Allergic bronchopulmonary aspergillosis


Nancy J. Nordenson

Alkali-resistant hemoglobin test see Fetal hemoglobin test

Alkalosis see Metabolic alkalosis; Respiratory alkalosis

Allergic alveolitis see Hypersensitivity pneumonitis

Allergic bronchopulmonary aspergillosis

Definition

Allergic bronchopulmonary aspergillosis, or ABPA, is one of four major types of infections in humans caused by Aspergillus fungi. ABPA is a hypersensitivity reaction that occurs in asthma patients who are allergic to this specific fungus.

Description

ABPA is an allergic reaction to a species of Aspergillus called Aspergillus fumigatus. It is sometimes grouped together with other lung disorders characterized by eosinophilia — an abnormal increase of a certain type of white blood cell in the blood — under the heading of eosinophilic pneumonia. These disorders are also called hypersensitivity lung diseases.

ABPA appears to be increasing in frequency in the United States, although the reasons for the increase are not clear. The disorder is most likely to occur in adult asthmatics aged 20-40. It affects males and females equally.

Causes & symptoms

ABPA develops when the patient breathes air containing Aspergillus spores. These spores are found world-wide, especially around riverbanks, marshes, bogs, forests, and wherever there is wet or decaying vegetation. They are also found on wet paint, construction materials, and in air conditioning systems. ABPA is a nosocomial
infection, which means that a patient can get it in a hospital. When *Aspergillus* spores reach the bronchi, which are the branches of the windpipe that lead into the lungs, the bronchi react by contracting spasmodically. So the patient has difficulty breathing and usually wheezes or *coughs*. Many patients with ABPA also run a low-grade *fever* and lose their appetites.

**Complications**

Patients with ABPA sometimes cough up large amounts of blood, a condition that is called *hemoptysis*. They may also develop a serious long-term form of *bronchiectasis*, the formation of fibrous tissue in the lungs. Bronchiectasis is a chronic bronchial disorder caused by repeated inflammation of the airway, and marked by the abnormal enlargement of, or damage to, the bronchial walls. ABPA sometimes occurs as a complication of *cystic fibrosis*.

**Diagnosis**

The diagnosis of ABPA is based on a combination of the patient’s history and the results of blood tests, sputum tests, skin tests, and diagnostic imaging. The doctor will be concerned to distinguish between ABPA and a worsening of the patient’s asthma, cystic fibrosis, or other lung disorders. There are seven major criteria for a diagnosis of allergic bronchopulmonary aspergillosis:

* A history of asthma.
* An accumulation of fluid in the lung that is visible on a chest x ray.
* Bronchiectasis (abnormal stretching, enlarging, or destruction of the walls of the bronchial tubes).
* Skin reaction to *Aspergillus* antigen.
* Eosinophilia in the patient’s blood and sputum.
* *Aspergillus* precipitins in the patient’s blood. Precipitins are antibodies that react with the antigen to form a solid that separates from the rest of the solution in the test tube.
* A high level of IgE in the patient’s blood. IgE refers to a class of antibodies in blood plasma that activate allergic reactions to foreign particles.

Other criteria that may be used to support the diagnosis include the presence of *Aspergillus* in samples of the patient’s sputum, the coughing up of plugs of brown mucus, or a late skin reaction to the *Aspergillus* antigen.

**Laboratory tests**

The laboratory tests that are done to obtain this information include a complete *blood count* (CBC), a *sputum culture*, a blood serum test of IgE levels, and a skin test for the *Aspergillus* antigen. In the skin test, a small amount of antigen is injected into the upper layer of skin on the patient’s forearm about four inches below the elbow. If the patient has a high level of IgE antibodies in the tissue, he or she will develop what is called a “wheat and flare” reaction in about 15-20 minutes. A “wheat and flare” reaction is characterized by the eruption of a reddened, *itching* spot on the skin. Some patients with ABPA will develop the so-called late reaction to the skin test, in which a red, sore, swollen area develops about six to eight hours after the initial reaction.

*Aspergillus* can sometimes be seen under a microscope slide made from the patient’s sputum, but the diagnosis is considered definite only when the fungus is cultured in the laboratory. *Aspergillus* is easy to culture, and can be identified when it is stained with periodic acid-Schiff (PAS), Calcofluor, or potassium hydroxide (KOH) preparations.

**Diagnostic imaging**

Chest x rays and CT scans are used to check for the presence of fluid accumulation in the lungs and signs of bronchiectasis.

**Treatment**

ABPA is usually treated with prednisone (Meticorten) or other *corticosteroids* taken by mouth, and with *bronchodilators*.

Antifungal drugs are *not* used to treat ABPA because it is caused by an allergic reaction to *Aspergillus* rather than by direct infection of tissue.

**Follow-up care**

Patients with ABPA should be given periodic checkups with chest x-rays and a spirometer test. A spirometer is an instrument that evaluates the patient’s lung capacity.

**Prognosis**

Most patients with ABPA respond well to corticosteroid treatment. Others have a chronic course with gradual improvement over time. The best indicator of a good prognosis is a long-term fall in the patient’s IgE level. Patients with lung complications from ABPA may develop severe airway obstruction.

**Prevention**

ABPA is difficult to prevent because *Aspergillus* is a common fungus; it can be found in the saliva and sputum of most healthy individuals. Patients with ABPA can protect themselves somewhat by avoiding haystacks, compost piles, bogs, marshes, and other locations with wet or rotting vegetation; by avoiding construction sites or newly painted surfaces; and by having their air condi-
tioners cleaned regularly. Some patients may be helped by air filtration systems for their bedrooms or offices.

Resources

BOOKS


ORGANIZATIONS

Centers for Disease Control. 1600 Clifton Road NE, Atlanta, GA, 30333. (404) 639-3534.

National Organization for Rare Disorders (NORD). P.O. Box 8923, New Fairfield, CT 06812-8923. (800) 999-NORD. (203) 746-6927 (TDD).

NIH/National Institute of Allergy and Infectious Diseases. 9000 Rockville Pike, Bethesda, MD 20892-0105. (301) 496-5717.

Rebecca J. Frey

Allergic interstitial pneumonitis see Hypersensitivity pneumonitis

KEY TERMS

Glomeruli—Knots of capillaries in the kidneys responsible for filtering the blood (singular, glomerulus).

Allergic purpura

Definition

Allergic purpura (AP) is an allergic reaction of unknown origin causing red patches on the skin and other symptoms. AP is also called Henoch-Schönlein purpura, named after the two doctors who first described it.

Description

"Purpura" is a bleeding disorder that occurs when capillaries rupture, allowing small amounts of blood to accumulate in the surrounding tissues. In AP, this occurs because the capillaries are blocked by protein complexes formed during an abnormal immune reaction. The skin is the most obvious site of reaction, but the joints, gastrointestinal tract, and kidneys are also often affected.

AP affects approximately 35,000 people in the United States each year. Most cases are children between the ages of two and seven. Boys are affected more often than girls, and most cases occur from late fall to winter.

Causes & symptoms

Causes

AP is caused by a reaction involving antibodies, special proteins of the immune system. Antibodies are designed to bind with foreign proteins, called antigens. In some situations, antigen-antibody complexes can become too large to remain suspended in the bloodstream. When this occurs, they precipitate out and become lodged in the capillaries. This can cause the capillary to burst, allowing a local hemorrhage.

The source of the antigen causing AP is unknown. Antigens may be introduced by bacterial or viral infection. More than 75% of patients report having had an infection of the throat, upper respiratory tract, or gastrointestinal system several weeks before the onset of AP. Other complex molecules can act as antigens as well, including drugs such as antibiotics or vaccines. Otherwise harmless substances that stimulate an immune reaction are known as allergens. Drug allergens that may cause AP include penicillin, ampicillin, erythromycin, and quinine. Vaccines possibly linked to AP include those for typhoid, measles, cholera, and yellow fever.

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GALE ENCYCLOPEDIA OF MEDICINE
Symptoms

The onset of AP may be preceded by a headache, fever, and loss of appetite. Most patients first develop an itchy skin rash. The rash is red, either flat or raised, and may be small and freckle-like. The rash may also be larger, resembling a bruise. Rashes become purple and then rust colored over the course of a day, and fade after several weeks. Rashes are most common on the buttocks, abdomen, and lower extremities. Rashes higher on the body may also occur, especially in younger children.

Joint pain and swelling is common, especially in the knees and ankles. Abdominal pain occurs in almost all patients, along with blood in the body waste (feces). About half of all patients show blood in the urine, low urine volume, or other signs of kidney involvement. Kidney failure may occur due to widespread obstruction of the capillaries in the filtering structures called glomeruli. Kidney failure develops in about 5% of all patients, and in 15% of those with elevated blood or protein in the urine.

Less common symptoms include prolonged headache, fever, and pain and swelling of the scrotum. Involvement of other organ systems may lead to heart attack (myocardial infarction), inflammation of the pancreas (pancreatitis), intestinal obstruction, or bowel perforation.

Diagnosis

Diagnosis of AP is based on the symptoms and their development, a careful medical history, and blood and urine tests. X rays or computed tomography scans (CT) may be performed to assess complications in the bowel or other internal organs.

Treatment

Most cases of AP resolve completely without treatment. Nonetheless, a hospital stay is required because of the possibility of serious complications. Non-aspirin pain relievers may be given for joint pain. Corticosteroids (like prednisone) are sometimes used, although not all specialists agree on their utility. Kidney involvement requires monitoring and correction of blood fluids and electrolytes.

Patients with severe kidney complications may require a kidney biopsy so that tissue can be analyzed. Even after all other symptoms subside, elevated levels of blood or protein in the urine may persist for months and require regular monitoring. Hypertension or kidney failure may develop months or even years after the acute phase of the disease. Kidney failure requires dialysis or transplantation.

Plasmapheresis, which removes antibodies from the blood, has been tried for AP with mixed results.

Prognosis

Most people who develop AP become better on their own after several weeks. About half of all patients have at least one recurrence. Cases that do not have kidney complications usually have the best prognosis.

Resources

PERIODICALS


OTHER


Allergic rhinitis

Definition

Allergic rhinitis, more commonly referred to as hay fever, is an inflammation of the nasal passages caused by allergic reaction to airborne substances.

Description

Allergic rhinitis (AR) is the most common allergic condition and one of the most common of all minor afflictions. It affects between 10-20% of all people in the United States. and is responsible for 2.5% of all doctor visits. Antihistamines and other drugs used to treat allergic rhinitis make up a significant fraction of both prescription and over-the-counter drug sales each year.

There are two types of allergic rhinitis: seasonal and perennial. Seasonal AR occurs in the spring, summer, and early fall, when airborne plant pollens are at their highest levels. In fact, the term hay fever is really a misnomer, since allergy to grass pollen is only one cause of symptoms for most people. Perennial AR occurs all year and is usually caused by home or workplace airborne pollutants. A person can be affected by one or both types. Symptoms of seasonal AR are worst after being outdoors, while symptoms of perennial AR are worst after spending time indoors.
KEY TERMS

**Allergen**—A substance that provokes an allergic response.

**Anaphylaxis**—Increased sensitivity caused by previous exposure to an allergen that can result in blood vessel dilation (swelling) and smooth muscle contraction. Anaphylaxis can result in sharp blood pressure drops and difficulty breathing.

**Antibody**—A specific protein produced by the immune system in response to a specific foreign protein or particle called an antigen.

**Antigen**—A foreign protein to which the body reacts by making antibodies.

**Granules**—Small packets of reactive chemicals stored within cells.

**Histamine**—A chemical released by mast cells that activates pain receptors and causes cells to become leaky.

**Mast cells**—A type of immune system cell that is found in the lining of the nasal passages and eyelids, displays a type of antibody called immunoglobulin type E (IgE) on its cell surface, and participates in the allergic response by releasing histamine from intracellular granules.

Both types of **allergies** can develop at any age, although onset in childhood through early adulthood is most common. Although allergy to a particular substance is not inherited, increased allergic sensitivity may “run in the family.” While allergies can improve on their own over time, they can also become worse over time.

**Causes & symptoms**

**Causes**

Allergic rhinitis is a type of immune reaction. Normally, the immune system responds to foreign microorganisms, or particles, like pollen or dust, by producing specific proteins, called antibodies, that are capable of binding to identifying molecules, or antigens, on the foreign particle. This reaction between antibody and antigen sets off a series of reactions designed to protect the body from infection. Sometimes, this same series of reactions is triggered by harmless, everyday substances. This is the condition known as allergy, and the offending substance is called an allergen.

Like all allergic reactions, AR involves a special set of cells in the immune system known as mast cells. Mast cells, found in the lining of the nasal passages and eyelids, display a special type of antibody, called immunoglobulin type E (IgE), on their surface. Inside, mast cells store reactive chemicals in small packets, called granules. When the antibodies encounter allergens, they trigger release of the granules, which spill out their chemicals onto neighboring cells, including blood vessels and nerve cells. One of these chemicals, histamine, binds to the surfaces of these other cells, through special proteins called histamine receptors. Interaction of histamine with receptors on blood vessels causes neighboring cells to become leaky, leading to the fluid collection, swelling, and increased redness characteristic of a runny nose and red, irritated eyes. Histamine also stimulates pain receptors, causing the itchy, scratchy nose, eyes, and throat common in allergic rhinitis.

The number of possible airborne allergens is enormous. Seasonal AR is most commonly caused by grass and tree pollens, since their pollen is produced in large amounts and is dispersed by the wind. Showy flowers, like roses or lilacs, that attract insects produce a sticky...
pollen which is less likely to become airborne. Different plants release their pollen at different times of the year, so seasonal AR sufferers may be most affected in spring, summer, or fall, depending on which plants provoke a response. The amount of pollen in the air is reflected in the pollen count, often broadcast on the daily news during allergy season. Pollen counts tend to be lower after a good rain that washes the pollen out of the air and higher on warm, dry, windy days.

Virtually any type of tree or grass may cause AR. A few types of weeds that tend to cause the most trouble for people include the following:

* Ragweed
* Sagebrush
* Lamb’s-quarters
* Plantain
* Pigweed
* Dock/sorrel
* Tumbleweed.

Perennial AR is often triggered by house dust, a complicated mixture of airborne particles, many of which are potent allergens. House dust contains some or all of the following:

* House mite body parts. All houses contain large numbers of microscopic insects called house mites. These harmless insects feed on fibers, fur, and skin shed by the house’s larger occupants. Their tiny body parts easily become airborne.
* Animal dander. Animals constantly shed fur, skin flakes, and dried saliva. Carried in the air, or transferred from pet to owner by direct contact, dander can cause allergy in many sensitive people.
* Mold spores. Molds live in damp spots throughout the house, including basements, bathrooms, air ducts, air conditioners, refrigerator drains, damp window sills, mattresses, and stuffed furniture. Mildew and other molds release airborne spores which circulate throughout the house.

Other potential causes of perennial allergic rhinitis include the following:

* Cigarette smoke
* Perfume
* Cosmetics
* Cleansers
* Copier chemicals
* Industrial chemicals
* Construction material gases.

**Symptoms**

Inflammation of the nose, or rhinitis, is the major symptom of AR. Inflammation causes itching, sneezing, runny nose, redness, and tenderness. Sinus swelling can constrict the eustachian tube that connects the inner ear to the throat, causing a congested feeling and “ear popping.” The drip of mucus from the sinuses down the back of the throat, combined with increased sensitivity, can also lead to throat irritation and redness. AR usually also causes redness, itching, and watery eyes. Fatigue and headache are also common.

**Diagnosis**

Diagnosing seasonal AR is usually easy and can often be done without a medical specialist. When symptoms appear in spring or summer and disappear with the onset of cold weather, seasonal AR is almost certainly the culprit. Other causes of rhinitis, including infection, can usually be ruled out by a physical examination and a nasal smear, in which a sample of mucus is taken on a swab for examination.

Allergy tests, including skin testing and provocation testing, can help identify the precise culprit, but may not be done unless a single source is suspected and subsequent avoidance is possible. Skin testing involves placing a small amount of liquid containing a specific allergen on the skin and then either poking, scratching, or injecting it into the skin surface to observe whether redness and swelling occurs. Provocation testing involves challenging an individual with either a small amount of an inhalable or ingestable allergen to see if a response is elicited.

Perennial AR can also usually be diagnosed by careful questioning about the timing of exposure and the onset of symptoms. Specific allergens can be identified through allergy skin testing.

**Treatment**

Avoidance of the allergens is the best treatment, but this is often not possible. When it is not possible to avoid one or more allergens, there are two major forms of medical treatment, drugs and immunotherapy.

**Drugs**

**ANTIHISTAMINES**

Antihistamines block the histamine receptors on nasal tissue, decreasing the effect of histamine release by mast cells. They may be used after symptoms appear, though they may be even more effective when used preventively, before symptoms appear. A wide variety of antihistamines are available.
Older antihistamines often produce drowsiness as a major side effect. Such antihistamines include the following:

• Diphenhydramine (Benadryl and generics)
• Chlorpheniramine (Chlor-trimeton and generics)
• Brompheniramine (Dimetane and generics)
• Clemastine (Tavist and generics).

Newer antihistamines that do not cause drowsiness are available by prescription and include the following:

• Astemizole (Hismanal)
• Loratidine (Claritin)
• Fexofenadine (Allegra)
• Azelastin HCl (Asthelin).

Hismanal has the potential to cause serious heart arrhythmias when taken with the antibiotic erythromycin, the antifungal drugs ketoconazole anditraconazole, or the antimalarial drug quinine. Taking more than the recommended dose of Hismanal can also cause arrhythmias. Seldane (terfenadine), the original non-drowsy antihistamine, was voluntarily withdrawn from the market by its manufacturers in early 1998 because of this potential and because of the availability of an equally effective, safer alternative drug, fexofenadine.

DECONGESTANTS

Decongestants constrict blood vessels to counteract the effects of histamine. Nasal sprays are available that can be applied directly to the nasal lining and oral systemic preparations are available. Decongestants are stimulants and may cause increased heart rate and blood pressure, headaches, and agitation. Use of topical decongestants for longer than several days can cause loss of effectiveness and rebound congestion, in which nasal passages become more severely swollen than before treatment.

TOPICAL CORTICOSTEROIDS

Topical corticosteroids reduce mucous membrane inflammation and are available by prescription. Allergies tend to become worse as the season progresses because the immune system becomes sensitized to particular antigens and can produce a faster, stronger response. Topical corticosteroids are especially effective at reducing this seasonal sensitization because they work more slowly and last longer than most other medication types. As a result, they are best started before allergy season begins. Side effects are usually mild, but may include headaches, nosebleeds, and unpleasant taste sensations.

MAST CELL STABILIZERS

Cromolyn sodium prevents the release of mast cell granules, thereby preventing release of histamine and the other chemicals contained in them. It acts as a preventive treatment if it is begun several weeks before the onset of the allergy season. It can be used for perennial AR as well.

Immunotherapy

Immunotherapy, also known as desensitization or allergy shots, alters the balance of antibody types in the body, thereby reducing the ability of IgE to cause allergic reactions. Immunotherapy is preceded by allergy testing to determine the precise allergens responsible. Injections involve very small but gradually increasing amounts of allergen, over several weeks or months, with periodic boosters. Full benefits may take up to several years to achieve and are not seen at all in about one in five patients. Individuals receiving all shots will be monitored closely following each shot because of the small risk of anaphylaxis, a condition that can result in difficulty breathing and a sharp drop in blood pressure.

Alternative treatment

Alternative treatments for AR often focus on modulation of the body’s immune response, and frequently center around diet and lifestyle adjustments. Tablets of quercetin, derived from buckwheat and citrus fruits, may help stabilize mast cells. Vitamin C in substantial amounts can help stabilize the mucous membrane response. For symptom relief, western herbal remedies including eyebright (Euphrasia officinalis) and nettle (Urtica dioica) may be helpful. Bee pollen may also be effective in alleviating or eliminating AR symptoms.

Prognosis

Most people with AR can achieve adequate relief with a combination of preventive strategies and treatment. While allergies may improve over time, they may also get worse or expand to include new allergens. Early treatment can help prevent an increased sensitization to other allergens.

Prevention

Reducing exposure to pollen may improve symptoms of seasonal AR. Strategies include the following:

• Stay indoors with windows closed during the morning hours, when pollen levels are highest.
• Keep car windows up while driving.
• Use a surgical face mask when outside.
• Avoid uncut fields.
• Learn which trees are producing pollen in which seasons, and avoid forests at the height of pollen season.
• Wash clothes and hair after being outside.
• Clean air conditioner filters in the home regularly.
• Use electrostatic filters for central air conditioning.

Moving to a region with lower pollen levels is rarely effective, since new allergies often develop.

Preventing perennial AR requires identification of the responsible allergens.

Mold spores:
• Keep the house dry through ventilation and use of dehumidifiers.
• Use a disinfectant such as dilute bleach to clean surfaces such as bathroom floors and walls.
• Have ducts cleaned and disinfected.
• Clean and disinfect air conditioners and coolers.
• Throw out moldy or mildewed books, shoes, pillows, or furniture.

House dust:
• Vacuum frequently, and change the bag regularly. Use a bag with small pores to catch extra-fine particles.
• Clean floors and walls with a damp mop.
• Install electrostatic filters in heating and cooling ducts, and change all filters regularly.

Animal dander:
• Avoid contact if possible.
• Wash hands after contact.
• Vacuum frequently.
• Keep pets out of the bedroom, and off furniture, rugs, and other dander-catching surfaces.
• Have your pets bathed and groomed frequently.

Resources

BOOKS


Bone marrow transplantation

Definition

The bone marrow—the sponge-like tissue found in the center of certain bones—contains stem cells that are the precursors of white blood cells, red blood cells, and platelets. These blood cells are vital for normal body functions—such as oxygen transport—and defense against infection and disease. Blood cells have a limited lifespan and are constantly being replaced; therefore, healthy stem cells are vital.

In association with certain diseases, stem cells may produce too many, too few, or otherwise abnormal blood cells. Also, medical treatments may destroy stem cells or alter blood cell production. The resultant blood cell abnormalities can be life threatening.

Bone marrow transplantation involves extracting bone marrow—which contains normal stem cells—from a healthy donor and transferring it to a recipient whose body cannot manufacture proper quantities of normal blood cells. The goal of the transplant is to rebuild the recipient’s blood cells and immune system and hopefully cure the underlying ailment.

Purpose

A person’s red blood cells, white blood cells, and platelets may be destroyed or abnormal due to disease. Also, certain medical therapies, particularly chemotherapy or radiation treatment, may destroy a person’s stem cells. The consequence to a person’s health are severe. Under normal circumstances, red blood cells carry oxygen throughout the body and remove carbon dioxide from the body’s tissues. White blood cells form the cornerstone of the body’s immune system and defend it against infection. Platelets limit bleeding by enabling the blood to clot if a blood vessel is damaged.

A bone marrow transplant is used to rebuild the body’s capacity to produce these blood cells and bring their numbers to normal levels. Ailments that may be treated with a bone marrow transplant include both cancerous and noncancerous diseases.

Cancerous diseases may or may not specifically involve blood cells; but, cancer treatment can destroy the body’s ability to manufacture new blood cells. Bone marrow transplantation may be used in conjunction with additional treatments, such as chemotherapy, for various types of leukemia. Hodgkin’s disease, lymphoma, breast and ovarian cancer, and other cancers. Noncancerous diseases for which bone marrow transplantation can be a treatment option include aplastic anemia, sticke cell disease, thalassemia, and severe immunodeficiency.

Precautions

Bone marrow transplants are not for everyone. Transplants are accompanied by a risk of infection, transplant rejection by the recipient’s immune system, and other complications. The procedure has a lower success rate the greater the recipient’s age. Complications are exacerbated for people whose health is already seriously impaired as in late-stage cancers. Therefore, a person’s age or state of health may prohibit use of a bone marrow transplant. The typical cut-off age for a transplant ranges from 40 to 55 years; however, a person’s general health is usually the more important factor.

Even in the absence of complications, the transplant and associated treatments are hard on the recipient. Bone marrow transplants are debilitating. A person’s ability to withstand the rigors of the transplant is a key consideration in deciding to use this treatment.

Description

Autologous and allogeneic transplants

Two important requirements for a bone marrow transplant are the donor and the recipient. Sometimes, the donor and the recipient may be the same person. This type of transplant is called an autologous transplant. It is typically used in cases in which a person’s bone marrow is generally healthy but will be destroyed due to medical treatment for diseases such as breast cancer and Hodgkin’s disease. If a person’s bone marrow is unsuitable for an autologous transplant, the bone marrow must be derived from another person in an allogeneic transplant.

Allogeneic transplants are more complicated because of proteins called human lymphocyte antigens (HLA) that are on the surface of bone marrow cells. If the donor and the recipient have very dissimilar antigens, the recipient’s immune system regards the donor’s bone marrow cells as invaders and launches a destructive attack against them. Such an attack negates any benefits offered by the transplant.

HLA matching

There are only five major HLA classes or types—designated HLA-A, -B, -C, -D, and class III—but much
ABO antigen—Protein molecules located on the surfaces of red blood cells that determine a person’s blood type: A, B, or O.

Allogeneic—Referring to bone marrow transplants between two different, genetically dissimilar people.

Antigen—A molecule that is capable of provoking an immune response.

Aplastic anemia—A disorder in which the body produces inadequate amounts of red blood cells and hemoglobin due to underdeveloped or missing bone marrow.

Autologous—Referring to bone marrow transplants in which recipients serve as their own donors.

Bone marrow—A spongy tissue located within flat bones— including the hip and breast bones and the skull. This tissue contains stem cells, the precursors of platelets, red blood cells, and white blood cells.

Chemotherapy—Medical treatment of a disease, particularly cancer, with drugs or other chemicals.

Donor—A healthy person who contributes bone marrow for transplantation.

Graft versus host disease—A life-threatening complication of bone marrow transplants in which the donated marrow causes an immune reaction against the recipient’s body.

HLA (human lymphocyte antigen)—A group of protein molecules located on bone marrow cells that can provoke an immune response. A donor’s and a recipient’s HLA types should match as closely as possible to prevent the recipient’s immune system from attacking the donor’s marrow as a foreign material that does not belong in the body.

Hodgkin’s disease—A type of cancer involving the lymph nodes and potentially affecting nonlymphatic organs in the later stage.

Immunodeficiency—A disorder in which the immune system is ineffective or disabled either due to acquired or inherited disease.

Leukemia—A type of cancer that affects leukocytes, a particular type of white blood cell. A characteristic symptom is excessive production of immature or otherwise abnormal leukocytes.

Lymphoma—A type of cancer that affects lymph cells and tissues, including certain white blood cells (T cells and B cells), lymph nodes, bone marrow, and the spleen. Abnormal cells multiply uncontrollably.

Platelets—Fragments of a large precursor cell—a megakaryocyte—found in the bone marrow. These fragments adhere to areas of blood vessel damage and release chemical signals that direct the formation of a blood clot.

Recipient—The person who receives the donated blood marrow.

Red blood cells—Cells that carry hemoglobin—the molecule that transports oxygen—and help remove wastes from tissues throughout the body.

Sickle cell disease—An inherited disorder characterized by a genetic flaw in hemoglobin production. (Hemoglobin is the substance within red blood cells that enables them to transport oxygen.) The hemoglobin that is produced has a kink in its structure that forces the red blood cells to take on a sickle shape, inhibiting their circulation and causing pain. This disorder primarily affects people of African descent.

Syngeneic—Referring to a bone marrow transplant from one identical twin to the other.

Thalassemia—A group of inherited disorders that affects hemoglobin production. (Hemoglobin is the substance within red blood cells that enables them to transport oxygen.) Because hemoglobin production is impaired, a person with this disorder may suffer mild to severe anemia. Certain types of thalassemia can be fatal.

White blood cells—A group of several cell types that occur in the bloodstream and are essential for a properly functioning immune system.

variation within the groupings. For example, HLA-A from one individual may be similar to, but not the same as, HLA-A in another individual; such a situation can render a transplant from one to the other impossible.

HLA matching is more likely if the donor and recipient are related, particularly if they are siblings; however, an unrelated donor may be a potential match. Only in rare cases is matching HLA types between two people not an issue: if the recipient has an identical twin. Identical twins carry the same genes; therefore, the same antigens. A bone marrow transplant between identical twins is called a syngeneic transplant.

The transplant procedure

The bone marrow extraction, or harvest, is the same whether for an autologous or allogeneic transplant. Har-
vesting is done under general anesthesia (i.e., the donor sleeps through the procedure). and discomfort is usually minimal afterwards. Bone marrow is drawn from the iliac crest—the part of the hip bone to either side of the lower back—with a special needle and a syringe. Several punctures are usually necessary to collect the needed amount of bone marrow, approximately 1–2 quarts. (This amount is only a small percentage of the total bone marrow and is typically replaced within 4 weeks.) The donor remains at the hospital for 24–48 hours and can resume normal activities within a few days.

If the bone marrow is meant for an autologous transplant, it is stored at -112 to -320°F (-80 to -196°C) until it is needed. Bone marrow for an allogeneic transplant is sometimes treated to remove the donor’s T cells (a type of white blood cell) or to remove ABO (blood type) antigens; otherwise, it is transplanted without modification.

The bone marrow is administered to the recipient via a catheter (a narrow, flexible tube) inserted into a large vein in the chest. From the bloodstream, it migrates to the cavities within the bones where bone marrow is normally stored. If the transplant is successful, the bone marrow begins to produce normal blood cells once it is in place, or engrafted.

**Costs**

Bone marrow transplantation is an expensive procedure. (Bone marrow donors are volunteers and do not pay for any part of the procedure.) Insurance companies and health maintenance organizations (HMOs) may not cover the costs.

**Preparation**

A bone marrow transplant recipient can expect to spend 4–8 weeks in the hospital. In preparation for receiving the transplant, the recipient undergoes “conditioning”—a preparative regimen in which the bone marrow and abnormal cells are destroyed. Conditioning rids the body of diseased cells and makes room for the marrow to be transplanted. It typically involves chemotherapy and/or radiation treatment, depending on the disease being treated. Unfortunately, this treatment also destroys healthy cells and has many side effects such as extreme weakness, nausea, vomiting, and diarrhea. These side effects may continue for several weeks.

**Aftercare**

A two- to four-week waiting period follows the marrow transplant before its success can begin to be judged. The marrow recipient is kept in isolation during this time to minimize potential infections. The recipient also receives antibiotic medications and blood and platelet transfusions to help fight off infection and prevent excessive bleeding. Further side effects, such as nausea and vomiting, can be treated with other medications. Once blood counts are normal and the side effects of the transplant abate, the recipient is taken off antibiotics and usually no longer needs blood and platelet transfusions.

Following discharge from the hospital, the recipient is monitored through home visits by nurses or out-patient visits for up to a year. For the first several months out of the hospital, the recipient needs to be careful in avoiding potential infections. For example, contact with other people who may be ill should be avoided or kept to a minimum. Further blood transfusions and medications may be necessary, but barring complications, the recipient can return to normal activities about 6–8 months after the transplant.

**Risks**

Bone marrow transplants are accompanied by serious and life-threatening risks. Furthermore, they are not always an absolute assurance of a cure for the underlying ailment: a disease may recur in the future. Approximately 30% of people receiving allogeneic transplants do not survive. Autologous transplants have a much better survival rate—nearly 90%—but are not appropriate for all types of ailments requiring a bone marrow transplant. Furthermore, they have a higher failure rate with certain diseases, specifically leukemia.

In the short term, there is the danger of pneumonia or other infectious disease. Excessive bleeding, or liver disorder caused by blocked blood vessels. The transplant may be rejected by the recipient’s immune system, or the donor bone marrow may launch an immune-mediated attack against the recipient’s tissues. This complication is called acute graft versus host disease, and it can be a life-threatening condition. Characteristic signs of the disease include fever, rash, diarrhea, liver problems, and a compromised immune system.

Approximately 25–50% of bone marrow transplant recipients develop long-term complications. Chronic graft versus host disease symptoms include skin changes such as dryness, altered pigmentation, and thickening: abnormal liver function tests; dry mouth and eyes; infections; and weight loss. Other long-term complications include cataracts (due to radiation treatment). abnormal lung function, hormonal abnormalities resulting in reduced growth or hypothyroidism, secondary cancers. and infertility.

**Normal results**

In a successful bone marrow transplant, the donor’s marrow migrates to the cavities in the recipient’s bones and produces normal numbers of healthy blood cells. Bone marrow transplants can extend a person’s life, im-
prove quality of life, and may aid in curing the underlying ailment.

Resources

BOOKS


PERIODICALS


OTHER


Julia Barrett

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**Bone nuclear medicine scan**

**Definition**

A bone scan is a diagnostic procedure used to evaluate abnormalities involving bones and joints. A radioactive substance is injected intravenously, and the image of its distribution in the skeletal system is analyzed to detect certain diseases or conditions.

**Purpose**

Bone scans are most frequently ordered to check whether a cancer which originated elsewhere has spread to the bones. Cancers which begin in the breasts, kidneys, lungs, prostate, thyroid, or urinary bladder are most likely to spread, or metastasize, to the bones. If metastases are found, periodic bone scans may be ordered to see if therapy is effective against a cancer.

Some cancers arise in bone. These are called primary bone cancers. When an abnormality is found on an x ray of a bone, a bone scan may be helpful in deciding if it is a primary bone cancer, or a non-cancerous (benign) condition.

Infection in the bone (osteomyelitis) can be detected or confirmed by a bone scan, often days or weeks before an x ray would reveal it. Bone scans are useful in diagnosing early arthritic changes, and monitoring both the progression of the disease and the effectiveness of treatment. Unexplained pain may be evaluated with a bone scan, because it can demonstrate fractures which are difficult to detect on x ray. Bone scans can be used to see if artificial joints have loosened or become infected. Suspected child abuse may be evaluated with a bone scan, due to its ability to see an overall pattern of repeated trauma. Abnormalities caused by altered circulation to the bone may be diagnosed with a bone scan.

**Precautions**

Women who are pregnant or breast feeding should not have this test. A patient who is unable to remain still for an extended period of time may require sedation for a bone scan.

**Description**

This test is performed in a radiology facility, either in a hospital department or an outpatient x-ray center. The patient usually sits or lies down while a radioactive substance is injected through a vein in the arm. For a bone scan, the radionuclide used is specifically chosen to accumulate in the bone. The patient then waits from three to four hours, for the substance to collect within the skeletal system. During this time, he or she will be instructed to drink several glasses of water. Patients are free to get up and move around as they desire during this waiting time, and should urinate frequently. Just before the scanning begins, the patient should empty his or her bladder again. This ensures that a lot of radioactive material is not concentrated in the urinary bladder, which could obscure part of the pelvic bones.
During the scan, the patient lies on his or her back on a table, but may be repositioned to the stomach or side during the study. It is important for the patient not to move, except when directed to by the technologist.

The radionuclide scanner, sometimes called a gamma camera, or scintillation camera, is positioned against the body part to be examined. Either the camera, the table, or both, may change position during the study. For a total body bone scan, the patient is scanned from head to foot, over a period of 30-60 minutes. Patients should experience no discomfort from this examination.

A special kind of bone scan, called a SPECT (Single Photon Emission Computed Tomography) scan may be added, to study a particular part of the body in more detail. Suspected diseases of the hips, lower back, or jaw are often evaluated using this study. It usually takes an additional 30-45 minutes. The camera circles completely around the area in question or multiple cameras are used to create a cross-sectional image. This helps pinpoint the location of the abnormality being evaluated.

Another variation is called a three-phase, or three-stage, bone scan. The procedure is the same, except the scanning takes place immediately after the radioactive substance is injected. Approximately 20 minutes after the injection, then two to four hours later.

Preparation

Some specialized blood studies should be drawn before this study is begun. Jewelry or metallic objects need to be removed. No other special physical preparation is required.

The patient should understand that there is no danger of radioactive exposure to themselves or others, as only small amounts of the radioisotope are used. The total dose of radiation absorbed is minimal, often less than the amount received from ordinary x rays. The radionuclide scanner does not emit any radiation at all, but detects and records it from the patient.

Aftercare

Fluids are encouraged after the scan to aid in the excretion of the radioisotope. It is almost completely eliminated from the body within 24 hours.

Normal results

The normal appearance of the scan will vary according to the patient's age. In general, a uniform concentration of radionuclide uptake is present in all bones in a normal scan.

Abnormal results

A high concentration of radionuclide occurs in areas of increased bone activity. These regions appear brighter and may be referred to as 'hot spots'. They may indicate healing fractures, tumors, infections, or other processes which trigger new bone formation. Lower concentrations of radionuclide may be called 'cold spots'. Poor blood flow to an area of bone, or bone destruction from tumor may produce a cold spot.

The bone scan is a very sensitive test and can detect subtle conditions more readily than other studies. However, it is not a very specific examination, and often cannot distinguish exactly what disease process is causing an abnormality. Results need to be correlated with the patient's medical history, and other radiologic and laboratory studies to make a definite diagnosis.

Resources

BOOKS

PERIODICALS
Sutter, Charles W. and David K. Shelton: "Three-Phase Bone Scan in Osteomyelitis and Other Musculoskeletal Disorders." American Family Physician, 54 (October 1996): 1639-1648.

Ellen S. Weber

Bone tumor see Sarcomas

Bone x rays

Definition

Bone x rays are a diagnostic test in which ionizing radiation passing through the bones being examined enables an image to be produced on film.

Purpose

Bone x rays are ordered to detect disease or injury to the bone such as broken bones, tumors, and other problems. They can determine bone density, texture, erosion, and changes in bone relationships. Bone x rays also evaluate the joints for diseases such as osteoarthritis.

Precautions

Precautions should be taken to protect patients from unnecessary exposure to radiation. Patients should be
KEY TERMS

Arthritis—A disease of the joints that arises from wear and tear, age and less often from inflammation.

Osteogenesis imperfecta—Also called brittle bones, this is a condition present at birth in which bones are abnormally fragile, brittle and break easily.

Osteomalacia—A disease in which bones gradually soften and bend.

Osteomyelitis—An infection of the bone marrow and the bone.

Osteoporosis—A disease which occurs primarily in post-menopausal women in which the amount of bone is reduced or skeletal tissue wastes away.

Paget’s disease—A disease, whose cause is unknown, which is generally found in older people. Symptoms include bone pain, bowed legs, curves spine, and broken bones. Another name for this disease is osteitis deformans.

Problems with bones that x rays can detect result from injury or from disease caused by a malfunction in the patient’s bone chemistry. Bone injuries, especially broken bones (fractures), are common and can be accurately diagnosed by bone x rays. X rays are especially helpful in diagnosing simple and incomplete fractures which can’t be detected during a physical examination. X rays can also be used to check for bone position in a fracture. Some bone diseases can be definitively diagnosed with bone x rays while others require additional tests.

Osteoporosis, a common bone disease, can be detected in bone x rays but other tests are then ordered to determine the extent of the disease. For osteomalacia and rickets, a blood test and x rays of the affected bone are usually definitive; in some cases a bone biopsy (microscopic analysis of a small amount of tissue) is also done. In a rare bone disease called Paget’s disease, x rays may be used in conjunction with bone, blood, and urine tests to make a diagnosis. In another rare bone disease, fibrous dysplasia, bone x rays or a bone biopsy (microscopic analysis of a small amount of tissue) are used to confirm the diagnosis. Bone x rays are definitive in diagnosing osteogenesis imperfecta. For osteomyelitis, bone x rays are used in conjunction with a blood test, bone scan, or needle biopsy to make the diagnosis. For arthritis, x rays of the bone are occasionally used in conjunction with blood tests. In bone tumors, bone x rays are helpful but they may not be definitive.

Bone x rays are performed by a technician or radiologist, and interpreted by a radiologist. They are taken in a physician’s office, radiology unit, outpatient clinic, or diagnostic clinic. Bone x rays generally take less than 10 minutes. There is no pain or discomfort associated with the test, but some people find it difficult to remain still. The results are often available in minutes.

During the test, the patient lies on a table. The technician taking the x ray will check the patient’s positioning and place the x-ray machine over the part of the body being examined. After asking the patient to remain motionless, he or she steps out of the area and presses a button to take the picture.

Preparation

The patient is asked to remove clothing, jewelry, and any other metal objects from the area being x rayed. If appropriate, a lead shield will be placed over other body parts to minimize exposure to radiation.

Aftercare

The patient can immediately resume normal activities.
Risks

The human body contains some natural radiation and is also exposed to radiation in the environment. There is a slight risk from exposure to radiation during bone x rays, however, the amount of radiation is small and the risk of harm is very low. If reproductive organs are exposed to radiation, genetic alterations may occur. Excessive or repeated doses of radiation can cause changes in other types of body tissue. No radiation remains in the body after the x ray.

Normal results

Normal bones show no fractures, dislocations, or other abnormalities.

Abnormal results

Results which indicate the presence of bone injury or disease differ in appearance according to the nature of the injury/disease. For example, fractures show up as clear breaks in the bones, while osteoporotic bone has the same shape as a normal bone on an x ray but is less dense.

Resources

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OTHER

Lori De Milto

Bone-mineral density test see Bone density test

Bordetella pertussis infection see Whooping cough

Borrelia burgdorferi infection see Lyme disease

Botanical medicine, western see Western herbal remedies

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Botulism

Definition

Botulism is caused by botulinum toxin, a poison produced by certain bacteria in the clostridium genus. Exposure to the botulinum toxin occurs mostly from eating contaminated food, or in infants, from certain clostridia growing in the intestine. Botulinum toxin blocks motor nerves’ ability to release acetylcholine, the neurotransmitter that relays nerve signals to muscles. and flaccid paralysis occurs. As botulism progresses, the muscles that control the airway and breathing fail.

Description

Botulism occurs rarely, but it incites concern because of its high fatality rate. Clinical descriptions of botulism possibly reach as far back in history as ancient Rome and Greece. However, the relationship between contaminated food and botulism wasn’t defined until the late 1700s. In 1793 the German physician, Justinius Kern, deduced that a substance in spoiled sausages, which he called wurstgift (German for sausage poison), caused botulism. The toxin’s origin and identity remained elusive until Emile von Ermengem, a Belgian professor, isolated Clostridium botulinum in 1895 and identified it as the poison source.

Four types of botulism have been identified: foodborne or adult, infant, wound, and infant-type (intestinal) botulism in an adult. The main difference between types hinges on the route of exposure to the toxin. Experts estimate that up to 90% of U.S. food-borne botulism cases can be traced to eating contaminated home-preserved food. Between 1975-1992, 543 people fell victim to food-borne botulism in the United States and Puerto Rico. In the early 1900s, 71% of botulism victims died, but with early diagnosis and advanced treatment, the fatality rate had dropped to fewer than 2% by 1993.

Worldwide, food-borne botulism is the most commonly reported form, but the United States experiences a higher incidence of infant botulism. Infant botulism is possibly under-reported worldwide because it is a relatively recent discovery and diagnosis can be difficult. Between 1975-1992, there were 1,134 cases of infant botulism in the United States. With proper treatment,