggests several corrective strategies. These include: 1) reducing frequency of exposure to irritating agents; 2) selecting products with lower irritating potential; 3) educating personnel about dermatitis and 4) increasing use of moisturizing skin care products or barrier creams. Reducing the frequency of hand hygiene is a conundrum, because compliance traditionally is low. One possibility is greater use of alcohol-based hand rubs. These rubs are effective and tolerated well when containing emollients. Hand washing with soap and water after each rub use can lead to dermatitis. However, washing is neither necessary nor recommended after each application of alcohol hand rubs. www.shea-online.org

Occupational Safety and Health Administration

OSHA estimates that 8-12 percent of healthcare workers are latex sensitive. Workers exposed by wearing latex gloves or using latex-containing medical supplies are at risk. Evaluation by a physician should occur for those experiencing symptoms. Diagnosis involves a medical history, a physical examination and tests. Testing involves application of a skin patch containing latex additives for several days. A positive reaction involves itching, redness, swelling, or blistering. Once a worker becomes allergic to latex, it is essential to prevent occupational exposure. Certain medications may reduce the allergy symptoms, but complete latex avoidance is the most effective approach. Many facilities maintain latex-safe areas for affected patients and workers.

www.osha.gov/SLTC/etools/hospital/hazards/latex/latex.html

Cutting Edge

In the United Kingdom, the Health & Safety at Work Act of 1974 requires employers to safeguard employee, patient and visitor health and safety. Employees must take reasonable care of their own health and safety and cooperate with measures designed to create a safer work environment.

The UK Control of Substances Hazardous to Health Regulations of 2002 requires employers to undertake an assessment for possible hazardous substances. Because natural rubber latex (NRL) can be hazardous, employers must conduct a risk assessment of its use, eliminating it where appropriate, substituting less hazardous substances, or limiting exposure when use is necessary. Employees must receive the results of this assessment and measures identified to minimize risks. A latex-free environment must be present for staff or patients with known latex allergies.

Health surveillance should include: 1) an initial assessment of an employee’s respiratory health and skin condition to provide a baseline record and 2) application at least annually of a questionnaire concerning dermatitis and asthma or a discussion during appraisal reviews with any positive results referred to an occupational health professional.

For employees sensitive to NRL and those considered at increased risk, there must be a higher level of health surveillance including periodic clinical assessments by an occupational health physician.
**Strategies to deal with possible hypersensitivities**

Because latex exposure is common and causes increasing numbers of problems, we will use it as the prime example. Also, latex is of importance to both workers and patients. However, many other potential allergens, including metals are present in dental environments.

It is estimated that 8% to 12% of healthcare workers have allergies to latex. The main route of exposure is wearing latex-containing gloves. Wearing latex gloves can trigger skin rashes, hives, eye or sinus symptoms, asthma and fortunately rarely, anaphylaxis.

Latex or more correctly natural rubber latex (NRL) can trigger any of three types of reactions:

1. irritant contact dermatitis, which is not a true allergy because the immune system is not involved, but is very often the cause of a problem;
2. allergic contact dermatitis, a delayed hypersensitivity or Type IV allergy, which is the most common immune reaction to NRL; and
3. immediate type hypersensitivity, which is a systemic Type I reaction involving IgE antibodies and can be very serious.

Obviously, the first task is to identify the type of reaction involved, which is often not easy. Is it latex? Or, is it just chemical irritation? A comparison may be helpful.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type I Immediate Allergy</th>
<th>Type IV Delayed or Allergic Contact Dermatitis</th>
<th>Irritant Contact Dermatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immune system</td>
<td>Systemic, IgE mediated</td>
<td>History of allergies or skin reactions</td>
<td>Localized inflammation, no immune system involvement</td>
</tr>
<tr>
<td>involvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible risk factors</td>
<td>Allergic reactions to NRL and some types of food, trees and pollens</td>
<td>History of allergies or skin reactions</td>
<td>History of allergies or skin reactions</td>
</tr>
<tr>
<td></td>
<td>Occupational exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>History of childhood surgeries, skin reactions or spina bifida</td>
<td></td>
<td>More common in females</td>
</tr>
<tr>
<td>Onset of symptoms</td>
<td>Within a few hours of exposure</td>
<td>Within hours to days of contact</td>
<td>Within minutes or hours of contact</td>
</tr>
<tr>
<td>Cessation of symptoms</td>
<td>Within a few hours of contact</td>
<td>Not for several weeks</td>
<td>Soon after the irritating material is removed or contact stops</td>
</tr>
<tr>
<td>Skin symptoms</td>
<td>Hives, swelling, burning, itching, redness and tingling</td>
<td>Soreness, itching, cracking, formation of papules or scales, peeling, swelling, redness and thickening</td>
<td>Soreness, burning and stinging sensation with redness, swelling and blistering</td>
</tr>
</tbody>
</table>

**COMPARISON OF POSSIBLE OUTCOMES DUE TO NRL EXPOSURE**

**Ask OSAP**

**Q**: One of our new patients told our hygienist that they are sensitive to latex. We would like to improve our patient medical history form to better detect persons who may be at risk. What would OSAP suggest?

**A**: Include questions regarding exposure to latex-containing items and certain foods. Latex is present in hundreds of household items, as well as some used during medical and dental treatment. Latex sensitivity can include allergies to certain types of foods. Examples are avocados, bananas, kiwi, oranges, figs, peaches, papaya, pineapple, melons, potatoes, tomatoes, chestnuts and peanuts. Others factors increase latex allergies, usually involving repeated exposure. At risk are healthcare and rubber industry workers and persons having multiple surgeries early in life, spinal cord abnormalities and repeated catheterizations.

Do you have an inquiry about infection control, occupational health, or practice safety? Ask OSAP. Send your questions to office@OSAP.org
Immunosuppression and Hypersensitivities

Ideally, your immune system will always work well providing protection against a wide variety of pathogenic microorganisms and harmful chemicals. Proper function involves complex and sophisticated reactions of chemicals and cells. However, this delicate coordination, which usually is so beneficial, can become dysfunctional.

A number of factors can result in immune suppression (immunodeficiency). Either or both the humeral and cell-mediated immune responses may be affected. Sometimes, there is a genetic defect or the presence of a cancer. AIDS is an immunodeficiency disease in which HIV selectively parasitizes one type of T cell. The result is poor cell-mediated immunity and a lack of stimulation of B cells and low antibody formation. This places infected persons at risk for infection and the development of various forms of cancer. Drug induced immune suppression is necessary in order that transplanted organs are not readily rejected by the recipients.

Your body can also overreact to the presence of antigens. This is hypersensitivity or more commonly, allergy. Hypersensitivity is an exaggerated immune reaction that is injurious. Allergic persons are sensitive to repeated antigens called allergens.

There are several types of hypersensitivity reactions. A descriptive and accepted classification divides hypersensitivity reactions into four types. The first three are antibody-mediated, while the fourth type is cell-mediated.

### TYPES OF HYPERSENSITIVITY REACTIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Antigen Source(s)</th>
<th>Mechanism</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>External</td>
<td>Anaphylactic reaction or immediate allergy, involves antibodies, mast cells and basophils</td>
<td>Anaphylaxis, atopic allergies, such as hay fever and asthma</td>
</tr>
<tr>
<td>II</td>
<td>External and internal</td>
<td>Cytotoxic reactions with antibodies act on cells causing lysis and includes some autoimmune disease</td>
<td>Blood group incompatibilities and pernicious anemia</td>
</tr>
<tr>
<td>III</td>
<td>External and internal</td>
<td>Immune complex reactions, antibody mediated inflammation and includes some autoimmune diseases</td>
<td>Systemic lupus erythematosis, rheumatoid arthritis, serum sickness and nephritis</td>
</tr>
<tr>
<td>IV</td>
<td>External</td>
<td>Delayed hypersensitivity or cell mediated reactions which involves T cells and macrophages resulting in granulomas and skin reactions</td>
<td>Infection reactions, contact dermatitis and graft rejection</td>
</tr>
</tbody>
</table>

**Talking points for the four types of hypersensitivity reactions**

Type I hypersensitivity reactions or anaphylactic reactions
- includes classic allergic responses such as hay fever symptoms, asthma, hives and GI allergic reactions to foods (shellfish, peanuts and dairy products)
- also includes reactions to insect stings and drugs
- severest form is anaphylactic shock
- process involves the IgE type of antibodies which stimulates certain body cells that release histamine
- person prone to allergies (atopic persons) produce IgE when exposed to allergens

Type II hypersensitivity reactions are cytotoxic in nature
- involves destruction of body cells and includes incompatible blood transfusions, Rh incompatibility reaction and myasthenia gravis
- process involved IgG or IgM types of antibodies
- antibodies attack foreign antigens, but unfortunately the antigens have bound themselves to some of our cells
- some drugs can bind to red blood cells and initiate antibody formation
- result is cellular death or impaired function

Type III hypersensitivity reactions involve formation of immune complexes
- immune complexes (antibodies + antigens + complement) form and bind to blood cells and body tissues
- immune system peruses the complexes and causes their rapid removal
- sometimes, the complexes persist and deposit in body tissues (often affected are the kidneys and the heart) resulting in inflammation and tissue injury

Type IV hypersensitivity reactions or T cell mediated
- process is delayed one or more days after exposure or contact
- classic example is a positive TB skin test which involves an intradermal injection of a purified protein derivative (PPD) of Mycobacterium tuberculosis with the reaction reaching maximum intensity after 24 to 48 hours
- another example is allergic contact dermatitis, which is a sensitization to simple chemicals, such as nickel, soaps, cosmetics, topical drugs, formaldehyde and plant materials (poison ivy and oak)
**Glossary**

**Allergy:** Disorder in which the immune system reacts inappropriately, usually by responding to an antigen it normally ignores (also called hypersensitivity).

**Allergen:** A foreign substance (e.g., pollen or a drug) or antigen that stimulates an allergic response.

**Antibodies:** Glycoproteins produced by B cell lymphocytes in response to an antigen that are capable of binding specifically to that antigen.

**Antigens:** Chemicals or cells that the body identifies as foreign and toward which it mounts an immune response.

**Atopy/atopic:** The genetic tendency to develop the classic allergic diseases, such as atopic dermatitis, allergic rhinitis (hay fever), and asthma; atopy involves the capacity to produce IgE in response to common environmental proteins such as dust mites, grass pollen, and food allergens.

**B cells:** Are lymphocytes also known a plasma cells that play a large role in the humoral immune response; the principal function of B cells is to make antibodies against soluble antigen and are an essential component of the adaptive immune system.

**Cell-mediated immunity:** Type of immune response brought about by T cells.

**Chemotaxis:** Body cells direct their movements according to certain chemicals in their environment; move and collect in response to an immune reaction.

**Cilia:** Are thin, tail-like projections extending approximately 5-10 micrometers outwards from the cell body, in the respiratory tract they constantly beat in a coordinated, rhythmic direction.

**Colostrum:** Is a thin, milky fluid secreted by mammary glands in late pregnancy and for several days after birth, which contains nutrients and maternal antibodies that help protect the mucous membranes in the throat, lungs, and intestines of the newborn for several months.

**Complement system:** A set of proteins present in blood that when activated form nonspecific host defense mechanisms against a variety of antigens.

**Humoral immunity:** Part of the immune system mediated by secreted antibodies produced in the cells of the B lymphocyte lineage (B cells); secreted antibodies bind to antigens on the surfaces of invading microbes; humoral immunity is called as such, because it involves substances found in the humors, or body fluids.

**Hypersensitivity:** Disorder in which the immune system reacts inappropriately, usually by responding to an antigen it normally ignores (also called an allergy).

**IgE:** Is also known as immunoglobulin E, which is the least abundant antibody subclass capable of triggering the most powerful immune reactions - a form of allergy known as Type I hypersensitivity.

**Immunodeficiency:** Disorder in which the immune system responds inadequately to an antigen because of inborn or acquired defects in B and/or T cell function.

**Interferon:** A small protein released from virus-infected cells that causes adjacent cells to produce a protein that interferes with viral replication.

**Nonspecific host defense mechanisms:** Includes external and internal body chemicals and cells that protect the body from harm; is not part of the immune system.

**Phagocytosis:** Ingestion and digestion of bacteria and other small particles by white blood cells.

**Specific host defense mechanisms:** Includes humoral and cell-mediated arms (B and T cells) of the immune system.

**T cells:** A type of lymphocyte that plays a central role in cell-mediated immunity; the “T”, in T cells stands for thymus since it is the principal organ for their development.

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**Best Practices**


If you wish to obtain one (1) hour of continuing education (CE) credit, complete the following test by selecting the best answer and fax or mail it to the OSAP Central Office for grading. Please include a check or credit card to cover handling charges. Pending satisfactory results (at least seven out of ten), you will be issued a letter for one (1) CE credit hour. OSAP is recognized by the American Dental Association as a CERP Provider. For more information, call OSAP at 800-298-6727 (410-571-0003).

For each question, pick the best answer.

1. Which of our lines of defense includes inflammation?
   a. first  b. second  c. third

2. Vaccination against hepatitis B is an example of:
   a. natural active acquired immunity  b. artificial active acquired immunity
   c. natural passive acquired immunity  d. artificial passive acquired immunity

3. Rheumatoid arthritis is an example of which type of hypersensitivity?
   a. delayed (cell mediated)  b. anaphylactic (immediate)  c. cytotoxic  d. immune complex

4. Which type of hypersensitivity involves T cells?
   a. Type I  b. Type II  c. Type III  d. Type IV

5. Which of the following produces antibodies?
   a. T cells  b. B cells  c. macrophages  d. mast cells

6. Last week you were skin tested for TB. A positive test result would include which type of hypersensitivity?
   a. Type I  b. Type II  c. Type III  d. Type IV

7. Which of following diseases involves immune suppression?
   a. hay fever  b. AIDS  c. systemic lupus erythematosis  d. serum sickness

8. According to OSHA, what percent of healthcare workers are allergic to latex?
   a. 1-2  b. 5  c. 8-12  d. 30-35

9. Histamine comes from:
   a. mast cells  b. B cells  c. T cells  d. macrophages

10. The mechanism of allergic contact dermatitis is the same as:
    a. hay fever  b. reaction to poison ivy  c. asthma

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Practice Tip

Sharpening instruments chairside safely & aseptically

So, how can we maintain proper aseptic technique while sharpening instruments chairside? We all know that sharp instruments increase our efficiency. Sharpening contaminated instruments, however, increases the chances for disease spread through an occupational exposure.

First, start with a sterilized sharpening device or stone. Follow manufacturers’ guidelines when using power sharpeners and sharpening templates. Either method requires a stable, well-lighted, protected working surface. A ceramic stone is best for chairside sharpening.

When choosing to move the stone rather than the instrument, place your arm flat on a stable surface, hold the instrument in the palm of your nondominant hand and secure the instrument with your thumb. The surface requiring sharpening will be lower than the countertop edge and will face your dominant hand. Adjust the angle of the cutting edge, not the handle, perpendicular to the flat table surface.

It is important to recognize the design of the instrument in order to keep the cutting edge intact. Hold the stone in your dominant hand and begin to move the stone in an “up-and-down” motion, following the lines of the cutting edge. To avoid injury, hold the stone on its edges and stroke away from your body. Evaluate your effort with a sterile test stick.

If choosing to move the instrument over the stone place the stone on a protected flat surface and move the instruments over the stone towards you. You will have to change your body position to gain a better view of the cutting edge. Use a finger or hand fulcrum to prevent instrument slip-page and to guide the instrument in a continuous controlled sweep over the stone. You can stabilize the stone with your nondominant hand being careful to keep your fingertips out of harm’s way.

No matter which technique you chose, all chairside methods carry some risk of injury.

Elizabeth Hughes RDH MS
Elizabeth Hughes is an Associate Clinical Professor in the Department of Periodontics and Allied Dental Programs and Clinical Director for Second Year Dental Hygiene Students at Indiana University School of Dentistry.

Do you have a practice tip you’d like to share with other OSAP members and subscribers? Send your suggestions for enhancing dental infection control and safety in practice to editor@OSAP.org. Be sure to include contact information, a photo, and a brief bio. Thanks!