

JUDITH ASTON

Judith Aston was born in Long Beach, California. She graduated from University of California at Los Angeles with a B.A. and a M.F.A. in dance. Her interest in movement arose from working as a dancer. In 1963 Aston established her first movement education program for dancers, actors, and athletes at Long Beach City College.

Five years later, while recovering from injuries sustained during two consecutive automobile accidents, Aston met Ida Rolf, the developer of Rolfing. Aston began working for Rolf, teaching a movement education program called Rolf-Aston Structural Patterning that emphasized using the body with minimum effort and maximum precision.

In time, Rolf and Aston's views on movement diverged, and the partnership was dissolved in 1977. Aston formed her own company called the Aston Paradigm Corporation in Lake Tahoe, California. This company provides training and certification for Aston practitioners. She also began exploring how environmental conditions affect body movement, foreshadowing the ergonomic movement in the workplace that developed in the 1990s. Over time, Aston has expanded her movement work to include a fitness program for older adults. Today, Judith Aston serves as director of Aston Paradigm Corporation.

- Movement education and bodywork, including massage, myofacial release, and arthrokinetics, to help release tension and make new movement patterns easier.
- Post-testing, when pre-testing movements are repeated, allowing the client to feel the changes that have taken place and integrate them into daily life.

Aston-Patterning requires more participation from the client than many bodywork techniques. The massage aspect of Aston-Patterning is designed around a three-dimensional, non-compressive touch that releases patterns of tension in the body. It is gentler than Rolfing. Myokinetics uses touch to release tension in the face and neck. Arthrokinetics addresses tension at bones and joints. This massage is accompanied by education about how new movement patterns may be established.

In addition to Aston-Patterning sessions, clients are also helped to examine their environment for factors, such as seating or sleeping arrangements, that may limit their body function and introduce tension. Finally, they may choose to participate in the Aston fitness training program that includes loosening techniques based on self-massage, toning, stretching, and cardiovascular fitness.

KEY TERMS

Rolfing—Developed by Dr. Ida Rolf (1896–1979), rolfing is a systematic approach to relieving stress patterns and dysfunctions in the body's structure through the manipulation of the highly pliant myofacial (connective) tissue. It assists the body in reorganizing its major segments into vertical alignment.

Preparations

No special preparation need be taken.

Precautions

No special precautions are necessary when participating.

Side effects

No undesirable side effects are reported. Usually clients report a diminution of tension, improved body movement, and an enhanced feeling of well being.

Research and general acceptance

Aston-Patterning is an outgrowth of Rolfing, which has been shown to be of benefit in a limited number of controlled studies. Little controlled research has been done on the either benefits or limitations of Aston-Patterning. Its claims have been neither proven nor disproved, although anecdotally many clients report relief from pain and tension and also improved body movement.

Resources

ORGANIZATIONS

The Aston Training Center. P. O. Box 3568, Incline Village, NV 89450. 775-831-8228. Astonpat@aol.com <<http://www.aston-patterning.com>>.

Tish Davidson

Astrocytoma see **Brain tumor**

Ataxia-telangiectasia

Definition

Ataxia-telangiectasia (A-T), also called Louis-Bar syndrome, is a rare, genetic neurological disorder of child-

hood that progressively destroys part of the motor control area of the brain, leading to a lack of balance and coordination. A-T also affects the immune system and increases the risk of leukemia and lymphoma in affected individuals.

Description

The disorder first appeared in the medical literature in the mid-1920s, but was not named specifically until 1957. The name is a combination of two recognized abnormalities: ataxia (lack of muscle control) and telangiectasia (abnormal dilatation of capillary vessels that often result in tumors and red **skin lesions**). However, A-T involves more than just the sum of these two findings. Other associated A-T problems include immune system deficiencies, extreme sensitivity to radiation, and blood cancers.

Medical researchers initially suspected that multiple genes (the units responsible for inherited features) were involved. However, in 1995, mutations in a single large gene were identified as causing A-T. Researchers named the gene ATM for A-T, mutated. Subsequent research revealed that ATM has a significant role in regulating cell division. The symptoms associated with A-T reflect the main role of the AT gene, which is to induce several cellular responses to DNA damage, such as preventing damaged DNA from being reproduced. When the AT gene is mutated into ATM, the signaling networks are affected and the cell no longer responds correctly to minimize the damage.

A-T is very rare, but it occurs in every population world wide, with an estimated frequency of between 1/40,000 and 1/100,000 live births. But it is believed that many A-T cases, particularly those who die at a young age, are never properly diagnosed. Therefore, this disease may actually be much more prevalent. According to the A-T Project Foundation, an estimated 1% (2.5 million in the United States) of the general population carries defective A-T genes. Carriers of one copy of this gene do not develop A-T, but have a significantly increased risk of **cancer**. This makes the A-T gene one of the most important cancer-related genes identified to date.

Causes and symptoms

The ATM gene is autosomal recessive, meaning the disease occurs only if a defective gene is inherited from both parents. Infants with A-T initially often appear very healthy. At around age two, ataxia and nervous system abnormalities becomes apparent. The root cause of A-T-associated ataxia is **cell death** in the brain, specifically the large branching cells of the nervous system (Purkinje's cells) which are located in the cerebellum. A toddler becomes clumsy, loses balance easily and lacks muscle control. Speech becomes slurred and more difficult, and the symptoms progressively worsen. Between ages two

and eight, telangiectases, or tiny, red "spider" veins, appear on the cheeks and ears and in the eyes.

By age 10-12, children with A-T can no longer control their muscles. Immune system deficiencies become common, and affected individuals are extremely sensitive to radiation. Immune system deficiencies vary between individuals but include lower-than-normal levels of proteins that function as antibodies (immunoglobulins) and white blood cells (blood cells not containing "iron" proteins). The thymus gland, which aids in development of the body's immune system, is either missing or has developed abnormally. Intelligence is normal, but growth may be retarded owing to immune system or hormonal deficiencies. Individuals with A-T are also sometimes afflicted with diabetes, prematurely graying hair, and difficulty swallowing. As the children grow older, the immune system becomes weaker and less capable of fighting infection. In the later stages, recurrent respiratory infections and blood cancers, such as leukemia or lymphoma, are common.

Diagnosis

Diagnosis relies on recognizing the hallmarks of A-T: progressive ataxia and telangiectasia. However, this may be difficult as ataxia symptoms do appear prior to telangiectasia symptoms by several years. Other symptoms can vary between individuals; for example, 70% of individuals with A-T have a high incidence of respiratory infection, 30% do not. The identification of the ATM gene raises hopes that screening, and perhaps treatment, may be possible.

Treatment

There is currently no cure for A-T, and treatment focuses on managing the individual's multiple symptoms. Physical therapy and speech therapy can help the patient adjust to ataxia. Injections of gamma globulin, or extracts of human blood that contain antibodies, are used to strengthen the weakened immune system. High-dose vitamin administrations may also be prescribed. Research continues in many countries to find effective treatments. Individuals and families living with this disorder may benefit from attending support groups.

Prognosis

A-T is a fatal condition. Children with A-T become physically disabled by their early teens and typically die by their early 20s, usually from the associated blood cancers and malignancies. In very rare cases, individuals with A-T may experience slower progression and a slightly longer life span, surviving into their 30s. A-T carriers have a five-fold higher risk than non-carriers of developing certain cancers, especially **breast cancer**.

KEY TERMS

Angioma—A tumor (such as a hemangioma or lymphangioma) that mainly consists of blood vessels or lymphatic vessels.

Antibody—Any of a large number of proteins produced by specialized blood cells after stimulation by an antigen and that act specifically against the antigen in an immune response.

Antigen—Any substance (such as a toxin or enzyme) capable of stimulating an immune response in the body.

Ataxia—The inability to control voluntary muscle movement, most frequently resulting from disorders in the brain or spinal cord.

Autosomal—Relating to any of the chromosomes except for X and Y, the sex chromosomes.

Cerebellum—The part of the brain responsible for coordination of voluntary movements.

Gamma-globulin—An extract of human blood that contains antibodies.

Immune response—A response from the body to an antigen that occurs when the antigen is identified as foreign and that induces the production of antibodies and lymphocytes capable of destroying the antigen or making it harmless.

Immunoglobulin—A protein in the blood that is the component part of an antibody.

Leukemia—A cancer of blood cells characterized by the abnormal increase in the number of white blood cells in the tissues. There are many types of leukemias and they are classified according to the type of white blood cell involved.

Lymphoma—A blood cancer in which lymphocytes, a variety of white blood cells, grow at an unusually rapid rate.

Mutation—Any change in the hereditary material of genes.

Purkinje's cells—Large branching cells of the nervous system.

Recessive—Producing little or no phenotypic effect when occurring in heterozygous condition with a contrasting allele.

Telangiectases—Spidery red skin lesions caused by dilated blood vessels.

Telangiectasia—Abnormal dilation of capillary blood vessels leading to the formation of telangiectases or angiomas.

Thymus—A gland located in the front of the neck that coordinates the development of the immune system.

Prevention

Medical researchers are investigating methods for screening individuals who may be carriers of the defective gene. Prenatal testing for A-T is possible but not done routinely, because commercial screening tests have yet to be developed.

Resources

PERIODICALS

Lavin, Martin F., and Yosef Shiloh. "The Genetic Defect in Ataxia-Telangiectasia." *Annual Review of Immunology* 15 (1997): 177.

ORGANIZATION

A-T Children's Project. 1 W. Camino Real, Suite 212, Boca Raton, FL 33432-5966. (561) 395-2621 or (800) 543-5728. <<http://www.med.jhu.edu/ataxia/>>.

A-T Medical Research Foundation. 5241 Round Meadow Rd., Hidden Hills, CA 91302. (818) 704-8146.

A-T Project. 3002 Enfield Rd., Austin, TX 78703. (512) 472-3417.

The Ataxia-Telangiectasia Society of the United Kingdom, <<http://www.atsociety.org.uk>>.

National Ataxia Foundation. 2600 Fernbrook Ln., Suite 119, Minneapolis, MN 55447-4752. (61) 553-0020. <<http://www.ataxia.org/>>.

National Organization for Rare Disorders. P.O. Box 8923, New Fairfield, CT 06812-1783. (203) 746-6518 or (800) 999-6673.

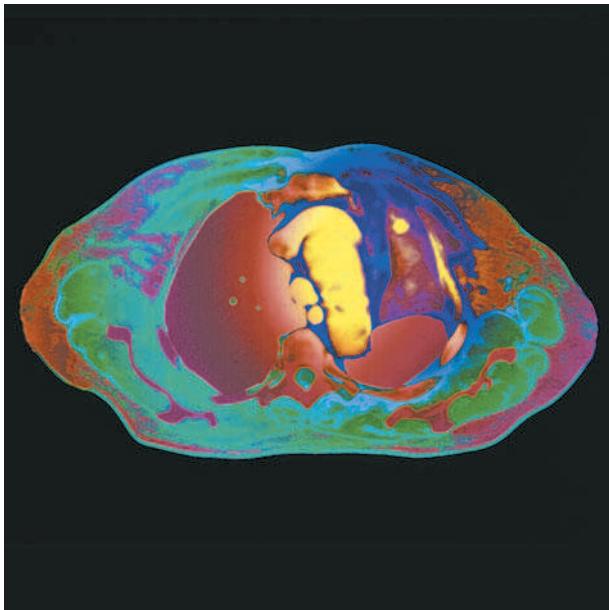
Bethanne Black

Ataxia see **Movement disorders**

Atelectasis

Definition

Atelectasis is a collapse of lung tissue affecting part or all of one lung. This condition prevents normal oxygen absorption to healthy tissues.



A computed tomography (CT) scan through a patient's chest. The collapsed lung appears at the right of the image.
(Photo Researchers, Inc. Reproduced by permission.)

Description

Atelectasis can result from an obstruction (blockage) of the airways that affects tiny air sacs called alveoli. Alveoli are very thin-walled and contain a rich blood supply. They are important for lung function, since their purpose is the exchange of oxygen and carbon dioxide. When the airways are blocked by a mucous "plug," foreign object, or tumor, the alveoli are unable to fill with air and collapse of lung tissue can occur in the affected area. Atelectasis is a potential complication following surgery, especially in individuals who have undergone chest or abdominal operations resulting in associated abdominal or chest **pain** during breathing. Congenital atelectasis can result from a failure of the lungs to expand at birth. This congenital condition may be localized or may affect all of both lungs.

Causes and symptoms

Causes of atelectasis include insufficient attempts at respiration by the newborn, bronchial obstruction, or absence of surfactant (a substance secreted by alveoli that maintains the stability of lung tissue by reducing the surface tension of fluids that coat the lung). This lack of surfactant reduces the surface area available for effective gas exchange causing it to collapse if severe. Pressure on the lung from fluid or air can cause atelectasis as well as obstruction of lung air passages by thick mucus resulting from various infections and lung diseases. Tumors and

inhaled objects can also cause obstruction of the airway, leading to atelectasis.

Anyone undergoing chest or abdominal surgery using general anesthesia is at risk to develop atelectasis, since breathing is often shallow after surgery to avoid pain from the surgical incision. Any significant decrease in airflow to the alveoli contributes to pooling of secretions, which in turn can cause infection. Chest injuries causing shallow breathing, including fractured ribs, can cause atelectasis. Common symptoms of atelectasis include **shortness of breath** and decreased chest wall expansion. If atelectasis only affects a small area of the lung, symptoms are usually minimal. If the condition affects a large area of the lung and develops quickly, the individual may turn blue (cyanotic) or pale, have extreme shortness of breath, and feel a stabbing pain on the affected side. **Fever** and increased heart rate may be present if infection accompanies atelectasis.

Diagnosis

To diagnose atelectasis, a doctor starts by recording the patient's symptoms and performing a thorough **physical examination**. When the doctor listens to the lungs through a stethoscope (auscultation), diminished or bronchial breath sounds may be heard. By tapping on the chest (percussion) while listening through the stethoscope, the doctor can often tell if the lung is collapsed. A **chest x ray** that shows an airless area in the lung confirms the diagnosis of atelectasis. If an obstruction of the airways is suspected, a computed tomography scan (CT) or **bronchoscopy** may be performed to locate the cause of the blockage.

Treatment

If atelectasis is due to obstruction of the airway, the first step in treatment is to remove the cause of the blockage. This may be done by coughing, suctioning, or bronchoscopy. If a tumor is the cause of atelectasis, surgery may be necessary to remove it. **Antibiotics** are commonly used to fight the infection that often accompanies atelectasis. In cases where recurrent or long-lasting infection is disabling or where significant bleeding occurs, the affected section of the lung may be surgically removed.

Prognosis

If atelectasis is caused by a thick mucus "plug" or inhaled foreign object, the patient usually recovers completely when the blockage is removed. If it is caused by a tumor, the outcome depends on the nature of the tumor involved. If atelectasis is a result of surgery, other post-operative conditions and/or complications affect the prognosis.

KEY TERMS

Alveoli—Tiny air sacs in the lungs where gas exchange takes place between alveolar air and pulmonary blood within the capillaries

Bronchial—Relating to the air passages to and from the lungs including the bronchi and the bronchioles.

Bronchoscopy—A procedure in which a hollow, flexible tube is inserted into the airway to allow visual examination of the larynx, trachea, bronchi, and bronchioles. It is also used to collect specimens for biopsy or culturing and to remove airway obstructions.

Incentive spirometer—A breathing device that provides feedback on performance to encourage deep breathing.

Mucus—A thin, slippery film secreted by the mucous membranes and glands.

Postural drainage—Techniques to help expel excess mucus by specific positions of the body (that decrease the effects of gravity) combined with manual percussion and vibration over various parts of the lung.

Surfactant—A substance secreted by the alveoli in the lungs that reduces the surface tension of lung fluids, allowing gas exchange and helping maintain the elasticity of lung tissue.

Tumor—An abnormal growth of tissue resulting from uncontrolled, progressive multiplication of cells.

Prevention

When recovering from surgery, frequent repositioning in bed along with coughing and deep breathing are important. Coughing and breathing deeply every one to two hours after any surgical operation with general anesthesia is recommended. Breathing exercises and the use of breathing devices, such as an incentive spirometer, may also help prevent atelectasis. Although smokers have a higher risk of developing atelectasis following surgery, stopping **smoking** six to eight weeks before surgery can help reduce the risk. Increasing fluid intake during respiratory illness or after surgery (by mouth or intravenously) helps lung secretions to remain loose. Increasing humidity may also be beneficial.

Postural drainage techniques can be learned from a respiratory therapist or physical therapist and are a useful tool for anyone affected with a respiratory illness that could cause atelectasis. Because **foreign objects** blocking the airway can cause atelectasis, it is very important to keep small objects that might be inhaled away from young children.

Resources

BOOKS

- Banasik, Jacquelyn L. "Restrictive Pulmonary Disorders." In *Perspectives on Pathophysiology*. Ed. Lee-Ellen C. Copstead. Philadelphia: W. B. Saunders Co., 1994.
 Chandrasoma, Parakrama, and Clive R. Taylor. *Concise Pathology*. East Norwalk, CT: Appleton & Lange, 1991.

ORGANIZATIONS

National Heart, Lung and Blood Institute. PO Box 30105, Bethesda, MD 20824-0105. (301) 251-1222. <<http://www.nhlbi.nih.gov>>.

Jeffrey P. Larson, RPT

Atenolol see **Beta blockers**

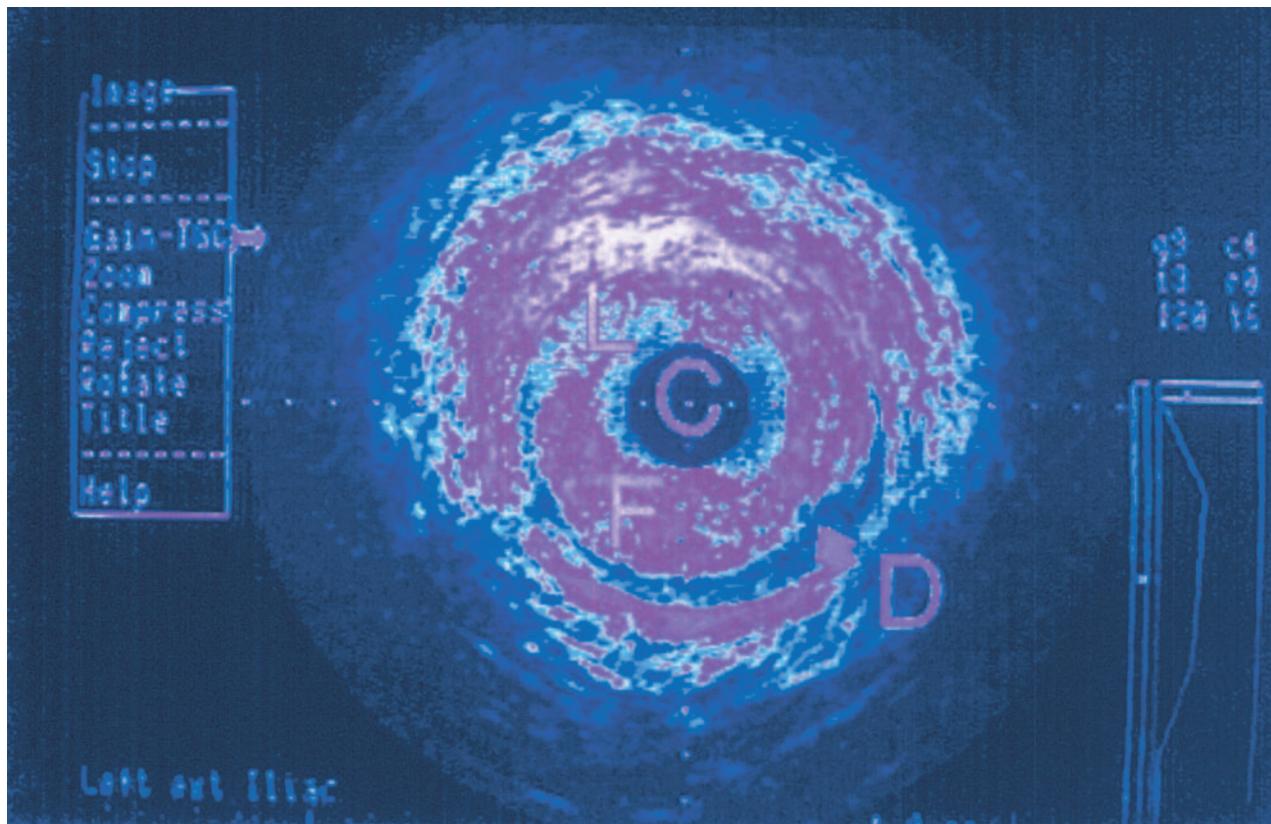
Atherectomy

Definition

Atherectomy is a non-surgical procedure to open blocked coronary arteries or vein grafts by using a device on the end of a catheter to cut or shave away atherosclerotic plaque (a deposit of fat and other substances that accumulate in the lining of the artery wall).

Purpose

Atherectomy is performed to restore the flow of oxygen-rich blood to the heart, to relieve chest **pain**, and to prevent heart attacks. It may be done on patients with chest pain who have not responded to other medical therapy and on certain of those who are candidates for balloon **angioplasty** (a surgical procedure in which a balloon catheter is used to flatten plaque against an artery wall) or **coronary artery bypass graft surgery**. It is



In this digitized ultrasound of a blood vessel, C is the catheter, D is the dissection, and F is the artherosclerotic flap. (Custom Medical Stock Photo. Reproduced by permission.)

sometimes performed to remove plaque that has built up after a coronary artery bypass graft surgery.

Precautions

Atherectomy should not be performed when the plaque is located where blood vessels divide into branches, when plaque is angular or inside an angle of a blood vessel, on patients with weak vessel walls, on ulcerated or calcium-hardened lesions, or on blockages through which a guide wire won't pass.

Description

Atherectomy uses a rotating shaver or other device placed on the end of a catheter to slice away or destroy plaque. At the beginning of the procedure, medications to control blood pressure, dilate the coronary arteries, and prevent blood clots are administered. The patient is awake but sedated. The catheter is inserted into an artery in the groin, leg, or arm, and threaded through the blood vessels into the blocked coronary artery. The cutting head is positioned against the plaque and activated, and the plaque is ground up or suctioned out.

The types of atherectomy are rotational, directional, and transluminal extraction. Rotational atherectomy uses a high speed rotating shaver to grind up plaque. Directional atherectomy was the first type approved, but is no longer commonly used; it scrapes plaque into an opening in one side of the catheter. Transluminal extraction coronary atherectomy uses a device that cuts plaque off vessel walls and vacuums it into a bottle. It is used to clear bypass grafts.

Performed in a **cardiac catheterization** lab, atherectomy is also called removal of plaque from the coronary arteries. It can be used instead of, or along with, balloon angioplasty. Atherectomy is successful about 95% of the time. Plaque forms again in 20-30% of patients.

Preparation

The day before atherectomy, the patient takes medication to prevent blood clots and may be asked to bathe and shampoo with an antiseptic skin cleaner.

Aftercare

After the procedure, the patient spends several days in the hospital's cardiac monitoring area. For at least 20

KEY TERMS

Atherosclerotic plaque—A deposit of fat and other substances that accumulate in the lining of the artery wall.

Balloon angioplasty—A surgical procedure in which a balloon catheter is used to flatten plaque against an artery wall.

Coronary arteries—The two main arteries that provide blood to the heart. The coronary arteries surround the heart like a crown, coming out of the aorta, arching down over the top of the heart, and dividing into two branches. These are the arteries where coronary artery disease occurs.

Hematoma—A localized collection of blood, usually clotted, due to a break in the wall of blood vessel.

minutes, pressure is applied to a dressing on the insertion site. For the first hour, an electrocardiogram and close monitoring are conducted; vital signs are checked every 15 minutes. Pain medication is then administered. The puncture site is checked once an hour or more. For most of the first 24 hours, the patient remains in bed.

Risks

Chest pain is the most common complication of atherectomy. Other common complications are injury to the blood vessel lining, plaque that re-forms, blood clots (hematoma), and bleeding at the site of insertion. More serious but less frequent complications are blood vessel holes, blood vessel wall tears, or reduced blood flow to the heart.

Resources

BOOKS

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DeBakey Michael E, and Antonio M. Gotto Jr. "Therapeutic Procedures." In *The New Living Heart*. Holbrook, MA: Adams Media Corporation, 1997.

Texas Heart Institute. "Coronary Artery Disease, Angina, and Heart Attacks." In *Texas Heart Institute Heart Owner's Handbook*. New York: John Wiley & Sons, 1996.

PERIODICALS

Bitl, John A., and Patricia Thomas. "Beyond the Balloon." *Harvard Health Letter* 21, no. 3 (Jan. 1996): 4.

ORGANIZATIONS

American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <<http://www.americanheart.org>>. Texas Heart Institute. Heart Information Service. PO Box 20345, Houston, TX 77225-0345. <<http://www.tmc.edu/thi>>.

OTHER

"Atherectomy." American Heart Association. 1997. 30 Mar. 1998 <<http://www.americanheart.org>>.

Lori De Milto

Atherectomy see **Angioplasty**

Atherosclerosis

Definition

Atherosclerosis is the build up of a waxy plaque on the inside of blood vessels. In Greek, *athere* means *gruel*, and *skleros* means *hard*. Atherosclerosis is often called arteriosclerosis. Arteriosclerosis (from the Greek *arteria*, meaning *artery*) is a general term for hardening of the arteries. Arteriosclerosis can occur in several forms, including atherosclerosis.

Description

Atherosclerosis, a progressive process responsible for most heart disease, is a type of arteriosclerosis or hardening of the arteries. An artery is made up of several layers: an inner lining called the endothelium, an elastic membrane that allows the artery to expand and contract, a layer of smooth muscle, and a layer of connective tissue. Arteriosclerosis is a broad term that includes a hardening of the inner and middle layers of the artery. It can be caused by normal **aging**, by high blood pressure, and by diseases such as diabetes. Atherosclerosis is a type of arteriosclerosis that affects only the inner lining of an artery. It is characterized by plaque deposits that block the flow of blood.

Plaque is made of fatty substances, cholesterol, waste products from the cells, calcium, and fibrin, a stringy material that helps clot blood. The plaque formation process stimulates the cells of the artery wall to produce substances that accumulate in the inner layer. Fat builds up within these cells and around them, and they form connective tissue and calcium. The inner layer of the artery wall thickens, the artery's diameter is reduced, and blood flow and oxygen delivery are decreased. Plaques can rupture or crack open, causing the sudden formation of a blood clot (thrombosis). Atherosclerosis

can cause a **heart attack** if it completely blocks the blood flow in the heart (coronary) arteries. It can cause a **stroke** if it completely blocks the brain (carotid) arteries. Atherosclerosis can also occur in the arteries of the neck, kidneys, thighs, and arms, causing kidney failure or **gangrene** and **amputation**.

Causes and symptoms

Atherosclerosis can begin in the late teens, but it usually takes decades to cause symptoms. Some people experience rapidly progressing atherosclerosis during their thirties, others during their fifties or sixties. Atherosclerosis is complex. Its exact cause is still unknown. It is thought that atherosclerosis is caused by a response to damage to the endothelium from **high cholesterol**, high blood pressure, and cigarette **smoking**. A person who has all three of these risk factors is eight times more likely to develop atherosclerosis than is a person who has none. Physical inactivity, diabetes, and **obesity** are also risk factors for atherosclerosis. High levels of the amino acid homocysteine and abnormal levels of protein-coated fats called lipoproteins also raise the risk of **coronary artery disease**. These substances are the targets of much current research. The role of triglycerides, another fat that circulates in the blood, in forming atherosclerotic plaques is unclear. High levels of triglycerides are often associated with diabetes, obesity, and low levels of high-density lipoproteins (HDL cholesterol). The more HDL ("good") cholesterol, in the blood, the less likely is coronary artery disease. These risk factors are all modifiable. Non-modifiable risk factors are heredity, sex, and age.

Risk factors that can be changed:

- Cigarette/tobacco smoke—Smoking increases both the chance of developing atherosclerosis and the chance of dying from coronary heart disease. Second hand smoke may also increase risk.
- High blood cholesterol—Cholesterol, a soft, waxy substance, comes from foods such as meat, eggs, and other animal products and is produced in the liver. Age, sex, heredity, and diet affect cholesterol. Total blood cholesterol is considered high at levels above 240 mg/dL and borderline at 200–239 mg/dL. High-risk levels of low-density lipoprotein (LDL cholesterol) begin at 130–159 mg/dL.
- High triglycerides—Most fat in food and in the body takes the form of triglycerides. Blood triglyceride levels above 400 mg/dL have been linked to coronary artery disease in some people. Triglycerides, however, are not nearly as harmful as LDL cholesterol.

- High blood pressure—Blood pressure of 140 over 90 or higher makes the heart work harder, and over time, both weakens the heart and harms the arteries.
- Physical inactivity—Lack of **exercise** increases the risk of atherosclerosis.
- Diabetes mellitus—The risk of developing atherosclerosis is seriously increased for diabetics and can be lowered by keeping diabetes under control. Most diabetics die from heart attacks caused by atherosclerosis.
- Obesity—Excess weight increases the strain on the heart and increases the risk of developing atherosclerosis even if no other risk factors are present.

Risk factors that cannot be changed:

- Heredity—People whose parents have coronary artery disease, atherosclerosis, or stroke at an early age are at increased risk. The high rate of severe **hypertension** among African-Americans puts them at increased risk.
- Sex—Before age 60, men are more likely to have heart attacks than women are. After age 60, the risk is equal among men and women.
- Age—Risk is higher in men who are 45 years of age and older and women who are 55 years of age and older.

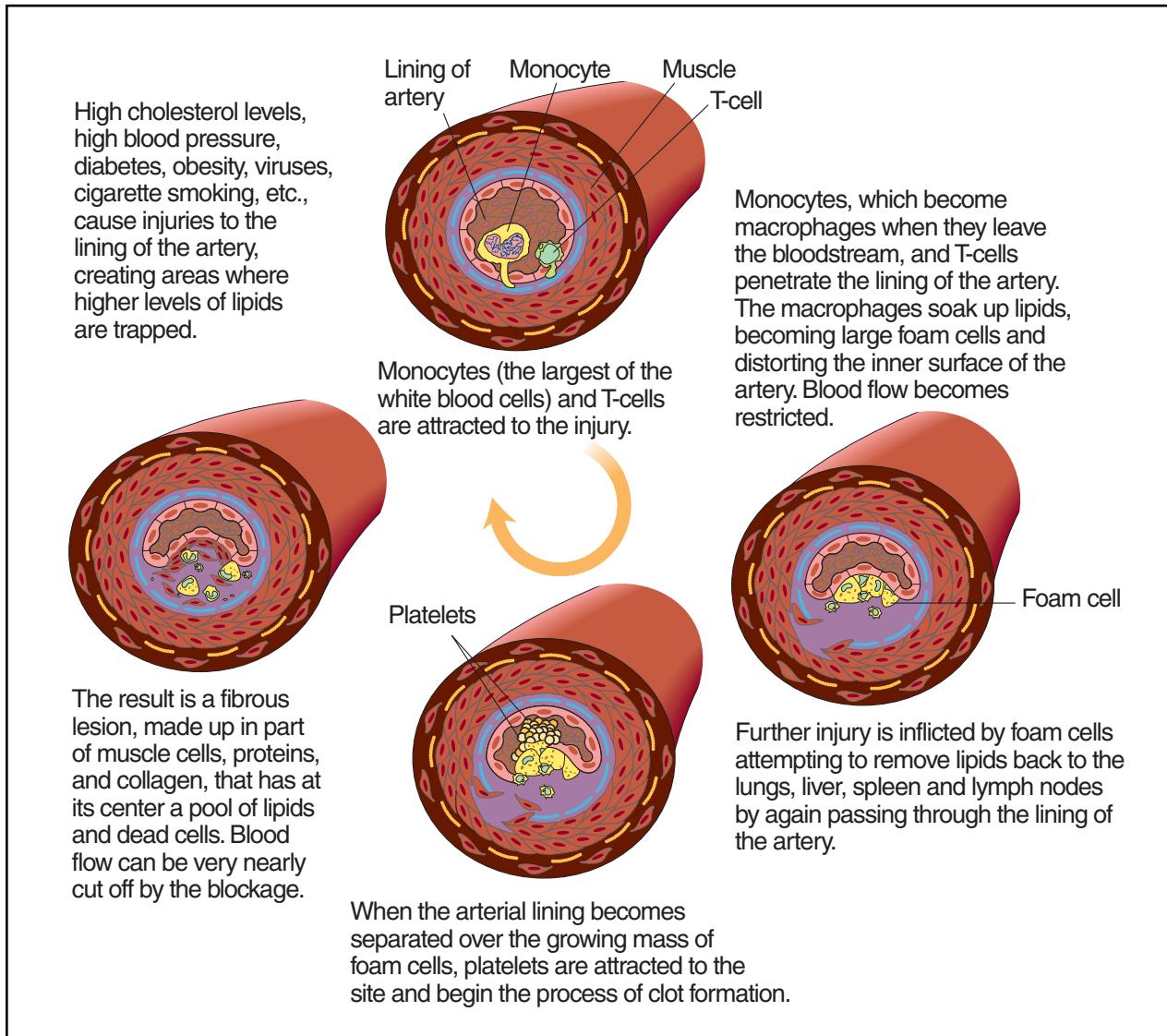
Symptoms differ depending upon the location of the atherosclerosis.

- In the coronary (heart) arteries: Chest **pain**, heart attack, or sudden **death**.
- In the carotid (brain) arteries: Sudden **dizziness**, weakness, loss of speech, or blindness.
- In the femoral (leg) arteries: Disease of the blood vessels in the outer parts of the body (**peripheral vascular disease**) causes cramping and **fatigue** in the calves when walking.
- In the renal (kidney) arteries: High blood pressure that is difficult to treat.

Diagnosis

Physicians may be able to make a diagnosis of atherosclerosis during a physical exam by means of a stethoscope and gentle probing of the arteries with the hand (palpation). More definite tests are **electrocardiography**, **echocardiography** or ultrasonography of the arteries (for example, the carotids), radionuclide scans, and **angiography**.

An electrocardiogram shows the heart's activity. Electrodes covered with conducting jelly are placed on the patient's body. They send impulses of the heart to a recorder. The test takes about 10 minutes and is performed in a physician's office. Exercise electrocardiography (**stress test**) is conducted while the patient exercises on a treadmill



The progression of atherosclerosis. (Illustration by Hans & Cassady.)

or a stationary bike. It is performed in a physician's office or an exercise laboratory and takes 15-30 minutes.

Echocardiography, cardiac ultrasound, uses sound waves to create an image of the heart's chambers and valves. A technician applies gel to a hand-held transducer, presses it against the patient's chest, and images are displayed on a monitor. This technique cannot evaluate the coronary arteries directly. They are too small and are in motion with the heart. Severe coronary artery disease, however, may cause abnormal heart motion that is detected by echocardiography. Performed in a cardiology outpatient diagnostic laboratory, the test takes 30-60 minutes. Ultrasonography is also used to assess arteries of the neck and thighs.

Radionuclide angiography and thallium (or sestamibi) scanning enable physicians to see the blood flow through the coronary arteries and the heart chambers. Radioactive material is injected into the bloodstream. A device that uses gamma rays to produce an image of the radioactive material (gamma camera) records pictures of the heart. Radionuclide angiography is usually performed in a hospital's nuclear medicine department and takes 30-60 minutes. Thallium scanning is usually done after an exercise **stress** test or after injection of a vasodilator, a drug to enlarge the blood vessels, like dipyridamole (Persantine). Thallium is injected, and the scan is done then and again four hours (and possibly 24 hours) later. Thallium scanning is usually performed in a hospital's nuclear medicine department. Each scan takes 30-60 minutes.

Coronary angiography is the most accurate diagnostic method and the only one that requires entering the body (invasive procedure). A cardiologist inserts a catheter equipped with a viewing device into a blood vessel in the leg or arm and guides it into the heart. The patient has been given a contrast dye that makes the heart visible to x rays. Motion pictures are taken of the contrast dye flowing though the arteries. Plaques and blockages, if present, are well defined. The patient is awake but has been given a sedative. Coronary angiography is performed in a **cardiac catheterization** laboratory and takes from 30 minutes to two hours.

Treatment

Treatment includes lifestyle changes, lipid-lowering drugs, percutaneous transluminal coronary **angioplasty**, and coronary artery bypass surgery. Atherosclerosis requires lifelong care.

Patients who have less severe atherosclerosis may achieve adequate control through lifestyle changes and drug therapy. Many of the lifestyle changes that prevent disease progression—a low-fat, low-cholesterol diet, losing weight (if necessary), exercise, controlling blood pressure, and not smoking—also help prevent the disease.

Most of the drugs prescribed for atherosclerosis seek to lower cholesterol. Many popular lipid-lowering drugs can reduce LDL-cholesterol by an average of 25–30% when combined with a low-fat, low-cholesterol diet. Lipid-lowering drugs include bile acid resins, “statins” (drugs that effect HMG-CoA reductase, an enzyme that controls the processing of cholesterol), niacin, and fibric acid derivatives such as gemfibrozil (Lobid). **Aspirin** helps prevent thrombosis and a variety of other medications can be used to treat the effects of atherosclerosis.

Percutaneous transluminal coronary angioplasty and bypass surgery are invasive procedures that improve blood flow in the coronary arteries. Percutaneous transluminal coronary angioplasty (coronary angioplasty) is a non-surgical procedure in which a catheter tipped with a balloon is threaded from a blood vessel in the thigh into the blocked artery. The balloon is inflated, compresses the plaque to enlarge the blood vessel, and opens the blocked artery. Coronary angioplasty is performed by a cardiologist in a hospital and generally requires a hospital stay of one or two days. It is successful about 90% of the time, but for one-third of patients the artery narrows again within six months. It can be repeated and a “stent” may be placed in the artery to help keep it open (see below).

In coronary artery bypass surgery (bypass surgery), a detour is built around the blockage with a healthy vein or artery, which then supplies oxygen-rich blood to the

heart. It is major surgery appropriate for patients with blockages in two or three major coronary arteries or severely narrowed left main coronary arteries, and for those who have not responded to other treatments. It is performed in a hospital under general anesthesia and uses a heart-lung machine. About 70% of patients experience full relief; about 20% partial relief.

Three other semi-experimental surgical procedures may be used to treat atherosclerosis. In **atherectomy**, a cardiologist shaves off and removes strips of plaque from the blocked artery. In laser angioplasty, a catheter with a laser tip is inserted to burn or break down the plaque. A metal coil called a stent may be permanently implanted to keep a blocked artery open.

Alternative treatment

Alternative therapies that focus on diet and lifestyle can help prevent, retard, or reverse atherosclerosis. Herbal therapies that may be helpful include: hawthorn (*Crataegus laevigata*), notoginseng root (*Panax notoginseng*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), hot red or chili peppers, yarrow (*Achillea millefolium*), and alfalfa (*Medicago sativum*). Relaxation techniques including **yoga**, **meditation**, **guided imagery**, **biofeedback**, and counseling and other “talking” therapies may also be useful to prevent or slow the progress of the disease. Dietary modifications focus on eating foods that are low in fats (especially saturated fats), cholesterol, sugar, and animal proteins and high in fiber and antioxidants (found in fresh fruits and vegetables). Liberal use of onions and garlic is recommended, as is eating raw and cooked fish, especially cold-water fish like salmon. Smoking, alcohol, and stimulants like coffee should be avoided. **Chelation therapy**, which uses anticoagulant drugs and nutrients to dissolve plaque and flush it through the kidneys, is controversial. Long-term remedies can be prescribed by specialists in **ayurvedic medicine**, which combines diet, herbal remedies, relaxation and exercise, and **homeopathy**, which treats a disease with small doses of a drug that causes the symptoms of the disease.

Prognosis

Atherosclerosis can be successfully treated but not cured. Recent clinical studies have shown that atherosclerosis can be delayed, stopped, and even reversed by aggressively lowering LDL cholesterol. New diagnostic techniques enable physicians to identify and treat atherosclerosis in its earliest stages. New technologies and surgical procedures have extended the lives of many patients who would otherwise have died. Research continues.

Prevention

A healthy lifestyle—eating right, regular exercise, maintaining a healthy weight, not smoking, and controlling hypertension—can reduce the risk of developing atherosclerosis, help keep the disease from progressing, and sometimes cause it to regress.

- Eat right—A healthy diet reduces excess levels of LDL cholesterol and triglycerides. It includes a variety of foods that are low in fat and cholesterol and high in fiber; plenty of fruits and vegetables; and limited sodium. Fat should comprise no more than 30%, and saturated fat no more than 8–10%, of total daily calories according to the American Heart Association. Cholesterol should be limited to about 300 milligrams per day and sodium to about 2,400 milligrams. The “Food Guide” Pyramid developed by the U.S. Departments of Agriculture and Health and Human Services provides daily guidelines: 6–11 servings of bread, cereal, rice, and pasta; 3–5 servings of vegetables; 2–4 servings of fruit; 2–3 servings of milk, yogurt, and cheese; and 2–3 servings of meat, poultry, fish, dry beans, eggs, and nuts. Fats, oils, and sweets should be used sparingly. Monounsaturated oils, like olive and rapeseed (Canola) are good alternatives to use for cooking.
- Exercise regularly—Aerobic exercise can lower blood pressure, help control weight, and increase HDL (“good”) cholesterol. It may keep the blood vessels more flexible. Moderate to intense aerobic exercise lasting about 30 minutes (or three 10-minute exercise periods) four or more times per week is recommended, according to the Centers for Disease Control and Prevention and the American College of Sports Medicine. Aerobic exercise includes walking, jogging, and cycling, active gardening, climbing stairs, or brisk housework. A physician should be consulted before exercise if a person has atherosclerosis or is at increased risk for it.
- Maintain a desirable body weight—Losing weight can help reduce total and LDL cholesterol, reduce triglycerides, and boost HDL cholesterol. It may also reduce blood pressure. Eating right and exercising are two key components in maintaining a desirable body weight.
- Do not smoke or use tobacco—Smoking has many adverse effects on the heart but quitting can repair damage. Ex-smokers face the same risk of heart disease as non-smokers within five to 10 years of quitting. Smoking is the worst thing a person can do to their heart and lungs.
- Seek treatment for hypertension—High blood pressure can be controlled through lifestyle changes—reducing sodium and fat, exercising, managing stress, quitting

KEY TERMS

Arteriosclerosis—Hardening of the arteries. It includes atherosclerosis, but the two terms are often used synonymously.

Cholesterol—A fat-like substance that is made by the human body and eaten in animal products. Cholesterol is used to form cell membranes and process hormones and vitamin D. High cholesterol levels contribute to the development of atherosclerosis.

HDL Cholesterol—About one-third or one-fourth of all cholesterol is high-density lipoprotein cholesterol. High levels of HDL, nicknamed “good” cholesterol, decrease the risk of atherosclerosis.

LDL Cholesterol—Low-density lipoprotein cholesterol is the primary cholesterol molecule. High levels of LDL, nicknamed “bad” cholesterol, increase the risk of atherosclerosis.

Plaque—A deposit of fatty and other substances that accumulates in the lining of the artery wall.

Triglyceride—A fat that comes from food or is made from other energy sources in the body. Elevated triglyceride levels contribute to the development of atherosclerosis.

smoking, and drinking alcohol in moderation—and medication. Drugs that provide effective treatment are: **diuretics**, beta-blockers, sympathetic nerve inhibitors, **vasodilators**, angiotensin converting enzyme inhibitors, and calcium antagonists. Hypertension usually has no symptoms so it must be checked to be known. Like cholesterol, hypertension is called a “silent killer”.

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- National Heart, Lung and Blood Institute. PO Box 30105, Bethesda, MD 20824-0105. (301) 251-1222. <<http://www.nhlbi.nih.gov>>.
- Texas Heart Institute. Heart Information Service. PO Box 20345, Houston, TX 77225-0345. <<http://www.tmc.edu/thi>>.

Lori De Milton

Athetosis see **Movement disorders**



Athlete's foot fungus on bottom of patient's foot. (Custom Medical Stock Photo. Reproduced by permission.)

because the infection was common among athletes who often used these areas.

Causes and symptoms

Athlete's foot is caused by a fungal infection that most often affects the fourth and fifth toe webs. *Trichophyton rubrum*, *T. mentagrophytes*, and *Epidermophyton floccosum*, the fungi that cause athlete's foot, are unusual in that they live exclusively on dead body tissue (hair, the outer layer of skin, and nails). The fungus grows best in moist, damp, dark places with poor ventilation. The problem doesn't occur among people who usually go barefoot.

Many people carry the fungus on their skin. However, it will only flourish to the point of causing athlete's foot if conditions are right. Many people believe athlete's foot is highly contagious, especially in public swimming pools and shower rooms. Research has shown, however, that it is difficult to pick up the infection simply by walking barefoot over a contaminated damp floor. Exactly why some people develop the condition and others don't is not well understood.

Sweaty feet, tight shoes, synthetic socks that don't absorb moisture well, a warm climate, and not drying the feet well after swimming or bathing, all contribute to the overgrowth of the fungus.

Symptoms of athlete's foot include itchy, sore skin on the toes, with scaling, cracking, inflammation, and blisters. Blisters that break, exposing raw patches of tissue, can cause **pain** and swelling. As the infection spreads, **itching** and burning may get worse.

If it's not treated, athlete's foot can spread to the soles of the feet and toenails. Stubborn toenail infections may appear at the same time, with crumbling, scaling and thickened nails, and nail loss. The infection can spread further if patients scratch and then touch themselves else-

Athlete's foot

Definition

A common fungus infection between the toes in which the skin becomes itchy and sore, cracking and peeling away. Athlete's foot (also known as tinea pedis or foot **ringworm**) can be treated, but it can be tenacious and difficult to clear up completely.

Description

Athlete's foot is a very common condition of itchy, peeling skin on the feet. In fact, it's so common that most people will have at least one episode at least once in their lives. It's less often found in women and children under age 12. (Symptoms that look like athlete's foot in young children most probably are caused by some other skin condition).

Because the fungi grow well in warm, damp areas, they flourish in and around swimming pools, showers, and locker rooms. Tinea pedis got its common name



Athlete's foot fungus on toes of patient. (Custom Medical Stock Photo. Reproduced by permission.)

where (especially in the groin or under the arms). It's also possible to spread the infection to other parts of the body via contaminated bed sheets or clothing.

Diagnosis

Not all foot **rashes** are athlete's foot, which is why a physician should diagnose the condition before any remedies are used. Using nonprescription products on a rash that is not athlete's foot could make the rash worse.

A dermatologist can diagnose the condition by **physical examination** and by examining a preparation of skin scrapings under a microscope. This test, called a KOH preparation, treats a sample of tissue scraped from the infected area with heat and potassium hydroxide (KOH). This treatment dissolves certain substances in the tissue sample, making it possible to see the fungi under the microscope.

Treatment

Athlete's foot may be resistant to medication and should not be ignored. Simple cases usually respond well to antifungal creams or sprays (clotrimazole, ketoconazole, miconazole nitrate, sulconazole nitrate, or tolnaftate). If the infection is resistant to topical treatment, the doctor may prescribe an oral antifungal drug.

Untreated athlete's foot may lead to a secondary bacterial infection in the skin cracks.

Alternative treatment

A footbath containing cinnamon has been shown to slow down the growth of certain molds and fungi, and is said to be very effective in clearing up athlete's foot. To make the bath:

- heat four cups of water to a boil
- add eight to 10 broken cinnamon sticks
- reduce heat and simmer five minutes
- remove and let the mixture steep for 45 minutes until lukewarm
- soak feet

Other herbal remedies used externally to treat athlete's foot include: a foot soak or powder containing goldenseal (*Hydrastis canadensis*); tea tree oil (*Melaleuca* spp.); or calendula (*Calendula officinalis*) cream to help heal cracked skin.

Prognosis

Athlete's foot usually responds well to treatment, but it is important to take all medication as directed by a dermatologist, even if the skin appears to be free of fungus. Otherwise, the infection could return. The toenail infections that may accompany athlete's foot, however, are typically very hard to treat effectively.

Prevention

Good personal hygiene and a few simple precautions can help prevent athlete's foot. To prevent spread of athlete's foot:

- wash feet daily
- dry feet thoroughly (especially between toes)
- avoid tight shoes (especially in summer)
- wear sandals during warm weather
- wear cotton socks and change them often if they get damp
- don't wear socks made of synthetic material
- go barefoot outdoors when possible
- wear bathing shoes in public bathing or showering areas
- use a good quality foot powder
- don't wear sneakers without socks
- wash towels, contaminated floors, and shower stalls well with hot soapy water if anyone in the family has athlete's foot

Resources

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American Podiatric Medical Association. 9312 Old Georgetown Road, Bethesda, MD 20814-1698. (301) 571-9200. <<http://www.apma.org>>.

Carol A. Turkington

Athletic heart syndrome

Definition

Athletic heart syndrome is the adaptation of an athlete's heart in response to the physiologic stresses of strenuous physical training. It can be difficult to distinguish a significant medical condition from an athletic heart.

Description

The heart adapts to physical demands by enlarging, especially the left ventricle. Enlargement increases the cardiac output, the amount of blood pumped with each beat of the heart. The exact type of adaptation depends on the nature of the physical demand. There are two types of demand, static and dynamic. Static demand involves smaller groups of muscles under extreme resistance for brief period. An example is weight lifting. Dynamic training involves larger groups of muscles at lower resistance for extended periods of time. Examples are aerobic training and tennis. Cardiac enlargement is associated with dynamic training. The heart's response to static training is hypertrophy, thickening of the muscle walls of the heart. As the wall of the heart adapts, there are changes in the electrical conducting system of the heart. Because of the larger volume of blood being pumped with each heart beat, the heart rate when at rest decreases below the normal level for nonathletes.

Sudden unexpected death (SUD) is the death of an athlete, usually during or shortly after physical activity. Often, there is no warning that the person will experience SUD, although in some cases, warning signs appear which cause the person to seek medical advice. Importantly, cases of death occurring during physical activity are not caused by athletic heart syndrome, but by undiagnosed heart disorders.

Causes and symptoms

Athletic heart syndrome is the consequence of a normal adaptation by the heart to increased physical activity. The changes in the electrical conduction system of the

heart may be pronounced and diagnostic, but should not cause problems. In the case of SUD, other heart problems are involved. In 85-97% of the cases of SUD, an underlying structural defect of the heart has been noted.

Diagnosis

The changes in the heart beat caused by the electrical conduction system of the heart are detectable on an electrocardiogram. Many of the changes seen in athletic heart syndrome mimic those of various heart diseases. Careful examination must be made to distinguish heart disease from athletic heart syndrome.

Prognosis

The yearly rate for occurrence of SUD in people less than 35 years of age is less than seven incidents per 100,000. Of all SUD cases, only about 8% are exercise related. On a national basis, this means that each year approximately 25 athletes experience SUD. In persons over age 35, the incidence of SUD is approximately 55 in 100,000, with only 3% of the cases occurring during exercise.

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John T. Lohr, PhD

Atkins diet

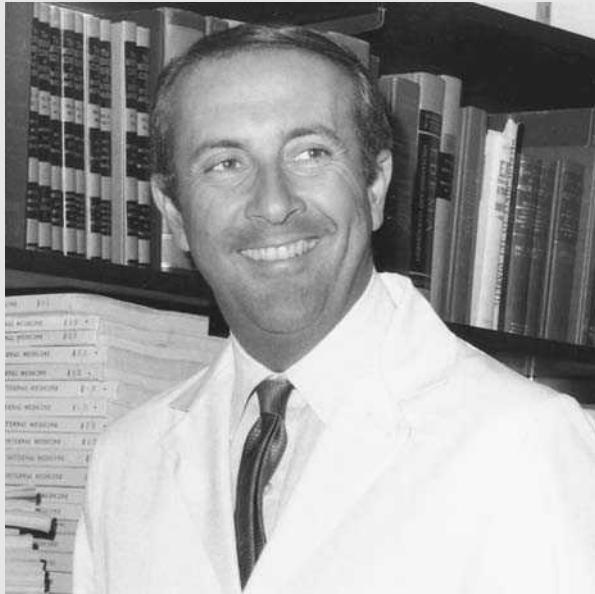
Definition

The Atkins diet is a high-protein, high-fat, and very low-carbohydrate regimen. It emphasizes meat, cheese, and eggs, while discouraging foods such as bread, pasta, fruit, and sugar. It is a form of ketogenic diet.

Purpose

The primary benefit of the diet is rapid and substantial weight loss. By restricting carbohydrate intake, the body will burn more fat stored in the body. Since there are no limits on the amount of calories or quantities of foods allowed on the diet, there is little hunger between meals. According to Atkins, the diet can alleviate symptoms of

DR. ROBERT C. ATKINS (1930–)



(AP/Wide World Photos. Reproduced by permission.)

Dr. Robert C. Atkins graduated from the University of Michigan in 1951 and received his medical degree from Cornell University Medical School in 1955 with a

specialty in cardiology. As an internist and cardiologist he developed the Atkins Diet in the early 1970s. The diet is a ketogenic diet—a high protein, high fat, and very low carbohydrate regimen resulting in ketosis. It emphasizes meat, cheese, and eggs, while discouraging foods such as bread, pasta, fruit, and sugar. It first came to public attention in 1972 with the publication of *Dr. Atkins' Diet Revolution*. The book quickly became a bestseller but unlike most other fad diet books, this one has remained popular. At last count, it had been reprinted 28 times and sold more than 10 million copies worldwide. Since then, Atkins has authored a number of other books on his diet theme, including *Dr. Atkins' New Diet Revolution* (1992), *Dr. Atkins' Quick and Easy New Diet Cookbook* (1997), and *The Vita-Nutrient Solution: Nature's Answer to Drugs* (1998).

Atkins has seen about 60,000 patients in his more than 30 years of practice. He has also appeared on numerous radio and television talk shows, has his own syndicated radio program, *Your Health Choices*, and authors the monthly newsletter *Dr. Atkins' Health Revelations*. Atkins has received the World Organization of Alternative Medicine's Recognition of Achievement Award and been named the National Health Federation's Man of the Year. He is director of the Atkins Center for Complementary Medicine which he founded in the early 1980s. The center is located at 152 E. 55th St., New York, NY 10022.

conditions such as **fatigue**, irritability, headaches, depression, and some types of joint and muscle **pain**.

Description

The regimen is a low-carbohydrate, or ketogenic diet, characterized by initial rapid weight loss, usually due to water loss. Drastically reducing the amount of carbohydrate intake causes liver and muscle glycogen loss, which has a strong but temporary diuretic effect. Long-term weight loss occurs because with a low amount of carbohydrate intake, the body burns stored fat for energy.

The four-step diet starts with a two-week induction program designed to rebalance an individual's metabolism. Unlimited amounts of fat and protein are allowed but carbohydrate intake is restricted to 15-20 grams per day. Foods allowed include butter, oil, meat, poultry, fish, eggs, cheese, and cream. The daily amount of carbohydrates allowed equals about three cups of salad vegetables, such as lettuce, cucumbers, and celery.

The second stage is for ongoing weight loss. It allows 15-40 grams of carbohydrates a day. When the

individual is about 10 pounds from their desired weight, they begin the pre-maintenance phase. This gradually adds one to three servings a week of high carbohydrate foods, such as a piece of fruit or slice of whole-wheat bread. When the desired weight is reached, the maintenance stage begins. It allows 40-60 grams of carbohydrates per day.

Opinion from the general medical community remains mixed on the Atkins diet, but is generally unfavorable. There have been no significant long-term scientific studies on the diet. A number of leading medical and health organizations, including the American Medical Association, American Dietetic Association (ADA), and the American Heart Association oppose it. It is drastically different than the dietary intakes recommended by the U.S. Department of Agriculture and the National Institutes of Health. Much of the opposition is because the diet is lacking in some **vitamins** and nutrients, and because it is high in fat. In a hearing before the U.S. Congress on February 24, 2000, an ADA representative called the Atkins diet "hazardous" and said it lacked scientific credibility.

Preparations

No advance preparation is needed to go on the diet. However, as with most **diets**, it is generally considered appropriate to consult with a physician and to have a physical evaluation before starting such a nutritional regimen. The evaluation should include blood tests to determine levels of cholesterol, triglycerides, glucose, insulin, and uric acid. A glucose tolerance test is also recommended.

Precautions

Adherence to the Atkins diet can result in vitamin and mineral deficiencies. In his books, Atkins recommends a wide-range of nutritional supplements, including a multi-vitamin. Among his recommendations, Atkins suggests the following daily dosages: 300-600 micrograms (mcg) of chromium picolinate, 100-400 milligrams (mg) of pantetheine, 200 mcg of selenium, and 450-675 mcg of biotin.

The diet is not recommended for lacto-ovo vegetarians, since it cannot be done as successfully without protein derived from animal products. Also, vegans cannot follow this diet, since a vegan diet is too high in carbohydrates, according to Atkins. Instead, he recommends vegetarians with a serious weight problem give up **vegetarianism**, or at least include fish in their diet.

Side effects

According to Atkins, the diet causes no adverse side effects. Many health care professionals disagree. In a fact sheet for the Healthcare Reality Check Web site (<http://www.hcrc.org>), Ellen Coleman, a registered dietitian and author, said the diet may have serious side effects for some people. She said complications associated with the diet include ketosis, **dehydration**, electrolyte loss, calcium depletion, weakness, nausea, and kidney problems. "It is certainly riskier for overweight individuals with medical problems such as heart disease, **hypertension**, kidney disease, and diabetes than it is for overweight people with no health problems," she said.

People with diabetes taking insulin are at risk of becoming hypoglycemic if they do not eat appropriate carbohydrates. Also, persons who **exercise** regularly may experience low energy levels and muscle fatigue from low carbohydrate intake.

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KEY TERMS

Biotin—A B complex vitamin, found naturally in yeast, liver, and egg yolks.

Carbohydrates—Neutral compounds of carbon, hydrogen, and oxygen found in sugar, starches, and cellulose.

Hypertension—Abnormally high arterial blood pressure, which if left untreated can lead to heart disease and stroke.

Ketogenic diet—A diet that supplies an abnormally high amount of fat, and small amounts of carbohydrates and protein.

Ketosis—An abnormal increase in ketones in the body, usually found in people with uncontrolled diabetes mellitus.

Pantetheine—A growth factor substance essential in humans, and a constituent of coenzyme A.

Triglycerides—A blood fat lipid that increases the risk for heart disease.

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OTHER

Atkins Center for Complementary Medicine, 152 E. 55th St., New York, NY 10022. 212-758-2110. <<http://www.atkinscenter.com>>.

Ken R. Wells

Atopic dermatitis

Definition

Eczema is a general term used to describe a variety of conditions that cause an itchy, inflamed skin rash. Atopic **dermatitis**, a form of eczema, is a non-contagious disorder characterized by chronically inflamed skin and sometimes intolerable **itching**.

Description

Atopic dermatitis refers to a wide range of diseases that are often associated with **stress** and allergic disorders that involve the respiratory system, like **asthma** and hay **fever**. Although atopic dermatitis can appear at any age, it is most common in children and young adults. Symptoms usually abate before the age of 25 and do not affect the patient's general health.

About one in ten babies develop a form of atopic dermatitis called infantile eczema. Characterized by skin that oozes and becomes encrusted, infantile eczema most often occurs on the face and scalp. The condition usually improves before the child's second birthday, and medical attention can keep symptoms in check until that time.

When atopic dermatitis develops after infancy, inflammation, blistering, oozing, and crusting are less pronounced. The patient's sores become dry, turn from red to brownish-gray, and skin may thicken and become scaly. In dark-skinned individuals, this condition can cause the complexion to lighten or darken. Itching associated with this condition is usually worst at night. It can be so intense that patients scratch until their sores bleed, sometimes causing scarring and infection.

Atopic dermatitis affects about 3% of the population of the United States, and about 80% of the people who have the condition have one or more relatives with the same condition or a similar one. Symptoms tend to be most severe in females. Atopic dermatitis can erupt on any part of the skin, and crusted, thickened patches on the fingers, palms, or the soles of the feet can last for years. In teenagers and young adults, atopic dermatitis often appears on one or more of the following areas:

- elbow creases
- backs of the knees

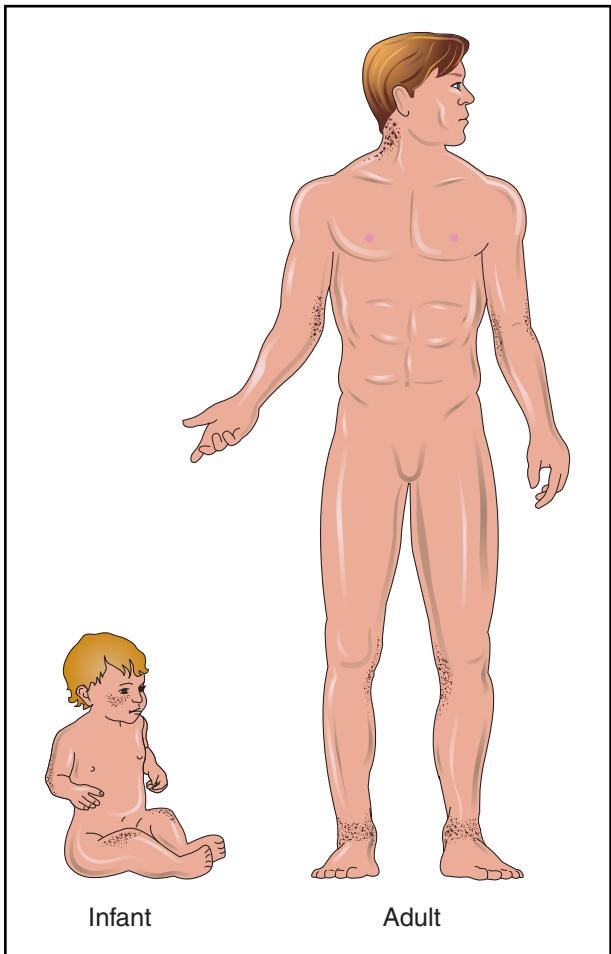


A close-up view of atopic dermatitis in the crook of the elbow of a 12-year-old patient. (Custom Medical Stock Photo. Reproduced by permission.)

- ankles
- wrists
- face
- neck
- upper chest
- palms and between the fingers

Causes and symptoms

While allergic reactions often trigger atopic dermatitis, the condition is thought to be the result of an inherited over-active immune system or a genetic defect that causes the skin to lose abnormally large amounts of moisture. The condition can be aggravated by a cycle that develops in which the skin itches, the patient scratches, the condition worsens, the itching worsens, the patient scratches, etc. This cycle must be broken by relieving the itching to allow the skin time to heal. If the skin becomes



Atopic dermatitis can erupt on any part of the skin. In infants, it often appears on the face, scalp, and knees, while it develops on the elbows, neck, back of the knees, and ankles in adults. (Illustration by Electronic Illustrators Group.)

broken, there is also a risk of developing skin infections which, if not recognized and treated promptly, can become more serious.

Symptoms of atopic dermatitis include the following:

- an itchy rash and dry, thickened skin on areas of the body where moisture can be trapped
- continual scratching
- chronic **fatigue**, caused when itching disrupts sleep

An individual is more at-risk for developing the condition if there is a personal or family history of atopic dermatitis, hay fever, asthma, or other **allergies**. Exposure to any of the following can cause a flare-up:

- hot or cold temperatures
- wool and synthetic fabrics
- detergents, fabric softeners, and chemicals

- use of drugs that suppress immune-system activity

Certain foods, such as peanuts, cow's milk, eggs, and fish, can trigger symptoms of atopic dermatitis. A small percentage of patients with atopic dermatitis find that their symptoms worsen after having been exposed to dust, feather pillows, rough-textured fabrics, or other materials to which dust adheres.

Diagnosis

Diagnosis of atopic dermatitis is usually based on the patient's symptoms and personal and family health history. Skin tests do not generally provide reliable information about this condition.

Treatment

Atopic dermatitis cannot be cured, but the severity and duration of symptoms can be controlled. A dermatologist should be consulted when symptoms first appear, and is likely to recommend warm baths to loosen encrusted skin, followed by applications of petroleum jelly or vegetable shortening to prevent the skin's natural moisture from escaping.

Externally applied (topical) steroids or preparations containing coal tar can relieve minor itching, but coal tar has an unpleasant odor, stains clothes, and may increase skin-cancer risk. Excessive use of steroid creams in young children can alter growth. Pregnant women should not use products that contain coal tar. Topical steroids can cause itching, burning, **acne**, permanent stretch marks, and thinning and spotting of the skin. Applying topical steroids to the area around the eyes can cause **glaucoma**.

Oral **antihistamines**, such as diphenhydramine (Benadryl), can relieve symptoms of allergy-related atopic dermatitis. More concentrated topical steroids are recommended for persistent symptoms. A mild tranquilizer may be prescribed to reduce stress and help the patient sleep, and **antibiotics** are used to treat secondary infections.

Cortisone ointments should be used sparingly, and strong preparations should never be applied to the face, groin, armpits, or rectal area. Regular medical monitoring is recommended for patients who use cortisone salves or lotions to control wide-spread symptoms. Oral cortisone may be prescribed if the patient does not respond to other treatments, but patients who take the medication for more than two weeks have a greater-than-average risk of developing severe symptoms when the treatment is discontinued.

Allergy shots rarely improve atopic dermatitis and sometimes aggravate the symptoms. Since food allergies may trigger atopic dermatitis, the doctor may suggest

eliminating certain foods from the diet if other treatments prove ineffective.

If symptoms are extremely severe, ultraviolet light therapy may be prescribed, and a wet body wrap recommended to help the skin retain moisture. This technique, used most often with children, involves sleeping in a warm room while wearing wet pajamas under dry clothing, rain gear, or a nylon sweatshirt. The patient's face may be covered with wet gauze covered by elastic bandages, and his hands encased in wet socks covered by dry ones.

A physician should be notified if the condition is widespread or resists treatment, or the skin oozes, becomes encrusted, or smells, as this may indicate an infection.

Alternative treatment

Alternative therapies can sometimes bring relief or resolution of atopic dermatitis when conventional therapies are not helping. If the condition becomes increasingly widespread or infected, a physician should be consulted.

Helpful alternative treatments for atopic dermatitis may include:

- Taking regular brisk walks, followed by bathing in warm water sprinkled with essential oil of lavender (*Lavandula officinalis*); lavender oil acts as a nerve relaxant for the whole body including the skin
- Supplementing the diet daily with zinc, fish oils, vitamin A, vitamin E, and evening primrose oil (*Oenothera biennis*)—all good sources of nutrients for the skin
- Reducing or eliminating red meat from the diet
- Eliminating or rotating potentially allergic foods such as cow's milk, peanuts, wheat, eggs, and soy
- Implementing **stress reduction** techniques in daily life.

Herbal therapies also can be helpful in treating atopic dermatitis. Western herbal remedies used in the treatment of this condition include burdock (*Arctium lappa*) and *Ruta* (*Ruta graveolens*). Long-term herbal therapy requires monitoring and should be guided by an experienced practitioner.

Other alternative techniques that may be useful in the treatment of atopic dermatitis include:

- Acupressure (**acupuncture** without needles) to relieve tension that may trigger a flare
- Aromatherapy, using essential oils like lavender, thyme (*Thymus vulgaris*), jasmine (*Jasminum officinale*) and chamomile (*Matricaria recutita*) in hot water, to add a soothing fragrance to the air

KEY TERMS

Corticosteroid—A steroid hormone produced by the adrenal gland or as a synthetic compound that reduces inflammation, redness, rashes, and irritation.

Dermatitis—Inflammation of the skin.

- Shiatsu massage and **reflexology**, performed by licensed practitioners, to alleviate symptoms by restoring the body's natural balance
- Homeopathy, which may temporarily worsen symptoms before relieving them, and should be supervised by a trained alternative healthcare professional
- Hydrotherapy, which uses water, ice, liquid, and steam, to stimulate the immune system
- Juice therapy to purify the liver and relieve bowel congestion
- Yoga to induce a sense of serenity.

Prognosis

Atopic dermatitis is unpredictable. Although symptoms occur less often with age and sometimes disappear altogether, they can recur without warning. Atopic dermatitis lowers resistance to infection and increases the risk of developing **cataracts**. Sixty percent of patients with atopic dermatitis will experience flares and remissions throughout their lives.

Prevention

Research has shown that babies weaned from breast milk before they are four months old are almost three times more likely than other babies to develop recurrent eczema. Feeding eggs or fish to a baby less than one year old can activate symptoms, and babies should be shielded from such irritants as mites, molds, pet hair, and smoke.

Possible ways to prevent flare-ups include the following:

- eliminate activities that cause sweating
- lubricate the skin frequently
- avoid wool, perfumes, fabric softeners, soaps that dry the skin, and other irritants
- avoid sudden temperature changes.

A doctor should be notified whenever any of the following occurs:

- fever or relentless itching develop during a flare

- an unexplained rash develops in someone who has a personal or family history of eczema or asthma
- inflammation does not decrease after seven days of treatment with an over-the-counter preparation containing coal tar or steroids
- a yellow, tan, or brown crust or pus-filled blisters appear on top of an existing rash
- a person with active atopic dermatitis comes into contact with someone who has cold sores, **genital herpes**, or another viral skin disease

Resources

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ORGANIZATIONS

American Academy of Dermatology. 930 N. Meacham Road, P.O. Box 4014, Schaumburg, IL 60168-4014. (847) 330-0230. <<http://www.aad.org>>.

Maureen Haggerty

Atrial ectopic beats

Definition

Atrial ectopic beats (AEB) refers to a contraction of the upper heart chamber which occurs before it would be expected. Atrial ectopic beats are also known as premature atrial beats, premature atrial complex (PAC), or atrial extrasystole.

Description

An AEB is usually a harmless disturbance in the normal rhythm of the heart. It can occur only occasionally, in a regular pattern, or several may occur in sequence and then disappear. Most often, the person is unaware of the event.

Causes and symptoms

As people age, extra beats tend to happen more frequently even in perfectly healthy individuals. AEB may be triggered or increased by **stress**, **caffeine**, **smoking**, and some medicines. Cold remedies containing ephedrine or pseudoephedrine have been known to increase the incidence of atrial ectopic beats. AEB may also be the result of an enlarged atria, lung disease, or the result of reduced blood supply to that area of the heart.

If a person is aware of the event, the first symptom of AEB is usually a feeling that the heart has skipped or missed a beat. This is often accompanied by a feeling that the heart is thumping or pounding in the chest. The thumping or pounding is caused by the fact that when there is an AEB, the pause before the next beat is usually longer than normal. The next beat must be stronger than usual to pump the accumulated blood out of the chamber.

Diagnosis

Diagnosis of AEB is often suspected on the basis of the patient's description of the occurrence. An electrocardiogram (ECG) can confirm the diagnosis. An ECG shows the heart beat as three wave forms. The first wave is called P, the second is called QRS, and the last is T. An atrial ectopic beat will show up on the ECG as a P wave that occurs closer than usual to the preceding T wave.

Treatment

Atrial ectopic beats do not usually require treatment. If treatment is necessary because the beats occur frequently and cause intolerable discomfort, the doctor may prescribe medication.

Prognosis

Occasional AEB usually have no significance. If they increase in frequency, they can lead to atrial tachycardia or fibrillation and to a decrease in cardiac output.

Prevention

AEB cannot usually be prevented. Aggravating factors can be addressed, like excessive stimulants, and uncontrolled pulmonary disorders.

Resources

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ORGANIZATIONS

American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <<http://www.americanheart.org>>.

Dorothy Elinor Stonely

Atrial extrasystole see **Atrial ectopic beats**

Atrial fibrillation and flutter

Definition

Atrial fibrillation and flutter are abnormal heart rhythms in which the atria, or upper chambers of the heart, are out of sync with the ventricles, or lower chambers of the heart. In atrial fibrillation, the atria “quiver” chaotically and the ventricles beat irregularly. In atrial flutter, the atria beat regularly and faster than the ventricles.

Description

Atrial fibrillation and flutter are two types of cardiac **arrhythmias**, irregularities in the heart’s rhythm. Nearly 2 million Americans have atrial fibrillation, according to the American Heart Association. It is the most common chronic arrhythmia. Atrial flutter is less common, but both of these arrhythmias can cause a blood clot to form in the heart. This can lead to a **stroke** or a blockage carried by the blood flow (an **embolism**) anywhere in the body’s arteries. Atrial fibrillation is responsible for about 15% of strokes.

The atria are the heart’s two small upper chambers. In atrial fibrillation, the heart beat is completely irregular. The atrial muscles contract very quickly and irregularly; the ventricles, the heart’s two large lower chambers, beat irregularly but not as fast as the atria. When the atria fibrillate, blood that is not completely pumped out can pool and form a clot. In atrial flutter, the heart beat is usually very fast but steady. The atria beat faster than the ventricles.

Atrial fibrillation often occurs in people with various types of heart disease. Atrial fibrillation may also result from an inflammation of the heart’s covering (**pericarditis**), chest trauma or surgery, pulmonary disease, and certain medications. Atrial fibrillation is more common in older people; about 10% of people over the age of 75 have it. Atrial flutter and fibrillation usually occur in people with hypertensive or coronary heart disease and other types of heart disorders.

Causes and symptoms

In most cases, the cause of atrial fibrillation and flutter can be found, but often it cannot. Causes of these heart beat abnormalities include:

- many types of heart disease
- stress and anxiety
- caffeine
- alcohol
- tobacco
- diet pills

- some prescription and over-the-counter medications
- open heart surgery

Symptoms, when present, include:

- a fluttering feeling in the chest
- a pulse that feels like the heart is skipping, racing, jumping, or is irregular
- low energy
- a faint or dizzy feeling
- pressure or discomfort in the chest
- shortness of breath
- anxiety.

Diagnosis

A doctor can sometimes hear these arrhythmias using an instrument (a stethoscope) to listen to the sounds within the chest. Atrial fibrillation and flutter are usually diagnosed through **electrocardiography** (EKGs), an **exercise stress test**, a 24-hour Holter EKG monitor, or a telephone cardiac monitor. An EKG shows the heart’s activity and may reveal a lack of oxygen (**ischemia**). Electrodes covered with conducting jelly are placed on the patient’s chest, arms, and legs. The electrodes send impulses of the heart’s activity through a monitor (called an oscilloscope) to a recorder that traces the pattern of the impulses onto paper. The test takes about 10 minutes and is performed in a doctor’s office. The exercise stress test measures how the heart and blood vessels respond to work when the patient is exercising on a treadmill or a stationary bike. This test is performed in a doctor’s office within an exercise laboratory and takes 15-30 minutes.

In 24-hour EKG (Holter) monitoring, the patient wears a small, portable tape recorder connected to disks on his/her chest that record the heart’s rhythm during normal activities. An EKG called transtelephonic monitoring identifies arrhythmias that occur infrequently. Like **Holter monitoring**, transtelephonic monitoring continues for days or weeks and enables patients to send the EKG via telephone to a monitoring station when an arrhythmia is felt, or to store the information in the recorder and transmit it later. Doctors can also use high-frequency sound waves (**echocardiography**) to determine the structure and function of the heart. This diagnostic method is often helpful to evaluate for underlying heart disease.

Treatment

Atrial fibrillation and flutter are usually treated with medications and/or electrical shock (**cardioversion**). In

some cases, removal of a small portion of the heart (ablation), implantation of a pacemaker or a cardioverter defibrillator, or maze surgery is needed.

If the heart rate cannot be quickly controlled, electrical cardioversion may be used. Cardioversion, the electric shock to the chest wall, is usually performed emergencies. This device briefly suspends the heart's activity and allows it to return to a normal rhythm.

Ablation destroys the heart tissue that causes the arrhythmia. The tissue can be destroyed by catheterization or surgery. Radiofrequency **catheter ablation**, performed in a **cardiac catheterization** laboratory, can cure atrial flutter and control the heart rate in atrial fibrillation. The patient is awake but sedated. A thin tube called a catheter is inserted into a vein and is threaded into the heart. At the end of the catheter, a device maps the electrical pathways of the heart. A cardiologist, a doctor specializing in the heart, uses this map to identify the pathway(s) causing the arrhythmia, and then eliminates it (them) with bursts of high-frequency radio waves. Surgical ablation is performed in an operating room under general anesthesia. Computerized mapping techniques are combined with a cold probe to destroy arrhythmia-causing tissue. Ablation is generally successful. When ablation is used for atrial fibrillation, it is usually followed by implantation of a pacemaker as well as drug therapy.

A pacemaker is a battery-powered device about the size of a matchbox that is surgically implanted near the collarbone to regulate the heart beat. Lead wires threaded to the right side of the heart supply electrical energy to pace the atria and ventricles. The implantable cardioverter defibrillator is a treatment for serious arrhythmias. The battery-powered device senses an abnormal heart rhythm and automatically provides electrical shock(s). The shock(s) suspends heart activity and then allows the heart to initiate a normal rhythm. Wire electrodes on the device are attached to the heart. Some of the electrodes are attached to the outside of the heart and some are attached to the inside of the heart through veins. The newest implantable cardioverter defibrillators can be implanted in the chest wall and do not require open chest surgery. These devices weigh less than 10 oz and generally last seven or eight years. An implantable cardioverter defibrillator is usually used with drug therapy, but the amount medication is reduced. In maze surgery, often the last resort, surgeons create a maze of stitches (sutures) that help the heart's electrical impulses travel effectively.

Most of the drugs used for treatment have potential side effects and should be carefully monitored by a doctor. The goal of treatment is to control the rate

and rhythm of the heart and to prevent the formation of blood clots. If the arrhythmia is caused by heart disease, the heart disease will also be treated. The American Heart Association recommends aggressive treatment.

A digitalis drug, most commonly digoxin, is usually prescribed to control the heart rate. **Digitalis drugs** slow the heart's electrical impulses, helping to restore the normal rate and rhythm. These drugs also increase the ability of the heart's muscular layer to contract and pump properly. Beta-blockers and **calcium channel blockers** can also be used for this purpose. Beta-blockers slow the speed of electrical impulses through the heart. Some calcium channel blockers dampen the heart's response to erratic electrical impulses.

To prevent blood clots, **aspirin** or warfarin (Coumadin) is administered. Warfarin, however, has potential bleeding side effects, especially in older patients. Amiodarone is fairly effective for atrial flutter. This drug is often able to maintain the heart's proper rhythm and can also help control the heart rate when the flutter occurs.

Prognosis

Patients with atrial fibrillation and flutter can live a normal life for many years as long as the arrhythmia is controlled and serious blood clots are prevented.

Prevention

Atrial fibrillation and flutter can sometimes be prevented when the cause can be identified and controlled. Depending on the cause, prevention could include:

- treating the underlying heart disease
- reducing stress and anxiety
- reducing or stopping consumption of caffeine, alcohol, or tobacco; and/or
- discontinuing diet pills or other medications (over-the-counter or prescription)

Resources

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KEY TERMS

Arrhythmia—A variation in the normal rhythm of the heart beat. Atrial fibrillation and flutter are two types of arrhythmia.

Atria—The two small upper chambers of the heart that receive blood from the lungs and the body.

Stroke—A brain attack caused by a sudden disruption of blood flow to the brain, in this case because of a blood clot.

Ventricles—The two large lower chambers of the heart that pump blood to the lungs and to the rest of the body.

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American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <<http://www.americanheart.org>>.

National Heart, Lung and Blood Institute. PO Box 30105, Bethesda, MD 20824-0105. (301) 251-1222. <<http://www.nhlbi.nih.gov>>.

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Lori De Milto

Atrial flutter see **Atrial fibrillation and flutter**

Atrial septal defect

Definition

An atrial septal defect is an abnormal opening in the wall separating the left and right upper chambers (atria) of the heart.

Description

During the normal development of the fetal heart, there is an opening in the wall (the septum) separating the left and right upper chambers of the heart. Normally, this opening closes before birth, but if it does not, the child is born with a hole between the left and right atria. This abnormal opening is called an atrial septal defect and causes blood from the left atrium to flow into the right atrium.

Different types of atrial septal defects can occur, and they are classified according to where in the separating wall they are found. The most commonly found atrial septal defect occurs in the middle of the atrial septum and accounts for about 70% of all atrial septal defects. Abnormal openings can form in the upper and lower parts of the atrial septum as well.

Causes and symptoms

Abnormal openings in the atrial septum occur during fetal development and are twice as common in females as in males. These abnormalities can go unnoticed if the opening is small, producing no abnormal symptoms. If the defect is big, large amounts of blood flowing from the left to the right atrium will cause the right atrium to swell to hold the extra blood.

People born with an atrial septal defect can have no symptoms through their twenties, but by age 40, most people with this condition have symptoms that can include **shortness of breath**, rapid abnormal beating of the atria (atrial fibrillation), and eventually **heart failure**.

Diagnosis

Atrial septal defects can be identified by various methods. Abnormal changes in the sound of the heart beats can be heard when a doctor listens to the heart with a stethoscope. In addition, a **chest x ray**, an electrocardiogram (ECG, an electrical printout of the heartbeats), and an echocardiogram (a test that uses sound waves to form a detailed image of the heart) can also be used to identify this condition.

An atrial septal defect can also be diagnosed by using a test called **cardiac catheterization**. This test involves

KEY TERMS

Cardiac catheterization—A test that involves having a tiny tube inserted into the heart through a blood vessel.

Dacron—A synthetic polyester fiber used to surgically repair damaged sections of heart muscle and blood vessel walls.

Echocardiogram—A test that uses sound waves to generate an image of the heart, its valves, and chambers.

inserting a very thin tube (catheter) into the heart's chambers to measure the amount of oxygen present in the blood within the heart. If the heart has an opening between the atria, oxygen-rich blood from the left atrium enters the right atrium. Through cardiac catheterization, doctors can detect the higher-than-normal amount of oxygen in the heart's right atrium, right ventricle, and the large blood vessels that carry blood to the lungs, where the blood would normally subsequently get its oxygen.

Treatment

Atrial septal defects often correct themselves without medical treatments by the age of two. If this does not happen, surgery is done by sewing the hole closed, or by sewing a patch of Dacron material or a piece of the sac that surrounds the heart (the pericardium), over the opening.

Some patients can have the defect fixed by having an clam-shaped plug placed over the opening. This plug is a man-made device that is put in place through a catheter inserted into the heart.

Prognosis

Individuals with small defects can live a normal life, but larger defects require surgical correction. Less than 1% of people younger than 45 years of age die from corrective surgery. Five to ten percent of patients can die from the surgery if they are older than 40 and have other heart-related problems. When an atrial septal defect is corrected within the first 20 years of life, there is an excellent chance for the individual to live normally.

Resources

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ORGANIZATIONS

American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <<http://www.americanheart.org>>.

Dominic De Bellis, PhD

Atrioventricular block see **Heart block**

Attapulgite see **Antidiarrheal drugs**

Attention-deficit/hyperactivity disorder (ADHD)

Definition

Attention-deficit/hyperactivity disorder (ADHD) is a developmental disorder characterized by distractibility, hyperactivity, impulsive behaviors, and the inability to remain focused on tasks or activities.

Description

ADHD, also known as hyperkinetic disorder (HKD) outside of the United States, is estimated to affect 3-9% of children, and afflicts boys more often than girls. Although difficult to assess in infancy and toddlerhood, signs of ADHD may begin to appear as early as age two or three, but the symptom picture changes as adolescence approaches. Many symptoms, particularly hyperactivity, diminish in early adulthood, but impulsivity and inattention problems remain with up to 50% of ADHD individuals throughout their adult life.

Children with ADHD have short attention spans, becoming easily bored and/or frustrated with tasks. Although they may be quite intelligent, their lack of focus frequently results in poor grades and difficulties in school. ADHD children act impulsively, taking action first and thinking later. They are constantly moving, running, climbing, squirming, and fidgeting, but often have trouble with gross and fine motor skills and, as a result, may be

physically clumsy and awkward. Their clumsiness may extend to the social arena, where they are sometimes shunned due to their impulsive and intrusive behavior.

Causes and symptoms

The causes of ADHD are not known. However, it appears that heredity plays a major role in the development of ADHD. Children with an ADHD parent or sibling are more likely to develop the disorder themselves. Before birth, ADHD children may have been exposed to poor maternal **nutrition**, viral infections, or maternal substance abuse. In early childhood, exposure to lead or other toxins can cause ADHD-like symptoms. Traumatic brain injury or neurological disorders may also trigger ADHD symptoms. Although the exact cause of ADHD is not known, an imbalance of certain neurotransmitters, the chemicals in the brain that transmit messages between nerve cells, is believed to be the mechanism behind ADHD symptoms.

A widely publicized study conducted by Dr. Ben Feingold in the early 1970s suggested that **allergies** to certain foods and food additives caused the characteristic hyperactivity of ADHD children. Although some children may have adverse reactions to certain foods that can affect their behavior (for example, a rash might temporarily cause a child to be distracted from other tasks), carefully controlled follow-up studies have uncovered no link between food allergies and ADHD. Another popularly held misconception about food and ADHD is that the consumption of sugar causes hyperactive behavior. Again, studies have shown no link between sugar intake and ADHD. It is important to note, however, that a nutritionally balanced diet is important for normal development in *all* children.

Psychologists and other mental health professionals typically use the criteria listed in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* as a guideline for determining the presence of ADHD. For a diagnosis of ADHD, *DSM-IV* requires the presence of at least six of the following symptoms of inattention, or six or more symptoms of hyperactivity and impulsivity combined:

Inattention:

- fails to pay close attention to detail or makes careless mistakes in schoolwork or other activities
- has difficulty sustaining attention in tasks or activities
- does not appear to listen when spoken to
- does not follow through on instructions and does not finish tasks
- has difficulty organizing tasks and activities

- avoids or dislikes tasks that require sustained mental effort (e.g., homework)
- is easily distracted
- is forgetful in daily activities

Hyperactivity:

- fidgets with hands or feet or squirms in seat
- does not remain seated when expected to
- runs or climbs excessively when inappropriate (in adolescence and adults, feelings of restlessness)
- has difficulty playing quietly
- is constantly on the move
- talks excessively

Impulsivity:

- blurts out answers before the question has been completed
- has difficulty waiting for his or her turn
- interrupts and/or intrudes on others

DSM-IV also requires that some symptoms develop before age seven, and that they significantly impair functioning in two or more settings (e.g., home and school) for a period of at least six months. Children who meet the symptom criteria for inattention, but not for hyperactivity/impulsivity are diagnosed with Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type, commonly called ADD. (Young girls with ADHD may not be diagnosed because they have mainly this subtype of the disorder.)

Diagnosis

The first step in determining if a child has ADHD is to consult with a pediatrician. The pediatrician can make an initial evaluation of the child's developmental maturity compared to other children in his or her age group. The physician should also perform a comprehensive **physical examination** to rule out any organic causes of ADHD symptoms, such as an overactive thyroid or vision or hearing problems.

If no organic problem can be found, a psychologist, psychiatrist, neurologist, neuropsychologist, or learning specialist is typically consulted to perform a comprehensive ADHD assessment. A complete medical, family, social, psychiatric, and educational history is compiled from existing medical and school records and from interviews with parents and teachers. Interviews may also be conducted with the child, depending on his or her age. Along with these interviews, several clinical inventories may also be used, such as the Conners Rating Scales (Teacher's Questionnaire and Parent's Ques-

Drugs Used To Treat ADHD

Brand Name (Generic Name)	Possible Common Side Effects Include:
Cylert (pemoline)	Insomnia
Dexedrine (dextroamphetamine sulfate)	Excessive stimulation, restlessness
Ritalin (methylphenidate hydrochloride)	Insomnia, nervousness, loss of appetite

tionnaire), Child Behavior Checklist (CBCL), and the Achenbach Child Behavior Rating Scales. These inventories provide valuable information on the child's behavior in different settings and situations. In addition, the Wender Utah Rating Scale has been adapted for use in diagnosing ADHD in adults.

It is important to note that mental disorders such as depression and **anxiety** disorder can cause symptoms similar to ADHD. A complete and comprehensive psychiatric assessment is critical to differentiate ADHD from other possible mood and behavioral disorders. **Bipolar disorder**, for example, may be misdiagnosed, as ADHD.

Public schools are required by federal law to offer free ADHD testing upon request. A pediatrician can also provide a referral to a psychologist or pediatric specialist for ADHD assessment. Parents should check with their insurance plans to see if these services are covered.

Treatment

Psychosocial therapy, usually combined with medications, is the treatment approach of choice to alleviate ADHD symptoms. Psychostimulants, such as dextroamphetamine (Dexedrine), pemoline (Cylert), and methylphenidate (Ritalin) are commonly prescribed to control hyperactive and impulsive behavior and increase attention span. They work by stimulating the production of certain neurotransmitters in the brain. Possible side effects of stimulants include nervous tics, irregular heartbeat, loss of appetite, and **insomnia**. However, the medications are usually well-tolerated and safe in most cases.

In children who don't respond well to stimulant therapy, tricyclic antidepressants such as desipramine (Norpramin, Pertofane) and amitriptyline (Elavil) are frequently recommended. Reported side effects of these drugs include persistent **dry mouth**, **sedation**, disorientation, and cardiac arrhythmia (particularly with desipramine). Other medications prescribed for ADHD therapy include bupropion (Wellbutrin), an antidepressant; fluoxetine (Prozac), an SSRI antidepressant; and carbamazepine (Tegretol, Atretol), an anticonvulsant drug. Clonidine (Catapres), an antihypertensive medication, has also been used to control aggression and hyper-

activity in some ADHD children, although it should not be used with Ritalin. A child's response to medication will change with age and maturation, so ADHD symptoms should be monitored closely and prescriptions adjusted accordingly.

Behavior modification therapy uses a reward system to reinforce good behavior and task completion and can be implemented both in the classroom and at home. A tangible reward such as a sticker may be given to the child every time he completes a task or behaves in an acceptable manner. A chart system may be used to display the stickers and visually illustrate the child's progress. When a certain number of stickers are collected, the child may trade them in for a bigger reward such as a trip to the zoo or a day at the beach. The reward system stays in place until the good behavior becomes ingrained.

A variation of this technique, **cognitive-behavioral therapy**, works to decrease impulsive behavior by getting the child to recognize the connection between thoughts and behavior, and to change behavior by changing negative thinking patterns.

Individual psychotherapy can help an ADHD child build self-esteem, give them a place to discuss their worries and anxieties, and help them gain insight into their behavior and feelings. **Family therapy** may also be beneficial in helping family members develop coping skills and in working through feelings of guilt or anger parents may be experiencing.

ADHD children perform better within a familiar, consistent, and structured routine with positive reinforcements for good behavior and real consequences for bad. Family, friends, and caretakers should all be educated on the special needs and behaviors of the ADHD child. Communication between parents and teachers is especially critical to ensuring an ADHD child has an appropriate learning environment.

Alternative treatment

A number of alternative treatments exist for ADHD. Although there is a lack of controlled studies to prove their efficacy, proponents report that they are successful in controlling symptoms in some ADHD patients. Some of the more popular alternative treatments include:

KEY TERMS

Conduct disorder—A behavioral and emotional disorder of childhood and adolescence. Children with a conduct disorder act inappropriately, infringe on the rights of others, and violate societal norms.

Nervous tic—A repetitive, involuntary action, such as the twitching of a muscle or repeated blinking.

Oppositional defiant disorder—A disorder characterized by hostile, deliberately argumentative, and defiant behavior towards authority figures.

- EEG (electroencephalograph) **biofeedback**. By measuring brainwave activity and teaching the ADHD patient which type of brainwave is associated with attention, EEG biofeedback attempts to train patients to generate the desired brainwave activity.
- Dietary therapy. Based in part on the Feingold food allergy diet, dietary therapy focuses on a nutritional plan that is high in protein and complex carbohydrates and free of white sugar and salicylate-containing foods such as strawberries, tomatoes, and grapes.
- Herbal therapy. Herbal therapy uses a variety of natural remedies to address the symptoms of ADHD, such as ginkgo (*Ginkgo biloba*) for memory and mental sharpness and chamomile (*Matricaria recutita*) extract for calming. The safety of herbal remedies has not been demonstrated in controlled studies. For example, it is known that ginkgo may affect blood coagulation, but controlled studies have not yet evaluated the risk of the effect.
- Homeopathic medicine. This is probably the most effective alternative therapy for ADD and ADHD because it treats the whole person at a core level. Constitutional homeopathic care is most appropriate and requires consulting with a well-trained homeopath who has experience working with ADD and ADHD individuals.

Prognosis

Untreated, ADHD negatively affects a child's social and educational performance and can seriously damage his or her sense of self-esteem. ADHD children have impaired relationships with their peers, and may be looked upon as social outcasts. They may be perceived as slow learners or troublemakers in the classroom. Siblings and even parents may develop resentful feelings towards the ADHD child.

Some ADHD children also develop a **conduct disorder** problem. For those adolescents who have both ADHD and a conduct disorder, up to 25% go on to develop antisocial personality disorder and the criminal behavior, substance abuse, and high rate of suicide attempts that are symptomatic of it. Children diagnosed with ADHD are also more likely to have a learning disorder, a mood disorder such as depression, or an anxiety disorder.

Approximately 70-80% of ADHD patients treated with stimulant medication experience significant relief from symptoms, at least in the short-term. Approximately half of ADHD children seem to "outgrow" the disorder in adolescence or early adulthood; the other half will retain some or all symptoms of ADHD as adults. With early identification and intervention, careful compliance with a treatment program, and a supportive and nurturing home and school environment, ADHD children can flourish socially and academically.

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- Children and Adults with Attention Deficit Disorder (CH.A.D.D.). 8181 Professional Place, Suite 201, Plantation, FL 33317. (800) 233-4050. <<http://www.chadd.org>>.



An audiologist conducting a hearing test. (Custom Medical Stock Photo. Reproduced by permission.)

The National Attention Deficit Disorder Association. (ADDA).
9930 Johnnycake Ridge Road, Suite 3E, Mentor, OH
44060. (800) 487-2282. <<http://www.add.org>>.

Paula Anne Ford-Martin

Attention deficit disorder see **Attention-deficit/Hyperactivity disorder (ADHD)**

Atypical mycobacterial infections see **Mycobacterial infections, atypical**

Atypical pneumonia see **Mycoplasma infections**

Audiometry

Definition

Audiometry is the testing of a person's ability to hear various sound frequencies. The test is performed with the use of electronic equipment called an audiometer. This testing is usually administered by a trained technician called an audiologist.

Purpose

Audiometry testing is used to identify and diagnose **hearing loss**. The equipment is used in health screening programs, for example in grade schools, to detect hearing problems in children. It is also used in the doctor's office or hospital audiology department to diagnose hearing problems in children, adults, and the elderly. With correct diagnosis of a person's specific pattern of hearing impairment,

the right type of therapy, which might include **hearing aids**, corrective surgery, or speech therapy, can be prescribed.

Precautions

Testing with audiometry equipment is simple and painless. No special precautions are required.

Description

A trained audiologist (a specialist in detecting hearing loss) uses an audiometer to conduct audiometry testing. This equipment emits sounds or tones, like musical notes, at various frequencies, or pitches, and at differing volumes or levels of loudness. Testing is usually done in a soundproof testing room.

The person being tested wears a set of headphones that blocks out other distracting sounds and delivers a test tone to one ear at a time. At the sound of a tone, the patient holds up a hand or finger to indicate that the sound is detected. The audiologist lowers the volume and repeats the sound until the patient can no longer detect it. This process is repeated over a wide range of tones or frequencies from very deep, low sounds, like the lowest note played on a tuba, to very high sounds, like the ping-pong of a triangle. Each ear is tested separately. It is not unusual for levels of sensitivity to sound to differ from one ear to the other.

A second type of audiometry testing uses a headband rather than headphones. The headband is worn with small plastic rectangles that fit behind the ears to conduct sound through the bones of the skull. The patient being tested senses the tones that are transmitted as vibrations through the bones to the inner ear. As with the headphones, the tones are repeated at various frequencies and volumes.

The results of the audiometry test may be recorded on a grid or graph called an audiogram. This graph is generally set up with low frequencies or tones at one end and high ones at the other end, much like a piano keyboard. Low notes are graphed on the left and high notes on the right. The graph also charts the volume of the tones used; from soft, quiet sounds at the top of the chart to loud sounds at the bottom. Hearing is measured in units called decibels. Most of the sounds associated with normal speech patterns are generally spoken in the range of 20-50 decibels. An adult with normal hearing can detect tones between 0-20 decibels.

Speech audiometry is another type of testing that uses a series of simple recorded words spoken at various volumes into headphones worn by the patient being tested. The patient repeats each word back to the audiologist as it is heard. An adult with normal hearing will be able to recognize and repeat 90-100% of the words.

KEY TERMS

Audiogram—A chart or graph of the results of a hearing test conducted with audiographic equipment. The chart reflects the softest (lowest volume) sounds that can be heard at various frequencies or pitches.

Decibel—A unit of measure for expressing the loudness of a sound. Normal speech is typically spoken in the range of about 20-50 decibels.

Otoscope—A hand-held instrument with a tiny light and a funnel-shaped attachment called an ear speculum, which is used to examine the ear canal and eardrum.

Preparation

The ears may be examined with an otoscope prior to audiometry testing to determine if there are any blockages in the ear canal due to ear wax or other material.

Normal results

A person with normal hearing will be able to recognize and respond to all of the tone frequencies administered at various volumes in both ears by the audiometry test. An adult with normal hearing can detect a range of low and high pitched sounds that are played as softly as between nearly 0-20 decibels. Normal speech is generally spoken in the range of 20-50 decibels.

Abnormal results

Audiometry test results are considered abnormal if there is a significant or unexplained difference between the levels of sound heard between the two ears, or if the person being tested is unable to hear in the normal range of frequencies and volume. The pattern of responses displayed on the audiogram can be used by the audiologist to identify if a significant hearing loss is present and if the patient might benefit from hearing aids or corrective surgery.

Resources

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American Academy of Audiology. 8201 Greensboro Drive, Suite 300, McLean, VA 22102. (703) 610-9022. <<http://audiology.org>>.

Audiology Awareness Campaign. 3008 Millwood Ave., Columbia, SC 29205. (800) 445-8629.

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Altha Roberts Edgren

Auditory integration training

Definition

Auditory integration training, or AIT, is one specific type of music/auditory therapy based upon the work of French otolaryngologists Dr. Alfred Tomatis and Dr. Guy Berard.

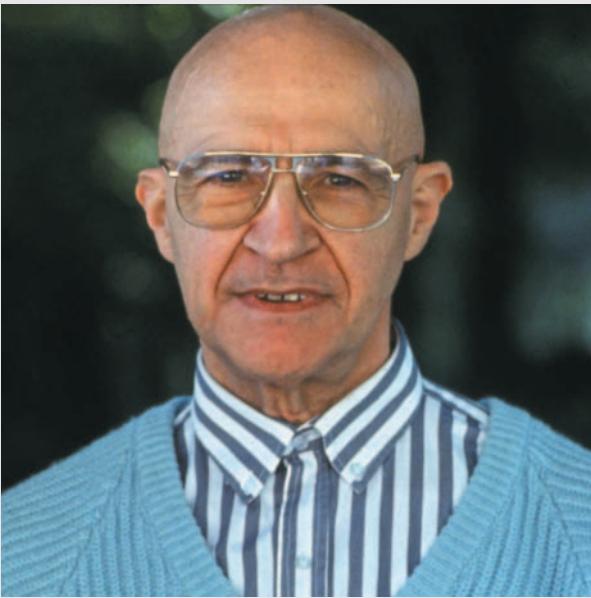
Origins

The premise upon which most auditory integration programs are based is that distortion in how things are heard contributes to commonly seen behavioral or learning disorders in children. Some of these disorders include **attention deficit/hyperactive disorder (ADHD)**, **autism**, dyslexia, and central auditory processing disorders (CAPD). Training the patient to listen can stimulate central and cortical organization.

Auditory integration is one facet of what audiologists call central auditory processing. The simplest definition of central auditory processing, or CAP, is University of Buffalo Professor of Audiology Jack Katz’s, which is: “What we do with what we hear.” Central auditory integration is actually the perception of sound, including the ability to attend to sound, to remember it, retaining it in both the long- and short-term memory, to be able to listen to sound selectively, and to localize it.

Guy Berard developed one of the programs commonly used. Berard’s auditory integration training consists of twenty half-hour sessions spent listening to musical sounds via a stereophonic system. The music is random, with filtered frequencies, and the person listens through earphones. These sound waves vibrate and exercise structures in the middle ear. This is normally done in sessions twice a day for 10 days.

ALFRED TOMATIS (1920–)



(Photograph by V. Brynner. Gamma Liaison. Reproduced by permission.)

Internationally renowned French otolaryngologist, psychologist, educator and inventor Alfred Tomatis perceived the importance of sound and hearing early in his career. He took his degree as a Doctor of Medicine from the University of Paris and specialized in ear, nose and throat medicine. The son of two opera singers, Tomatis

early in his career treated some of his parents' fellow opera singers. From these experiences with the sound of music, he developed the principle that has come to be known as the Tomatis Effect, i.e. that the human voice can only sing what it hears.

Tomatis has been called the Einstein of the ear. It was his research that made the world aware that the ears of an infant in utero are already functioning at four and half months of age. Just as the umbilical cord provides nourishment to the unborn infant's body, Tomatis postulated that the sound of the mother's voice is also a nutrient heard by the fetus. This sound literally charges and stimulates the growth of the brain.

Tomatis took this further, into the realm of language. Tomatis concluded that the need to communicate and to be understood are among our most basic needs. He was a pioneer in perceiving that language problems convert into social problems for people. "Language is what characterizes man and makes him different from other creatures," Tomatis is quoted as saying. The techniques he developed to teach people how to listen effectively are internationally respected tools used in the treatment of autism, attention-deficit disorder, and other learning disabilities.

His listening program, the invention of the Electronic Ear, and his work with the therapeutic use of sound and music for the past fifty years have made Tomatis arguably the best known and most successful ear specialist in the world. There are more than two hundred Tomatis Centers worldwide, treating a vast variety of problems related to the ability to hear.

Alfred Tomatis is also the inventor of the Electronic Ear. This device operates through a series of filters, and reestablishes the dominance of the right ear in hearing. The basis of Tomatis' work is a series of principles that follow:

- The most important purpose of the ear is to adapt sound waves into signals that charge the brain.
- Sound is conducted via both air and bone. It can be considered something that nourishes the nervous system, either stimulating or destimulating it.
- Just as seeing is not the same as looking, hearing is not the same as listening. Hearing is passive. Listening is active.
- A person's ability to listen affects all language development for that person. This process influences every aspect of self-image and social development.
- The capacity to listen can be changed or improved through auditory stimulation using musical and vocal sounds at high frequencies.

- Communication begins in the womb. As early as the beginning of the second trimester, fetuses can hear sounds. These sounds literally cause the brain and nervous system of the baby to develop.

Description

A quartet of CAP defects have been identified that can unfavorably alter how each person processes sound. Among these are:

- Phonetic decoding, a problem that occurs when the brain incorrectly decodes what is being heard. Sounds are unrecognizable, often because the person speaking talks too fast.
- Tolerance-fading memory, a condition with little or poor tolerance for background sounds.
- Auditory integration involves a person's ability to put together things heard with things seen. Characteristically,

ly there are long response delays and trouble with phonics, or recognizing the symbols for sounds.

- The fourth problem area, often called auditory organization, overlaps the previous three. It is characterized by disorganization in handling auditory and other information.

Certain audiological tests are carried out to see if the person has a CAP problem, and if so, how severe it is. Other tests give more specific information regarding the nature of the CAP problem. They include:

- Puretone air-conduction threshold testing, which measures peripheral hearing loss. If loss is found, then bone-conduction testing, or evaluation of the vibration of small bones in the inner ear, is also carried out.
- Word discrimination scores (WDS) determines a person's clarity in hearing ideal speech. This is done by presenting 25–50 words at 40 decibels above the person's average sound threshold in each ear. Test scores equal the percentage of words heard correctly.
- Immittance testing is made up of two parts, assessing the status of, and the protective mechanisms of the middle ear.
- Staggered sporadic word (SSW) testing delivers 40 compound words in an overlapping way at 50 decibels above threshold to each ear of the person being tested. This test provides expanded information that makes it possible to break down CAP problems into the four basic types.
- Speech in noise discrimination (SN) testing is similar to Staggered Sporadic Word testing except that other noise is also added and the percentage correct in quiet is compared with that correct when there is added noise.
- Phonemic synthesis (PS) determines serious learning problems. The types of errors made in sounding out written words or associating written letters with the sounds they represent help in determining the type and severity of CAP problems.

Purpose

Upon completion of an auditory integration training program, the person's hearing should be capable of perceiving all frequencies at, or near, the same level. Total improvement from this therapy, in both hearing and behavior, can take up to one year.

Research and general acceptance

Auditory integration training is based upon newly learned information about the brain. Though brain structures and connections are predetermined, probably by

heredity, another factor called *plasticity* also comes into play. Learning, we now know, continues from birth to death. Plasticity is the ability of the brain to actually change its structuring and connections through the process of learning.

Problems with auditory processing are now viewed as having a wide-reaching ripple effect on our society. It is estimated that 30–40% of children starting school have language-learning skills that can be described as poor. CAP difficulties are a factor in several different learning disabilities. They affect not only academic success, but also nearly every aspect of societal difficulties. One example to illustrate this is a 1989 University of Buffalo study where CAP problems were found to be present in a surprising 97% of youth inmates in an upstate New York corrections facility.

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Joan Schonbeck

Australia antigen-associated hepatitis see
Hepatitis B

Autism

Definition

Autism is a severe disorder of brain function marked by problems with social contact, intelligence and lan-

guage, together with ritualistic or compulsive behavior and bizarre responses to the environment.

Description

Autism is a lifelong disorder that interferes with the ability to understand what is seen, heard, and touched. This can cause profound problems in personal behavior and in the ability to relate to others. A person with autism must learn how to communicate normally and how to relate to people, objects and events. However, not all patients suffer the same degree of impairment. There is a full spectrum of symptoms, which can range from mild to severe.

Autism occurs in as many as one or two per 1,000 children. It is found four times more often in boys (usually the first-born) and occurs around the world in all races and social backgrounds. Autism usually is evident in the first three years of life, although in some children it's hard to tell when the problem develops. Sometimes the condition isn't diagnosed until the child enters school.

While a person with autism can have symptoms ranging from mild to severe, about 10% have an extraordinary ability in one area, such as in mathematics, memory, music, or art. Such children are known as "autistic savants" (formerly known as "idiot savants".).

Causes and symptoms

Autism is a brain disorder that affects the way the brain uses or transmits information. Studies have found abnormalities in several parts of the brain that almost certainly occurred during fetal development. The problem may be centered in the parts of the brain responsible for processing language and information from the senses.

There appears to be a strong genetic basis for autism. Identical twins are more likely to both be affected than twins who are fraternal (not genetically identical). In a family with one autistic child, the chance of having another child with autism is about 1 in 20, much higher than in the normal population. Sometimes, relatives of an autistic child have mild behaviors that look very much like autism, such as repetitive behaviors and social or communication problems. Research also has found that some emotional disorders (such as manic depression) occur more often in families of a child with autism.

At least one group of researchers has found a link between an abnormal gene and autism. The gene may be just one of at least three to five genes that interact in some way to cause the condition. Scientists suspect that a faulty gene or genes might make a person vulnerable to develop autism in the presence of other factors, such as a

chemical imbalance, viruses or chemicals, or a lack of oxygen at birth.

In a few cases, autistic behavior is caused by a disease such as:

- **rubella** in the pregnant mother
- tuberous sclerosis
- **fragile X syndrome**
- encephalitis
- untreated **phenylketonuria**.

The severity of the condition varies between individuals, ranging from the most severe (extremely unusual, repetitive, self- injurious, and aggressive behavior) to very mild, resembling a personality disorder with some learning disability.

Profound problems with social interaction are the most common symptoms of autism. Infants with the disorder won't cuddle; they avoid eye contact and don't seem to want or need physical contact or affection. They may become rigid or flaccid when they are held, cry when picked up, and show little interest in human contact. Such a child doesn't smile or lift his arms in anticipation of being picked up. He forms no attachment to parents nor shows any normal **anxiety** toward strangers. He doesn't learn typical games of childhood, such as peek-a-boo.

Language problems

The child with autism may not speak at all; if he does, it is often in single words. He may endlessly repeat words or phrases that are addressed to him and may reverse pronouns ("You go sleep" instead of "I want to go to sleep").

Restricted interests and activity

Usually a child with autism has many problems playing normally. He probably won't act out adult roles during play time, and instead of enjoying fantasy play, he may simply repeatedly mimic the actions of someone else. Bizarre behavior patterns are very common among autistic children and may include complex rituals, screaming fits, rhythmic rocking, arm flapping, finger twiddling, and crying without tears. Autistic children may play with their own saliva, feces or urine. They may be self-destructive, biting their own hands, gouging at their eyes, pulling their hair, or banging their head.

Sensory problems

The sensory world poses a real problem to many autistic children, who seem overwhelmed by their own senses. A child with autism may ignore objects or



This autistic child is encouraged to interact with the guinea pig in an effort to improve his social interaction. (*Helen B. Senisi. Photo Researchers, Inc. Reproduced by permission.*)

become obsessed with them, continually watching the object or the movement of his fingers over it. Many of these children may react to sounds by banging their head or flapping fingers. Some high-functioning autistic adults who have written books about their childhood experiences report that sounds were often excruciatingly painful to them, forcing them to withdraw from their environment or try to cope by withdrawing into their own world of sensation and movement.

Intellectual problems

Most autistic children appear to be moderately mentally retarded. They may giggle or cry for no reason, have no fear of real danger, but exhibit terror of harmless objects.

Diagnosis

There is no medical test for autism. Because the symptoms of autism are so varied, the condition may go undiagnosed for some time (especially in those with mild cases or if other handicaps are also present). It may be confused with other diseases, such as fragile X syndrome, tuberous sclerosis, and untreated phenylketonuria.

Autism is diagnosed by observing the child's behavior, communication skills, and social interactions. Medical tests should rule out other possible causes of autistic symptoms. Criteria that mental health experts use to diagnose autism include:

- problems with developing friendships
- problems with make-believe or social play
- endlessly repeated words or strings of words
- difficulty in carrying on a conversation
- obsessions with rituals or restricted patterns
- preoccupation with parts of objects

Some children have a few of the symptoms of autism, but not enough to be diagnosed with the "classical" form of the condition. Children who have autistic behavior but no problems with language may be diagnosed with "Asperger syndrome." Children who seem normal at first but who begin to show autistic behavior as they get older might be diagnosed with "childhood disintegrative disorder" (CDD). These problems are sometimes called "autistic spectrum disorders." It is also important to rule out other problems that seem similar to autism.

KEY TERMS

Antidepressants—A type of medication that is used to treat depression; it is also sometimes used to treat autism.

Asperger syndrome—Children who have autistic behavior but no problems with language.

Encephalitis—A rare inflammation of the brain caused by a viral infection. It has been linked to the development of autism.

Fragile X syndrome—A genetic condition related to the X chromosome that affects mental, physical and sensory development.

Major tranquilizers—The family of drugs that includes the psychotropic or neuroleptic drugs, sometimes used to help autistic people. They carry significant risk of side effects, including Parkinsonism and movement disorders, and should be prescribed with caution.

Opiate blockers—A type of drug that blocks the

effects of natural opiates in the system. This makes some people, including some people with autism, appear more responsive to their environment.

Phenylketonuria (PKU)—An enzyme deficiency present at birth that disrupts metabolism and causes brain damage. This rare inherited defect may be linked to the development of autism.

Rubella—Also known as German measles. When a woman contracts rubella during pregnancy, her developing infant may be damaged. One of the problems that may result is autism.

Stimulants—A class of drugs, including Ritalin, used to treat people with autism. They may make children calmer and better able to concentrate, but they also may limit growth or have other side effects.

Tuberous sclerosis—A genetic disease that causes skin problems, seizures, and mental retardation. It may be confused with autism.

Treatment

There is no cure for autism. Treatments are aimed at reducing specific symptoms. Because the symptoms vary so widely from one person to the next, there is not a single approach that works for every person. A spectrum of interventions include training in music, listening, vision, speech and language, and senses. Special diets and medications may also be prescribed.

Studies show that people with autism can improve significantly with proper treatment. A child with autism can learn best with special teachers in a structured program that emphasizes individual instruction. The two most-often studied types of treatment are:

Educational or behavioral treatment

Typically, behavioral techniques are used to help the child respond and decrease symptoms. This might include positive reinforcement (food and rewards) to boost language and social skills. This training includes structured, skill-oriented instruction designed to boost social and language abilities. Training needs to begin as early as possible, since early intervention appears to influence brain development.

Most experts believe that modern treatment is most effective when carried out at home, although treatment

may also take place in a psychiatric hospital, specialized school, or day care program.

Medication

No single medication has yet proved highly effective for the major features of autism. However, a variety of drugs can control self-injurious, aggressive, and other of the more difficult behaviors. Drugs also can control epilepsy, which afflicts up to 20% of people with autism.

Five types of drugs are sometimes prescribed to help the behavior problems of people with autism:

- stimulants, such as methylphenidate (Ritalin)
- antidepressants, such as fluoxetine (Prozac)
- opiate blockers, such as naltrexone (ReVia)
- antipsychotics
- tranquilizers

Today, most experts recommend a complex treatment regimen that begins early and continues through the teenage years. Behavioral therapies are used in conjunction with medications.

Alternative treatment

Many parents report success with megavitamin therapy. Some studies have shown that vitamin B₆ improves

eye contact and speech and lessens tantrum behavior. Vitamin B₆ causes fewer side effects than other medications and is considered safe when used in appropriate doses. However, not many health practitioners advocate its use in the treatment of autism, citing that the studies showing its benefit were flawed.

DMG (dimethylglycine)

This compound, available in many health food stores, is legally classified as a food, not a vitamin or drug. Some researchers claim that it improves speech in children with autism. Those who respond to this treatment will usually do so within a week. Again, many doctors do not feel that the studies are adequate to promote this treatment.

Exercise

One researcher found that vigorous **exercise** (20 minutes or longer, three or four days a week) seems to decrease hyperactivity, aggression, self-injury and other autistic symptoms.

Prognosis

While there is no cure, with appropriate treatment the negative behaviors of autism may improve. Earlier generations placed autistic children in institutions; today, even severely disabled children can be helped in a less restrictive environment to develop to their highest potential. Many can eventually become more responsive to others as they learn to understand the world around them, and some can lead nearly normal lives.

People with autism have a normal life expectancy. Some people with autism can handle a job; they do best with structured jobs that involve a degree of repetition.

Prevention

Until the cause of autism is discovered, prevention is not possible.

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Autism Network International. PO Box 448, Syracuse, NY 13210.

Autism Research Institute. 4182 Adams Ave., San Diego, CA 92116. (619) 281-7165.

National Autism Hotline. c/o Autism Services Center, PO Box 507, 605 Ninth St., Huntington, WV 25710. (304) 525-8014.

National Fragile X Foundation. PO Box 190488, San Francisco, CA 94119. (800) 688-8765. <<http://www.nfxf.org>>.

National Institute of Neurological Disorders and Stroke. PO Box 5801, Bethesda, MD 20824. (800) 352-9424. <<http://www.ninds.nih.gov/index.htm>>.

National Alliance for Autism Research. <naar@naar.org>.

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Carol A. Turkington

Autograft see **Skin grafting**

Autoimmune disorders

Definition

Autoimmune disorders are conditions in which a person's immune system attacks the body's own cells, causing tissue destruction.

Description

Autoimmunity is accepted as the cause of a wide range of disorders, and it is suspected to be responsible for many more. Autoimmune diseases are classified as either general, in which the autoimmune reaction takes place simultaneously in a number of tissues, or organ specific, in which the autoimmune reaction targets a single organ.

Autoimmune disorders include the following:

- **Systemic lupus erythematosus.** A general autoimmune disease in which antibodies attack a number of different tissues. The disease recurs periodically and is seen mainly in young and middle-aged women.
- **Rheumatoid arthritis.** Occurs when the immune system attacks and destroys the tissues that line bone joints and cartilage. The disease occurs throughout the body, although some joints may be more affected than others.
- **Goodpasture's syndrome.** Occurs when antibodies are deposited in the membranes of both the lung and kidneys, causing both inflammation of kidney glomerulus (**glomerulonephritis**) and lung bleeding. It is typically a disease of young males.
- **Grave's disease.** Caused by an antibody that binds to specific cells in the thyroid gland, causing them to make excessive amounts of thyroid hormone.
- **Hashimoto's thyroiditis.** Caused by an antibody that binds to cells in the thyroid gland. Unlike in Grave's disease, however, this antibody's action results in less thyroid hormone being made.
- **Pemphigus vulgaris.** A group of autoimmune disorders that affect the skin.
- **Myasthenia gravis.** A condition in which the immune system attacks a receptor on the surface of muscle cells, preventing the muscle from receiving nerve impulses and resulting in severe muscle weakness.
- **Scleroderma.** Also called CREST syndrome or progressive systemic sclerosis, scleroderma affects the connective tissue.
- **Autoimmune hemolytic anemia.** Occurs when the body produces antibodies that coat red blood cells.
- **Autoimmune thrombocytopenic purpura.** Disorder in which the immune system targets and destroys blood platelets.
- **Polymyositis and Dermatomyositis.** Immune disorders that affect the neuromuscular system.
- **Pernicious anemia.** Disorder in which the immune system attacks the lining of the stomach in such a way that the body cannot metabolize vitamin B₁₂.
- **Sjögren's syndrome.** Occurs when the exocrine glands are attacked by the immune system, resulting in excessive dryness.
- **Ankylosing spondylitis.** Immune system induced degeneration of the joints and soft tissue of the spine.
- **Vasculitis.** A group of autoimmune disorders in which the immune system attacks and destroys blood vessels.
- **Type I diabetes mellitus.** May be caused by an antibody that attacks and destroys the islet cells of the pancreas, which produce insulin.
- **Amyotrophic lateral sclerosis.** Also called Lou Gehrig's disease. An immune disorder that causes the **death** of neurons which leads to progressive loss of muscular control.
- **Guillain-Barre syndrome.** Also called infectious polyneuritis. Often occurring after an infection or an immunization (specifically Swine flu), the disease affects the myelin sheath, which coats nerve cells. It causes progressive muscle weakness and **paralysis**.
- **Multiple sclerosis.** An autoimmune disorder that may involve a virus affects the central nervous system, causing loss of coordination and muscle control.

Causes and symptoms

To further understand autoimmune disorders, it is helpful to understand the workings of the immune system. The purpose of the immune system is to defend the body against attack by infectious microbes (germs) and **foreign objects**. When the immune system attacks an invader, it is very specific—a particular immune system cell will only recognize and target one type of invader. To function properly, the immune system must not only develop this specialized knowledge of individual invaders, but it must also learn how to recognize and not destroy cells that belong to the body itself. Every cell carries protein markers on its surface that identifies it in one of two ways: what kind of cell it is (e.g. nerve cell, muscle cell, blood cell, etc.) and to whom that cell belongs. These markers are called major histocompatibility complexes (MHCs). When functioning properly, cells of the immune system will not attack any other cell with markers identifying it as belonging to the

body. Conversely, if the immune system cells do not recognize the cell as "self," they attach themselves to it and put out a signal that the body has been invaded, which in turn stimulates the production of substances such as antibodies that engulf and destroy the foreign particles. In case of autoimmune disorders, the immune system cannot distinguish between "self" cells and invader cells. As a result, the same destructive operation is carried out on the body's own cells that would normally be carried out on bacteria, viruses, and other such harmful entities.

The reasons why immune systems become dysfunctional in this way is not well understood. However, most researchers agree that a combination of genetic, environmental, and hormonal factors play into autoimmunity. Researchers also speculate that certain mechanisms may trigger autoimmunity. First, a substance that is normally restricted to one part of the body, and therefore not usually exposed to the immune system, is released into other areas where it is attacked. Second, the immune system may mistake a component of the body for a similar foreign component. Third, cells of the body may be altered in some way, either by drugs, infection, or some other environmental factor, so that they are no longer recognizable as "self" to the immune system. Fourth, the immune system itself may be damaged, such as by a genetic mutation, and therefore cannot function properly.

Symptoms

The symptoms of the above disorders include:

- Systemic lupus erythematosus. Symptoms include **fever**, **chills**, **fatigue**, weight loss, skin **rashes** (particularly the classic "butterfly" rash on the face), vasculitis, polyarthralgia, patchy hair loss, sores in the mouth or nose, lymph-node enlargement, gastric problems, and, in women, irregular periods. About half of those who suffer from lupus develop cardiopulmonary problems, and some may also develop urinary problems. Lupus can also effect the central nervous system, causing seizures, depression, and psychosis.
- Rheumatoid arthritis. Initially may be characterized by a low-grade fever, loss of appetite, weight loss, and a generalized **pain** in the joints. The joint pain then becomes more specific, usually beginning in the fingers, then spreading to other areas, such as the wrists, elbows, knees, and ankles. As the disease progresses, joint function diminishes sharply and deformities occur, particularly the characteristic "swan's neck" curling of the fingers.
- Goodpasture's syndrome. Symptoms are similar to that of **iron deficiency anemia**, including fatigue and pal-
- lor. Symptoms involving the lungs may range from a **cough** that produces bloody sputum to outright hemorrhaging. Symptoms involving the urinary system include blood in the urine and/or swelling.
- Grave's disease. This disease is characterized by an enlarged thyroid gland, weight loss without loss of appetite, sweating, heart **palpitations**, nervousness, and an inability to tolerate heat.
- Hashimoto's thyroiditis. This disorder generally displays no symptoms.
- Pemphigus vulgaris. This disease is characterized by blisters and deep lesions on the skin.
- Myasthenia gravis. Characterized by fatigue and muscle weakness that at first may be confined to certain muscle groups, but then may progress to the point of paralysis. Myasthenia gravis patients often have expressionless faces as well as difficulty chewing and swallowing. If the disease progresses to the respiratory system, artificial respiration may be required.
- Scleroderma. Disorder is usually preceded by Raynaud's phenomenon. Symptoms that follow include pain, swelling, and stiffness of the joints, and the skin takes on a tight, shiny appearance. The digestive system also becomes involved, resulting in weight loss, appetite loss, **diarrhea**, **constipation**, and distention of the abdomen. As the disease progresses, the heart, lungs, and kidneys become involved, and malignant **hypertension** causes death in approximately 30% of cases.
- Autoimmune hemolytic anemia. May be acute or chronic. Symptoms include fatigue and abdominal tenderness due to an enlarged spleen.
- Autoimmune thrombocytopenic purpura. Characterized by pinhead-size red dots on the skin, unexplained **bruises**, bleeding from the nose and gums, and blood in the stool.
- Polymyositis and Dermatomyositis. In polymyositis, symptoms include muscle weakness, particularly in the shoulders or pelvis, that prevents the patient from performing everyday activities. In dermatomyositis, the same muscle weakness is accompanied by a rash that appears on the upper body, arms, and fingertips. A rash may also appear on the eyelids, and the area around the eyes may become swollen.
- Pernicious anemia. Signs of pernicious anemia include weakness, sore tongue, bleeding gums, and tingling in the extremities. Because the disease causes a decrease in stomach acid, nausea, vomiting, loss of appetite, weight loss, diarrhea, and constipation are possible. Also, because Vitamin B_{12} is essential for the nervous system function, the deficiency of it brought on by the disease can result in a host of neu-

rological problems, including weakness, lack of coordination, blurred vision, loss of fine motor skills, loss of the sense of taste, ringing in the ears, and loss of bladder control.

- Sjögren's syndrome. Characterized by excessive dryness of the mouth and eyes.
- Ankylosing spondylitis. Generally begins with lower back pain that progresses up the spine. The pain may eventually become crippling.
- Vasculitis. Symptoms depend upon the group of veins affected and can range greatly.
- Type I diabetes mellitus. Characterized by fatigue and an abnormally high level of glucose in the blood (hyperglycemia).
- Amyotrophic lateral sclerosis. First signs are stumbling and difficulty climbing stairs. Later, muscle cramps and twitching may be observed as well as weakness in the hands making fastening buttons or turning a key difficult. Speech may become slowed or slurred. There may also be difficulty swallowing. As respiratory muscles atrophy, there is increased danger of aspiration or lung infection.
- Guillain-Barre syndrome. Muscle weakness in the legs occurs first, then the arms and face. Paresthesias (a prickly, tingling sensation) is also felt. This disorder affects both sides of the body and may involve paralysis and the muscles that control breathing.
- Multiple sclerosis. Like Lou Gehrig's disease, the first symptom may be clumsiness. Weakness or exhaustion is often reported, as well as blurry or double vision. There may be **dizziness**, depression, loss of bladder control, and muscle weakness so severe that the patient is confined to a wheelchair.

Diagnosis

A number of tests are involved in the diagnosis of autoimmune diseases, depending on the particular disease; e.g. blood tests, cerebrospinal fluid analysis, electromyogram (measures muscle function), and **magnetic resonance imaging** of the brain. Usually, these tests determine the location and extent of damage or involvement. They are useful in charting progress of the disease and as baselines for treatment.

The principle tool, however, for authenticating autoimmune disease is antibody testing. Such tests involve measuring the level of antibodies found in the blood and determining if they react with specific antigens that would give rise to an autoimmune reaction. An elevated amount of antibodies indicates that a humoral immune reaction is occurring. Since elevated antibody

levels are also seen in common infections, they must be ruled out as the cause for the increased antibody levels.

Antibodies can also be typed by class. There are five classes of antibodies, and they can be separated in the laboratory. The class IgG is usually associated with autoimmune diseases. Unfortunately, IgG class antibodies are also the main class of antibody seen in normal immune responses.

The most useful antibody tests involve introducing the patient's antibodies to samples of his or her own tissue, usually thyroid, stomach, liver, and kidney tissue. If antibodies bind to the "self" tissue, it is diagnostic for an autoimmune disorder. Antibodies from a person without an autoimmune disorder would not react to "self" tissue.

Treatment

Treatment of autoimmune diseases is specific to the disease, and usually concentrates on alleviating or preventing symptoms rather than correcting the underlying cause. For example, if a gland involved in an autoimmune reaction is not producing a hormone such as insulin, administration of that hormone is required. Administration of a hormone, however, will restore the function of the gland damaged by the autoimmune disease.

The other aspect of treatment is controlling the inflammatory and proliferative nature of the immune response. This is generally accomplished with two types of drugs. Steroid compounds are used to control inflammation. There are many different steroids, each having side effects. The proliferative nature of the immune response is controlled with immunosuppressive drugs. These drugs work by inhibiting the replication of cells and, therefore, also suppress non-immune cells leading to side effects such as anemia.

Systemic **enzyme therapy** is a new treatment that is showing results for rheumatoid arthritis, multiple sclerosis, ankylosing spondylitis, and other inflammatory diseases. Enzymes combinations of pancreatin, trypsin, chymotrypsin, bromelain, and papain help stimulate the body's own defenses, accelerate inflammation in order to reduce swelling and improve circulation, and break up the immune complexes within the bloodstream. Symptoms have been reduced using this treatment.

Other treatments that hold some promise are irradiation of the spleen and **gene therapy**. Splenic irradiation is touted to be a safe, alternative for patients with autoimmune blood diseases, especially autoimmune hemolytic anemia, or others with compromised immune systems, such as HIV patients and the elderly. It is reported to have few side effects and seems to be working. Cytokine

KEY TERMS

Autoantibody—An antibody made by a person that reacts with their own tissues.

Paresthesias—A prickly, tingling sensation.

and cytokine inhibitor genes injected directly into muscle tissue also appear to be effective in treating Type I diabetes mellitus, systemic lupus erythematosus, thyroditis, and arthritis.

Prognosis

Prognosis depends upon the pathology of each autoimmune disease.

Prevention

Most autoimmune diseases cannot be prevented. Though the mechanisms involved in how these diseases affect the body are known, it is still unclear why the body turns on itself. Since more women than men seem to be affected by some of these disorders (e.g. lupus), some researchers are looking into hormones as a factor. This, and gene therapy, may be the preventatives of the future.

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Janie F. Franz

Autoimmune hepatitis see **Hepatitis, autoimmune**

Autologous transfusion see **Transfusion**

Autologous transplant see **Bone marrow transplantation**

Automatic implantable cardioverter-defibrillator see **Implantable cardioverter-defibrillator**

Autopsy

Definition

An autopsy is a postmortem assessment or examination of a body to determine the cause of **death**. An autopsy is performed by a physician trained in pathology.

Purpose

Most autopsies advance medical knowledge and provide evidence for legal action. Medically, autopsies determine the exact cause and circumstances of death, discover the pathway of a disease, and provide valuable information to be used in the care of the living. When foul play is suspected, a government coroner or medical examiner performs autopsies for legal use. This branch of medical study is called forensic medicine. Forensic specialists investigate deaths resulting from violence or occurring under suspicious circumstances.

Benefits of research from autopsies include the production of new medical information on diseases such as **toxic shock syndrome**, acquired **immunodeficiency syndrome (AIDS)**. Organ donation, which can potentially save the lives of other patients, is also another benefit of autopsies.

Precautions

When performed for medical reasons, autopsies require formal permission from family members or the legal guardian. (Autopsies required for legal reasons when foul play is suspected do not need the consent of next of kin.) During the autopsy, very concise notes and documentation must be made for both medical and legal reasons. Some religious groups prohibit autopsies.

KEY TERMS

Acquired immunodeficiency syndrome (AIDS)—A group of diseases resulting from infection with the human immunodeficiency virus (HIV). A person infected with HIV gradually loses immune function, becoming less able to resist ailments and cancers, resulting in eventual death.

Computed tomography scan (CT scan)—The technique used in diagnostic studies of internal bodily structures in the detection of tumors or brain aneurysms. This diagnostic test consists of a computer analysis of a series of cross-sectional scans made along a single axis of a bodily structure or tissue that is used to construct a three-dimensional image of that structure.

Creutzfeld-Jakob disease—A rare, often fatal disease of the brain, characterized by gradual dementia and loss of muscle control that occurs most often in middle age and is caused by a slow virus.

Hepatitis—Inflammation of the liver, caused by infectious or toxic agents and characterized by jaundice, fever, liver enlargement, and abdominal pain.

Magnetic resonance imaging (MRI)—A diagnostic tool that utilizes nuclear magnetic energy in the production of images of specific atoms and molecular structures in solids, especially human cells, tissues, and organs.

Postmortem—After death.

Description

An autopsy can be described as the examination of a deceased human body with a detailed exam of the person's remains. This procedure dates back to the Roman era when few human dissections were performed; autopsies were utilized, however, to determine the cause of death in criminal cases. At the beginning of the procedure the exterior body is examined and then the internal organs are removed and studied. Some pathologists argue that more autopsies are performed than necessary. However, recent studies show that autopsies can detect major findings about a person's condition that were not suspected when the person was alive. And the growing awareness of the influence of genetic factors in disease has also emphasized the importance of autopsies.

Despite the usefulness of autopsies, fewer autopsies have been performed in the United States during the past

10-20 years. A possible reason for this decline is concern about malpractice suits on the part of the treating physician. Other possible reasons are that hospitals are performing fewer autopsies because of the expense or because modern technology, such as CT scans and **magnetic resonance imaging**, can often provide sufficient diagnostic information. Nonetheless, federal regulators and pathology groups have begun to establish new guidelines designed to increase the number and quality of autopsies being performed.

Many experts are concerned that if the number of autopsies increases, hospitals may be forced to charge families a fee for the procedure as autopsies are not normally covered by insurance companies or Medicare. Yet, according to several pathologists, the benefit of the procedure for families and doctors does justify the cost. In medical autopsies, physicians remain cautious to examine only as much of the body as permitted according to the wishes of the family. It is important to note that autopsies can also provide peace of mind for the bereaved family in certain situations.

Preparation

If a medical autopsy is being performed, written permission is secured from the family of the deceased.

Aftercare

Once the autopsy has been completed, the body is prepared for final arrangements according to the family's wishes.

Risks

There are some risks of disease transmission from the deceased. In fact, some physicians may refuse to do autopsies on specific patients because of a fear of contracting diseases such as AIDS, hepatitis, or Creutzfeld-Jakob disease.

Normal results

In most situations the cause of death is determined from the procedure of an autopsy without any transmission of disease.

Abnormal results

Abnormal results would include inconclusive results from the autopsy and transmission of infectious disease during the autopsy.

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Jeffrey P. Larson, RPT

Aviation medicine

Definition

Also known as aerospace medicine, flight medicine, or space medicine, aviation medicine is a medical specialty that focuses on the physical and psychological conditions associated with flying and space travel.

Purpose

Since flying airplanes and spacecraft involves great risk and physical demands, such as changes in gravity and oxygen, pilots and astronauts need medical experts to protect their safety and the public's safety.

Description

Pressure changes

In the United States, the Federal Aviation Administration (FAA) requires all pilots who fly above 14,500 ft (4,420 m) to be prepared for pressure changes caused by lower oxygen levels at high altitude. Pilots must either have a pressurized cabin or access to an oxygen mask. Without these protections, they could experience hypoxia, or **altitude sickness**. Hypoxia reduces the amount of oxygen in the brain, causing such symptoms as **dizziness, shortness of breath**, and mental confusion. These symptoms could cause the pilot to lose control of the plane. Hypoxia can be treated with oxygen therapy.

Rapid altitude increases and decreases can cause **pain** because there is an air pocket in the middle portion of the ear. To equalize pressure in the ear, physicians typically advise pilots and passengers to clear their sinuses by plugging their nose and blowing until the eardrums "pop." Other options include yawning, swallowing or

chewing gum. For people with a cold or a severely blocked middle ear, the use of **decongestants, antihistamines**, or nasal sprays may help. Without taking steps to equalize pressure, the tympanic membrane could rupture, causing **hearing loss**, vertigo, dizziness, and nausea.

Gravity's impact

Fighter pilots who fly high-performance jets can experience health problems during rapid acceleration and when executing tight turns at high speed. During these moves, a pilot experiences extreme gravity conditions that can pull blood away from the brain and heart and into the lower body. This can cause the pilot to have tunnel vision or pass out. To prevent these potentially deadly situations, the military requires fighter pilots to wear special flight suits, or G suits, which have compartments that fill with air or fluid to keep blood from pooling in the lower body.

Some pilots, like the Blue Angels, use a technique called the **Valsalva Maneuver** instead of G suits to prevent black outs during high-performance flying. The Valsalva Maneuver involves grunting and tightening the abdominal muscles to stop blood from collecting in the wrong parts of the body.

PREVENTIVE CARE. Since any routine health problem that affects a pilot could mean the loss of hundreds of lives, aviation medicine specialists who work for commercial airlines and the military take special care to educate pilots about proper diet, **exercise** and preventive health tools. For example, physicians may frequently screen pilots for vision changes caused by **glaucoma** or **cataracts**. They also will check for hearing loss and encourage the pilot to wear earplugs or headphones to buffer engine noise. To monitor for heart disease, physicians will check blood pressure and may order diagnostic tests such as an ECG or **stress test**.

Motion sickness

Many people experience nausea, vertigo, and disorientation when they first arrive in space. This is caused by changes in the fluid in the inner ear, which is sensitive to gravity and affects our sense of spatial orientation. The symptoms typically ease after several days, but often recur when the astronaut returns to Earth. To treat this condition, physicians give astronauts **motion sickness** medication, such as lorazepam.

Bone and muscle loss

In zero-gravity conditions, astronauts lose bone and muscle mass. On earth, the natural resistance of gravity helps build stronger muscles and bones during normal

KEY TERMS

G suits—Special flight suits, worn by fighter pilots, which have compartments that fill with air or fluid to keep blood from pooling in the lower body during rapid acceleration and tight turns.

Hypoxia—Hypoxia, or altitude sickness, reduces the amount of oxygen in the brain causing such symptoms as dizziness, shortness of breath, and mental confusion.

Tympanic membrane—A structure in the middle ear that can rupture if pressure in the ear is not equalized during airplane ascents and descents.

Valsalva Maneuver—Pilots grunt and tighten their abdominal muscles to prevent black outs during high-performance flying.

weight-bearing activities like walking or even sitting at a desk. In space, however, astronauts must work harder to prevent bone and muscle loss. Exercise is an important treatment. Crew members may use an exercise cycle or resistive rubber bands to stay in shape. Physicians also may give them medication to prevent bone loss and prescribe nutritional supplements, such as a mixture of essential amino acids and carbohydrates, to limit muscle atrophy.

Radiation

Another health threat to space travelers is radiation. Harmful rays can alter the DNA in human cells and cause **cancer**. Excess radiation also can weaken the immune system. To prevent these problems, physicians may give astronauts nutritional supplements. For example, research has shown that n-3 fatty acids found in fish oil reduce DNA damage.

Cardiovascular issues

When astronauts return to earth after a long mission, they tend to feel dizzy and black out. Scientists are concerned about this dilemma because it could be dangerous if the crew members need to make an emergency exit. One way to prevent this problem, which is caused by a drop in blood pressure, is to have the astronauts drink extra fluids and increase salt intake to increase blood volume. Physicians also may prescribe medication that causes blood vessels to contract. As another precaution, astronauts also put on protective flight suits, or G suits, before they re-enter the earth's atmosphere.

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National Space Biomedical Research Institute. One Baylor Plaza, NA-425, Houston, TX 77030. (713) 798-7412. info@www.ns bri.org. <<http://www.ns bri.org>>.

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Melissa Knopper

AVM see **Arteriovenous malformations**

Avoidant personality disorder see
Personality disorders

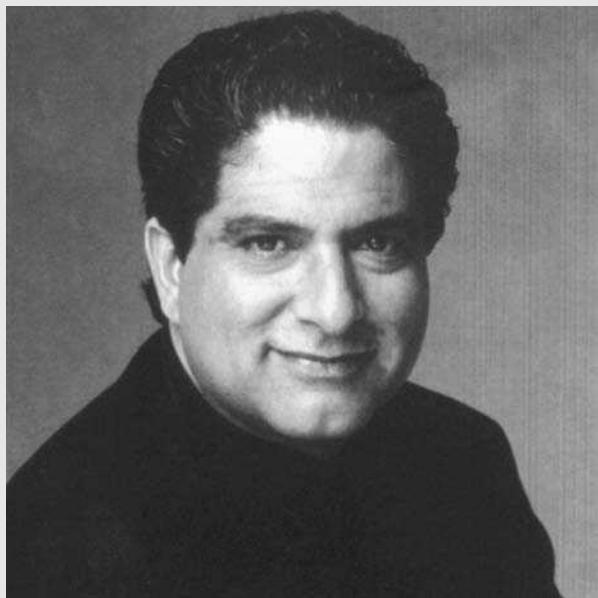
Avulsions see **Wounds**

Ayurvedic medicine

Definition

Ayurvedic medicine is a system of healing that originated in ancient India. In Sanskrit, *ayur* means life or living, and *veda* means knowledge, so Ayurveda has been defined as the "knowledge of living" or the "science of longevity." Ayurvedic medicine utilizes diet, **detoxification** and purification techniques, herbal and mineral remedies, **yoga**, breathing exercises, **meditation**, and **massage therapy** as holistic healing methods. Ayurvedic medicine is widely practiced in modern India and has been steadily gaining followers in the West.

DEEPAK CHOPRA (1946–)



(AP/Wide World Photos. Reproduced by permission.)

Deepak Chopra was born in India and studied medicine at the All India Institute of Medical Science. He left his home for the United States in 1970 and completed residencies in internal medicine and endocrinology. He went on to teaching posts at major medical institutions—

Tufts University and Boston University schools of medicine—while establishing a very successful private practice. By the time he was thirty-five, Chopra had become chief of staff at New England Memorial Hospital.

Disturbed by Western medicine's reliance on medication, he began a search for alternatives and discovered one in the teachings of the Maharishi Mahesh Yogi, an Indian spiritualist who had gained a cult following in the late sixties teaching Transcendental Meditation (TM). Chopra began practicing TM fervently and eventually met the Maharishi. In 1985 Chopra established the Ayurvedic Health Center for Stress Management and Behavioral Medicine in Lancaster, Massachusetts, where he began his practice of integrating the best aspects of Eastern and Western medicine.

In 1993, he published *Creating Affluence: Wealth Consciousness in the Field of All Possibilities*, and the enormously successful best seller, *Ageless Body, Timeless Mind*. In the latter he presents his most radical thesis: that aging is not the inevitable deterioration of organs and mind that we have been traditionally taught to think of it as. It is a process that can be influenced, slowed down, and even reversed with the correct kinds of therapies, almost all of which are self-administered or self-taught. He teaches that applying a regimen of nutritional balance, meditation, and emotional clarity characterized by such factors as learning to easily and quickly express anger, for instance, can lead to increased lifespans of up to 120 years.

Purpose

According to the original texts, the goal of Ayurveda is prevention as well as promotion of the body's own capacity for maintenance and balance. Ayurvedic treatment is non-invasive and non-toxic, so it can be used safely as an alternative therapy or alongside conventional therapies. Ayurvedic physicians claim that their methods can also help stress-related, metabolic, and chronic conditions. Ayurveda has been used to treat **acne**, **allergies**, **asthma**, **anxiety**, **arthritis**, **chronic fatigue syndrome**, **colds**, **colitis**, **constipation**, depression, diabetes, flu, heart disease, **hypertension**, immune problems, inflammation, **insomnia**, nervous disorders, **obesity**, skin problems, and ulcers.

Ayurvedic physicians seek to discover the roots of a disease before it gets so advanced that more radical treatments are necessary. Thus, Ayurveda seems to be limited in treating severely advanced conditions, traumatic injuries, acute **pain**, and conditions and injuries requiring

invasive surgery. Ayurvedic techniques have also been used alongside **chemotherapy** and surgery to assist patients in recovery and healing.

Description

Origins

Ayurvedic medicine originated in the early civilizations of India some 3,000-5,000 years ago. It is mentioned in the *Vedas*, the ancient religious and philosophical texts that are the oldest surviving literature in the world, which makes Ayurvedic medicine the oldest surviving healing system. According to the texts, Ayurveda was conceived by enlightened wise men as a system of living harmoniously and maintaining the body so that mental and spiritual awareness could be possible. Medical historians believe that Ayurvedic ideas were transported from ancient India to China and were instrumental in the development of Chinese medicine.

Ayurvedic Body Types

	Vata	Pitta	Kapha
Physical characteristics	Thin	Average build	Large build
	Prominent features	Fair, thin hair	Wavy, thick hair
	Cool, dry skin	Warm, moist skin	Pale, cool, oily skin
	Constipation	Ulcers, heartburn, and hemorrhoids	Obesity, allergies, and sinus problems
	Cramps	Acne	High cholesterol
	Moody	Intense	Relaxed
Emotional characteristics	Vivacious	Quick tempered	Not easily angered
	Imaginative	Intelligent	Affectionate
	Enthusiastic	Loving	Tolerant
	Intuitive	Articulate	Compassionate
Behavioral characteristics	Unscheduled sleep and meal times	Orderly	Slow, graceful
	Nervous disorders	Structured sleep and meal times	Long sleeper and slow eater
	Anxiety	Perfectionist	Procrastination

Today, Ayurvedic medicine is used by 80% of the population in India. Aided by the efforts of Deepak Chopra and the Maharishi, it has become an increasingly accepted alternative medical treatment in America during the last two decades. Chopra is an M.D. who has written several bestsellers based on Ayurvedic ideas. He also helped develop the Center for Mind/Body Medicine in La Jolla, California, a major Ayurvedic center that trains physicians in Ayurvedic principles, produces herbal remedies, and conducts research and documentation of its healing techniques.

Key ideas

To understand Ayurvedic treatment, it is necessary to have an idea how the Ayurvedic system views the body. The basic life force in the body is *prana*, which is also found in the elements and is similar to the Chinese notion of *chi*. As Swami Vishnudevananda, a yogi and expert, put it, “Prana is in the air, but is not the oxygen, nor any of its chemical constituents. It is in food, water, and in the sunlight, yet it is not vitamin, heat, or light-rays. Food, water, air, etc., are only the media through which the prana is carried.”

In Ayurveda, there are five basic elements that contain prana: earth, water, fire, air, and ether. These elements interact and are further organized in the human body as three main categories or basic physiological principles in the body that govern all bodily functions known as the *doshas*. The three doshas are *vata*, *pitta*, and *kapha*. Each person has a unique blend of the three doshas, known as the person’s *prakriti*, which is why Ayurvedic treatment is always individualized. In Ayurveda, disease is viewed as a state of imbalance in one or more of a person’s doshas, and an Ayurvedic physician strives to adjust and balance them, using a variety of techniques.

The *vata* dosha is associated with air and ether, and in the body promotes movement and lightness. *Vata* people are generally thin and light physically, dry-skinned, and very energetic and mentally restless. When *vata* is out of balance, there are often nervous problems, hyperactivity, sleeplessness, lower back pains, and headaches.

Pitta is associated with fire and water. In the body, it is responsible for metabolism and digestion. *Pitta* characteristics are medium-built bodies, fair skin, strong digestion, and good mental concentration. *Pitta* imbalances show up as anger and aggression and stress-related conditions like **gastritis**, ulcers, liver problems, and hypertension.

The *kapha* dosha is associated with water and earth. People characterized as *kapha* are generally large or heavy with more oily complexions. They tend to be slow, calm, and peaceful. *Kapha* disorders manifest emotionally as greed and possessiveness, and physically as obesity, **fatigue**, **bronchitis**, and sinus problems.

Diagnosis

In Ayurvedic medicine, disease is always seen as an imbalance in the dosha system, so the diagnostic process strives to determine which doshas are underactive or overactive in a body. Diagnosis is often taken over a course of days in order for the Ayurvedic physician to most accurately determine what parts of the body are being affected. To diagnose problems, Ayurvedic physicians often use long questionnaires and interviews to determine a person’s dosha patterns and physical and psychological histories. Ayurvedic physicians also intricately observe the pulse, tongue, face, lips, eyes, and fingernails for abnormalities or patterns that they believe can indicate deeper problems in the internal systems. Some Ayurvedic physicians also use laboratory tests to assist in diagnosis.

Treatment

Ayurvedic treatment seeks to re-establish balance and harmony in the body's systems. Usually the first method of treatment involves some sort of detoxification and cleansing of the body, in the belief that accumulated toxins must be removed before any other methods of treatment will be effective. Methods of detoxification include therapeutic vomiting, **laxatives**, medicated **enemas**, **fasting**, and cleansing of the sinuses. Many Ayurvedic clinics combine all of these cleansing methods into intensive sessions known as *panchakarma*. Panchakarma can take several days or even weeks and they are more than elimination therapies. They also include herbalized oil massage and herbalized **heat treatments**. After purification, Ayurvedic physicians use herbal and mineral remedies to balance the body as well. Ayurvedic medicine contains a vast knowledge of the use of herbs for specific health problems.

Ayurvedic medicine also emphasizes how people live their lives from day to day, believing that proper lifestyles and routines accentuate balance, rest, diet, and prevention. Ayurveda recommends yoga as a form of **exercise** to build strength and health, and also advises massage therapy and self-massage as ways of increasing circulation and reducing **stress**. Yogic breathing techniques and meditation are also part of a healthy Ayurvedic regimen, to reduce stress and improve mental energy.

Of all treatments, though, diet is one of the most basic and widely used therapy in the Ayurvedic system. An Ayurvedic diet can be a very well planned and individualized regimen. According to Ayurveda, there are six basic tastes: sweet, sour, salty, pungent, bitter, and astringent. Certain tastes and foods can either calm or aggravate a particular dosha. For instance, sweet, sour, and salty decrease vata problems and increase kapha. Sour, salty, and pungent can increase pitta. After an Ayurvedic physician determines a person's dosha profile, they will recommend a specific diet to correct imbalances and increase health. The Ayurvedic diet emphasizes primarily vegetarian foods of high quality and freshness, tailored to the season and time of day. Cooling foods are eaten in the summer and heating ones in the winter, always within a person's dosha requirements. In daily routine, the heaviest meal of the day should be lunch, and dinner should eaten well before bedtime, to allow for complete digestion. Also, eating meals in a calm manner with proper chewing and state of mind is important, as is combining foods properly and avoiding overeating.

Cost

Costs of Ayurvedic treatments can vary, with initial consultations running anywhere from \$40 to over \$100,

KEY TERMS

Dosha—One of three constitutional types, either vata, pitta, or kapha, found in Ayurvedic medicine.

Meditation—Technique of calming the mind.

Panchakarma—Intensive Ayurvedic cleansing and detoxification program.

Prakriti—An individual's unique dosha pattern.

Prana—Basic life energy found in the elements.

Yoga—System of body and breathing exercises.

with follow-up visits costing less. Herbal treatments may cost from \$10 to \$50 per month, and are often available from health food or bulk herb stores. Some clinics offer panchakarma, the intensive Ayurvedic detoxification treatment, which can include overnight stays for up to several weeks. The prices for these programs can vary significantly, depending on the services and length of stay. Insurance reimbursement may depend on whether the primary physician is a licensed M.D.

Preparations

Ayurveda is a mind/body system of health that contains some ideas foreign to the Western scientific model. Those people considering Ayurveda should approach it with an open mind and willingness to experiment. Also, because Ayurveda is a whole-body system of healing and health, patience and discipline are helpful, as some conditions and diseases are believed to be brought on by years of bad health habits and require time and effort to correct. Finally, the Ayurvedic philosophy believes that each person has the ability to heal themselves, so those considering Ayurveda should be prepared to bring responsibility and participation into the treatment.

Precautions

An Ayurvedic practitioner should always be consulted.

Side effects

During Ayurvedic detoxification programs, some people report fatigue, muscle soreness, and general sickness. Also, as Ayurveda seeks to release mental stresses and psychological problems from the patient, some people can experience mental disturbances and depression during treatment, and psychological counseling may be part of a sound program.

Research and general acceptance

Because Ayurveda had been outside the Western scientific system for years, research in the United States is new. Another difficulty in documentation arises because Ayurvedic treatment is very individualized; two people with the same disease but different dosha patterns might be treated differently. Much more scientific research has been conducted over the past several decades in India. Much research in the United States is being supported by the Maharishi Ayur-Ved organization, which studies the Ayurvedic products it sells and its clinical practices.

Some Ayurvedic herbal mixtures have been proven to have high antioxidant properties, much stronger than vitamins A, C, and E, and some have also been shown in laboratory tests to reduce or eliminate tumors in mice and to inhibit cancer growth in human lung tumor cells. In a 1987 study at MIT, an Ayurvedic herbal remedy was shown to significantly reduce colon cancer in rats. Another study was performed in the Netherlands with Maharishi Ayur-Ved products. A group of patients with chronic illnesses, including asthma, chronic bronchitis, hypertension, eczema, psoriasis, constipation, rheumatoid arthritis, headaches, and non-insulin dependent diabetes mellitus, were given Ayurvedic treatment. Strong results were observed, with nearly 80% of the patients improving and some chronic conditions being completely cured.

Other studies have shown that Ayurvedic therapies can significantly lower cholesterol and blood pressure in stress-related problems. Diabetes, acne, and allergies have also been successfully treated with Ayurvedic remedies. Ayurvedic products have been shown to increase short-term memory and reduce headaches. Also, Ayurvedic remedies have been used successfully to support the healing process of patients undergoing chemotherapy, as these remedies have been demonstrated to increase immune system activity.

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American Institute of Vedic Studies. P.O. Box 8357, Santa Fe, NM 87504. (505) 983-9385

Ayurveda Holistic Center. Bayville, Long Island, NY. (516)759-7731 mail@Ayurvedahc.com <<http://www.Ayurvedahc.com>>

The Ayurvedic Institute. 11311 Menaul, NE Albuquerque, New Mexico 87112. (505)291-9698. info@Ayurveda.com <<http://www.Ayurveda.com>>

Ayurvedic and Naturopathic Medical Clinic. 10025 NE 4th Street, Bellevue, WA 98004. (206)453-8022.

Bastyr University of Natural Health Sciences. 144 N.E. 54th Street, Seattle, WA 98105. (206)523-9585.

Center for Mind/Body Medicine. P.O. Box 1048, La Jolla, CA 92038. (619)794-2425.

The College of Maharishi Ayur-Ved, Maharishi International University. 1000 4th Street, Fairfield, IA 52557. (515)472-7000.

National Institute of Ayurvedic Medicine. (914)278-8700. drgerson@erols.com <<http://www.niam.com>>

The Rocky Mountain Institute of Yoga and Ayurveda. P.O. Box 1091, Boulder, CO 80306. (303)443-6923.

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"Inside Ayurveda: An Independent Journal of Ayurvedic Health Care." P.O. Box 3021, Quincy, CA 95971. <<http://www.insideayurveda.com>>

Douglas Dupler

Azithromycin see **Erythromycins**

AZT see **Antiretroviral drugs**

B

B-cell count see **Lymphocyte typing**

Babesiosis

Definition

Babesiosis is an infection of red blood cells caused by the single-celled parasite, *Babesia microti*, which is spread to humans by a tick bite.

Description

Babesiosis is a rare, tick-transmitted disease that is caused most often by the single-celled parasite *Babesia microti*. By 1995, fewer than 500 cases of babesiosis had been reported in the United States. The disease occurs primarily in New England and New York, especially on the coastal islands. However, cases have occurred in other parts of the United States. Because of tick activity, the risk for babesiosis is highest during June and July.

Ticks are small, blood-sucking arachnids. Although some ticks carry disease-causing organisms, most do not. *Babesia microti* is spread to humans through the bite of the tick *Ixodes scapularis* (also called *Ixodes dammini*). *Ixodes scapularis*, called the “blacklegged deer tick,” usually feeds on deer and mice. A tick picks up the parasites by feeding on an infected mouse and then passes them on by biting a new host, possibly a human. To pass on the parasites, the tick must be attached to the skin for 36–48 hours. Once in the bloodstream, *Babesia microti* enters a red blood cell, reproduces by cell division, and destroys the cell. Humans infected with *Babesia microti* produce antibodies that can be helpful in diagnosing the infection.

Causes and symptoms

Babesia microti live and divide within red blood cells, destroying the cells and causing anemia. The

majority of people who are infected have no visible symptoms. In those who become ill, symptoms appear one to six weeks following the tick bite. Because the ticks are small, many patients have no recollection of a tick bite. The symptoms are flu-like and include tiredness, loss of appetite, **fever**, drenching sweats, and muscle **pain**. Nausea, vomiting, **headache**, shaking chills, blood in the urine, and depression can occur.

Persons who are over 40 years old, have had their spleen removed (splenectomized), and/or have a serious disease (**cancer**, **AIDS**, etc.) are at a greater risk for severe babesiosis. In severe cases of babesiosis, up to 85% of the blood cells can be infected. This causes a serious, possibly fatal, blood deficiency.

Diagnosis

Babesiosis can be diagnosed by examining a blood sample microscopically and detecting the presence of *Babesia microti* within the blood cells. The blood can also be checked for the presence of antibodies to the parasite.

Treatment

In serious cases, babesiosis is treated with a combination of clindamycin (Cleocin) and quinine. Clindamycin is given by injection and quinine is given orally three to four times a day for four to seven days. To reduce the number of parasites in the blood, severely ill patients have been treated with blood transfusions.

Prognosis

Otherwise healthy patients will recover completely. Babesiosis may last several months without treatment and is a severe, potentially fatal disease in splenectomized patients.

Prevention

The only prevention for babesiosis is to minimize exposure to ticks by staying on trails when walking

KEY TERMS

Anemia—A below normal number of red blood cells in the bloodstream.

Parasite—An organism that lives upon or within another organism.

through the woods, avoiding tall grasses, wearing long sleeves and tucking pant legs into socks, wearing insect repellent, and checking for ticks after an outing. Remove a tick as soon as possible by grasping the tick with tweezers and gently pulling. Splenectomized people should avoid northeastern coastal regions during the tick season.

Resources

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Belinda Rowland, PhD

Bach flower remedies see **Flower remedies**

Bacillary angiomatosis

Definition

A life-threatening but curable infection that causes an eruption of purple lesions on or under the skin that resemble **Kaposi's sarcoma**. The infection, which occurs almost exclusively in patients with **AIDS**, can be a complication of **cat-scratch disease**.

Description

Bacillary angiomatosis is a re-emerging bacterial infection that is identical or closely related to one which commonly afflicted thousands of soldiers during World War I. Today, the disease, caused by two versions of the

same bacteria, is linked to homeless AIDS patients and to those afflicted with cat-scratch disease.

The infection is rarely seen today in patients who don't have HIV. According to the U.S. Centers for Disease Control and Prevention (CDC), an HIV patient diagnosed with bacillary angiomatosis is considered to have progressed to full-blown AIDS.

Causes and symptoms

Scientists have recently isolated two varieties of the *Bartonella* bacteria as the cause of bacillary angiomatosis: *Bartonella* (formerly *Rochalimaea quintana*) and *B. henselae* (cause of cat-scratch disease).

B. quintana infection is known popularly as **trench fever**, and is the infection associated with body lice that sickened European troops during World War I. Lice carry the bacteria, and can transmit the infection to humans. The incidence of trench fever was believed to have faded away with the end of World War I. It was not diagnosed in the United States until 1992, when 10 cases were reported among homeless Seattle men.

The related bacteria *B. henselae* was first identified several years ago as the cause of cat-scratch fever. It also can lead to bacillary angiomatosis in AIDS patients. Bacillary angiomatosis caused by this bacteria is transmitted to AIDS patients from cat fleas.

These two different types of bacteria both cause bacillary angiomatosis, a disease which is characterized by wildly proliferating blood vessels that form tumor-like masses in the skin and organs. The nodules that appear in bacillary angiomatosis are firm and don't turn white when pressed. The lesions can occur anywhere on the body, in numbers ranging from one to 100. They are rarely found on palms of the hands, soles of the feet, or in the mouth. As the number of lesions increase, the patient may develop a high fever, sweats, chills, poor appetite, vomiting, and weight loss. If untreated, infection may be fatal.

In addition to the basic disease process, the two different types of bacteria cause some slightly different symptoms. Patients infected with *B. henselae* also experience blood-filled cysts within the liver and abnormal liver function, whereas *B. quintana* patients may have tumor growths in the bone.

Diagnosis

This life-threatening but curable infection is often misdiagnosed, because it may be mistaken for other conditions (such as Kaposi's sarcoma). A blood test developed in 1992 by the CDC detects antibodies to the bacteria. It can be confirmed by reviewing symptoms, history

KEY TERMS

Cat-scratch disease—An infectious disease caused by bacteria transmitted by the common cat flea that causes a self-limiting, mild infection in healthy people.

Kaposi's sarcoma—A malignant condition that begins as soft brown or purple lesions on the skin that occurs most often in men with AIDS.

and negative tests for other diseases that cause swollen lymph glands. It isn't necessary to biopsy a small sample of the lymph node unless there is a question of **cancer** of the lymph node or some other disease.

Treatment

Recent research indicates that **antibiotics** used to treat other HIV opportunistic infections can both prevent and treat bacillary angiomatosis. Treatment is usually given until the lesions disappear, which typically takes three or four weeks. A severely affected lymph node or blister may have to be drained, and a heating pad may help swollen, tender lymph glands. **Acetaminophen** (Tylenol) may relieve **pain**, aches, and fever over 101°F (38.3°C).

Prognosis

In most cases, prompt antibiotic treatment in patients with AIDS cured the infection caused by either variety of the bacteria, and patients may resume normal life. Early diagnosis is crucial to a cure.

Prevention

Studies suggest that antibiotics may prevent the disease. Patients also should be sure to treat cats for fleas.

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Carol A. Turkington

Bacillary dysentery see **Shigellosis**

Bacitracin see **Antibiotics, topical**

Bacteremia

Definition

Bacteremia is an invasion of the bloodstream by bacteria.

Description

Bacteremia occurs when bacteria enter the bloodstream. This may occur through a wound or infection, or through a surgical procedure or injection. Bacteremia may cause no symptoms and resolve without treatment, or it may produce **fever** and other symptoms of infection. In some cases, bacteremia leads to **septic shock**, a potentially life-threatening condition.

Causes and symptoms

Causes

Several types of bacteria live on the surface of the skin or colonize the moist linings of the urinary tract, lower digestive tract, and other internal surfaces. These bacteria are normally harmless as long as they are kept in check by the body's natural barriers and the immune system. People in good health with strong immune systems rarely develop bacteremia. However, when bacteria are introduced directly into the circulatory system, especially in a person who is ill or undergoing aggressive medical treatment, the immune system may not be able to cope with the invasion, and symptoms of bacteremia may develop. For this reason, bacteremia is most common in people who are already affected by or being treated for some other medical problem. In addition, medical treatment may bring a person in contact with new types of bacteria that are more invasive than those already residing in that person's body, further increasing the likelihood of bacterial infection.

Conditions which increase the chances of developing bacteremia include:

- immune suppression, either due to HIV infection or drug therapy
- antibiotic therapy which changes the balance of bacterial types in the body
- prolonged or severe illness
- alcoholism or other drug abuse
- malnutrition
- diseases or drug therapy that cause ulcers in the intestines, e.g. **chemotherapy** for cancer

Common immediate causes of bacteremia include:

- drainage of an **abscess**, including an abscessed tooth.
- urinary tract infection, especially in the presence of a bladder catheter.
- decubitus ulcers (pressure sores).
- intravenous procedures using unsterilized needles, including IV drug use.
- prolonged IV needle placement.
- use of **ostomy** tubes, including **gastrostomy** (surgically making a new opening into the stomach), **jejunostomy** (surgically making an opening from the abdominal wall into the jejunum), and **colostomy** (surgically creating an artificial opening into the colon).

The bacteria most likely to cause bacteremia include members of the *Staphylococcus*, *Streptococcus*, *Pseudomonas*, *Haemophilus*, and *Escherichia coli* (*E. coli*) genera.

Symptoms

Symptoms of bacteremia may include:

- fever over 101°F (38.3°C)
- chills
- malaise
- **abdominal pain**
- nausea
- vomiting
- diarrhea
- anxiety
- shortness of breath
- confusion

Not all of these symptoms are usually present. In the elderly, confusion may be the only prominent symptom. Bacteremia may lead to **septic shock**, whose symptoms include decreased consciousness, rapid heart and breathing rates and multiple organ failures.

Diagnosis

Bacteremia is diagnosed by culturing the blood for bacteria. Samples may need to be tested several times over several hours. Blood analysis may also reveal an elevated number of white blood cells. Blood pressure is monitored closely; a decline in blood pressure may indicate the onset of septic shock.

Treatment

Antibiotics are the mainstay of treatment, and are often begun before positive identification of the bacteria is made. Close observation is required to guard against

KEY TERMS

Colostomy—Surgical creation of an artificial anus on the abdominal wall by cutting into the colon and bringing it up to the surface.

Gastrostomy—Surgical creation of an artificial opening into the stomach through the abdominal wall to allow tube feeding.

Jejunostomy—Surgical creation of an opening to the middle portion of the small intestine (jejunum), through the abdominal wall.

Septic shock—A life-threatening drop in blood pressure caused by bacterial infection.

septic shock. Since bacteremia is usually associated with an existing infection elsewhere in the body, finding and treating this infection is an important part of treatment.

Bacteremia may cause no symptoms, but may be discovered through a blood test for another condition. In this situation, it may not need to be treated, except in patients especially at risk for infection, such as those with heart valve defects or whose immune systems are suppressed.

Prognosis

Prompt antibiotic therapy usually succeeds in clearing bacteria from the bloodstream. Recurrence may indicate an undiscovered site of infection. Untreated bacteria in the blood may spread, causing infection of the heart (**endocarditis** or **pericarditis**) or infection of the covering of the central nervous system (**meningitis**).

Prevention

Bacteremia can be prevented by preventing the infections which often precede it. Good personal hygiene, especially during viral illness, may reduce the risk of developing bacterial infection. Treating bacterial infections quickly and thoroughly can minimize the risk of spreading infection. During medical procedures, the burden falls on medical professionals to minimize the number and duration of invasive procedures, to reduce patients' exposure to sources of bacteria when being treated, and to use scrupulous technique.

Resources

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Richard Robinson

Bacterial meningitis see **Meningitis**
 Bacterial vaginosis see **Vulvovaginitis**
 Bacteroides infection see **Anaerobic infections**

Bad breath

Definition

Bad breath, sometimes called halitosis, is an unpleasant odor of the breath.

Description

Bad breath is likely to be experienced by most adults at least occasionally. Bad breath, either real or imagined, can have a significant impact on a person's social and professional life.

Causes and symptoms

Bad breath can be caused by a number of problems. Oral diseases, fermentation of food particles in the mouth, sinus infections, and unclean dentures can all contribute to mouth odor. Many non-oral diseases, such as lung infections, kidney failure, or severe liver disease, can also cause bad breath, though rarely. Many people think that bad breath can originate in the stomach or intestines; this is extremely rare. The esophagus is usually collapsed and closed, and, although a belch may carry odor up from the stomach, the chance of bad breath being caused from air continually escaping from the stomach is remote. Cigarette smoke can cause bad breath, not only in the cigarette smoker, but also in one who is constantly exposed to second-hand smoke.

Diagnosis

The easiest way to determine if one has bad breath is to ask someone who is trustworthy and discrete. This is usually not too difficult. Another, more private, method of determining if one has bad breath is to lick one's wrist, wait until it dries, then smell the area. Scraping the rear area of the tongue with a plastic spoon, then smelling the spoon, is another method one can use to assess bad breath.

KEY TERMS

Halitosis—The medical term for bad breath.

Treatment

The most effective treatment of bad breath is to treat the cause. Poor **oral hygiene** can be improved by regular brushing and flossing, as well as regular dental checkups. Gentle brushing of the tongue should be part of daily oral hygiene. In addition to good oral hygiene, the judicious use of mouthwashes is helpful. Mouth dryness, experienced at night or during **fasting**, or due to certain medications and medical conditions, can contribute to bad breath. Dryness can be avoided by drinking adequate amounts of water. Chewing gum may be beneficial.

As mentioned, some medications, such as some high blood pressure medications, can cause **dry mouth**. If this problem is significant, a medication change, under the supervision of one's health care provider, may improve the dry-mouth condition. Oral or sinus infections, once diagnosed, can be treated medically, usually with **antibiotics**. Lung infections and kidney or liver problems will, of course, need medical treatment.

Alternative treatment

Depending on the cause, a multitude of alternative therapeutic remedies can be used. For example, **sinusitis** can be treated with steam inhalation of essential oils and/or herbs.

Prognosis

Most bad breath can be treated successfully with good oral hygiene and/or medical care. Occasionally, for patients who feel that these therapies are unsuccessful, some delusional or obsessive behavior pattern might persist, and mental health counseling may be appropriate.

Resources

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ORGANIZATIONS

American Dental Association. 211 E. Chicago Ave., Chicago, IL 60611. (312) 440-2500. <<http://www.ada.org>>.

American Medical Association. 515 N. State St., Chicago, IL 60612. (312) 464-5000. <<http://www.ama-assn.org>>.

Joseph Knight, PA

Balance and coordination tests

Definition

Balance is the ability to maintain a position. Coordination is the capacity to move through a complex set of movements. Balance and coordination depend on the interaction of multiple body organs and systems including the eyes, ears, brain and nervous system, cardiovascular system, and muscles. Tests or examination of any or all of these organs or systems may be necessary to determine the causes of loss of balance, **dizziness**, or the inability to coordinate movement or activities.

Purpose

Tests of balance and coordination, and the examination of the organs and systems that influence balance and coordination, can help to identify causes of dizziness, **fainting**, falling, or incoordination.

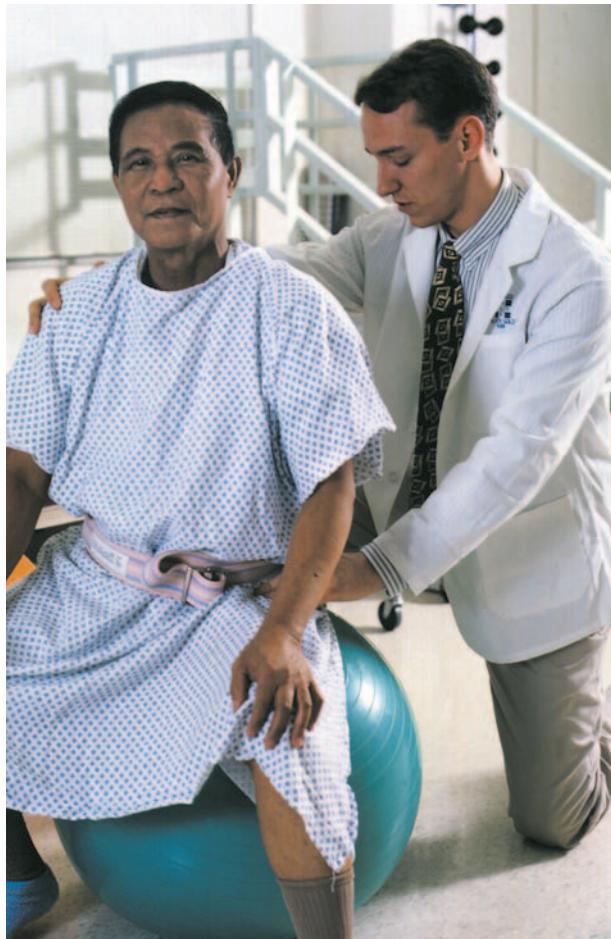
Precautions

Tests for balance and coordination should be conducted in a safe and controlled area where patients will not experience injury if they become dizzy or fall.

Description

Assessment of balance and coordination can include discussion of the patient's medical history and a complete **physical examination** including evaluation of the heart, head, eyes, and ears. A slow pulse or heart rate, or very low blood pressure may indicate a circulatory system problem, which can cause dizziness or fainting. During the examination, the patient may be asked to rotate the head from side to side while sitting up or while lying down with the head and neck extended over the edge of the examination table. If these tests produce dizziness or a rapid twitching of the eyeballs (**nystagmus**), the patient may have a disorder of the inner ear, which is responsible for maintaining balance.

An examination of the eyes and ears may also give clues to episodes of dizziness or incoordination. The patient may be asked to focus on a light or on a distant point or object, and to look up, down, left, and right moving only the eyes while the eyes are examined. Problems



A patient sits on a ball, working on his balance. He wears a belt so that the physical therapist can catch him if he loses balance. (Custom Medical Stock Photo. Reproduced by permission.)

with vision may, in themselves, contribute to balance and coordination disturbances, or may indicate more serious problems of the nervous system or brain function. **Hearing loss**, fluid in the inner ear, or ear infection might indicate the cause of balance and coordination problems.

Various physical tests may also be used. A patient may be asked to walk a straight line, stand on one foot, or touch a finger to the nose to help assess balance. The patient may be asked to squeeze or push against the doctor's hands, to squat down, to bend over, stand on tiptoes or stand on their heels. Important aspects of these tests include holding positions for a certain number of seconds, successfully repeating movements a certain number of times, and repeating the test accurately with eyes closed. The patient's reflexes may also be tested. For example, the doctor may tap on the knees, ankles, and elbows with a small rubber mallet to test nervous system functioning. These tests may reveal

KEY TERMS

Meniere's disease—An abnormality of the inner ear that causes dizziness, ringing in the ears, and hearing loss.

muscle weakness or nervous system problems that could contribute to incoordination.

Preparation

No special preparation is required prior to administration of balance and coordination tests. The patient may be asked to disrobe and put on an examination gown to make it easier for the doctor to observe muscles and reflex responses.

Aftercare

No special aftercare is generally required, however, some of the tests may cause episodes of dizziness or incoordination. Patients may need to use caution in returning to normal activities if they are experiencing any symptoms of dizziness, lightheadedness, or weakness.

Risks

These simple tests of balance and coordination are generally harmless.

Normal results

Under normal conditions, these test will not cause dizziness, loss of balance, or incoordination.

Abnormal results

The presence of dizziness, lightheadedness, loss of coordination, unusual eye movements, muscle weakness, or impaired reflexes are abnormal results and may indicate the problem causing the loss of balance or incoordination. In some cases, additional testing may be needed to diagnose the cause of balance or coordination problems.

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American Academy of Otolaryngology-Head and Neck Surgery, Inc. One Prince St., Alexandria VA 22314-3357. (703) 836-4444. <<http://www.entnet.org>>.

Ear Foundation. 1817 Patterson St., Nashville, TN 37203. (800) 545-4327. <<http://www.earfoundation.org>>.

Vestibular Disorders Association (VEDA). P.O. Box 4467, Portland, OR 97208-4467. (800) 837-8428 or (503) 229-7705 (phone); (503) 229-8064 (FAX).

Altha Roberts Edgren

Balanitis

Definition

Balanitis is an inflammation of the head and foreskin of the penis.

Description

Balanitis generally affects uncircumcised males. These are men who have a foreskin, which is the "hood" of soft skin that partially covers the head of the penis. In balanitis, the head and foreskin become red and inflamed. (In circumcised men, who lack a foreskin, these symptoms only affect the tip of the penis.) The condition often occurs due to the fungus *Candida albicans*, the same organism that causes vaginal yeast infections in women. Balanitis (which is also referred to as balanoposthitis) can be caused by a variety of other fungal or bacterial infections, or may occur due to a sensitivity reaction to common chemical agents.

Uncircumcised men are more at risk for balanitis due to the presence of the foreskin. The snug fit of the foreskin around the top of the penis tends to create a damp, warm environment that encourages the growth of microorganisms. Most of the organisms associated with balanitis are already present on the penis, but in very small numbers. However, if the area between the head and foreskin is not cleansed thoroughly on a regular basis, these organisms can multiply and lead to infection.

Diabetes can increase the risk of developing the condition.

Causes and symptoms

Balanitis is usually a result of poor hygiene—for example, neglecting to bathe for several days. A failure

to properly wash (or rinse) the area between the head and foreskin can lead to the development of fungal or bacterial infections that cause the condition. In other cases, balanitis may occur due to an allergic reaction: Some men may be sensitive to chemicals found in harsh soaps, laundry detergents, or contraceptive creams. Men who contract a **sexually transmitted disease** (STD) such as trichomoniasis may also develop symptoms.

The symptoms of balanitis are limited to the foreskin and head of the penis (in circumcised men, only the head is affected). These include redness, inflammation, pain, discharge, sore or itchy skin, and difficulty retracting the foreskin.

Diagnosis

Balanitis is usually diagnosed based on a brief **physical examination**. This may be conducted by your regular health care provider or by a urologist, the type of doctor who specializes in such disorders. The doctor may take a sample of the discharge (if any) to determine the nature of the possible infection. A urine test may be recommended to evaluate glucose (sugar) levels in the urine. Balanitis treatment is typically covered by medical insurance.

Treatment

The treatment of balanitis depends on the specific cause, which can vary from case to case. **Antibiotics** are used to treat bacterial infections, while topical antifungals such as clotrimazole can combat balanitis caused by *Candida*. If an allergic reaction is causing symptoms, the goal is to identify the chemical agent responsible. Ointments or creams may be used to ease skin irritation.

No matter what the cause, it is important to thoroughly clean the penis on a daily basis in order to alleviate symptoms. If the condition keeps occurring, or if the inflammation is interfering with urination, **circumcision** may be advised.

Alternative treatment

According to practitioners of alternative medicine, certain herbs may be effective in controlling or preventing yeast infections—a common cause of balanitis. These remedies include garlic, calendula, and goldenseal. Eating yogurt that contains acidophilus may also help to clear up a *Candida* infection.

Prognosis

Most cases go away quickly once the cause is identified and treated. However, regular bouts of balanitis can result in urethral stricture.

KEY TERMS

Acidophilus—A bacteria believed to combat yeast infections.

Circumcision—The surgical removal of the foreskin.

Urethral stricture—A narrowing of the urethra (urine tube).

Prevention

Proper hygiene is the best way to avoid balanitis. Circumcision is sometimes performed to prevent repeated cases.

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Greg Annussek

Balantidiasis

Definition

Balantidiasis is an infectious disease produced by a single-celled microorganism (protozoan) called *Balantidium coli* that infects the digestive tract. It is primarily a disease of the tropics, although it is also found in cooler, temperate climates. Most persons with balantidiasis do not exhibit any noticeable symptoms (asymptomatic), but a few individuals will develop **diarrhea** with blood and mucus and an inflamed colon (colitis).

Description

Balantidiasis is caused by *Balantidium coli*, a parasitic protozoan that infects the large intestine. *B. coli* is

the largest and only protozoan, having cilia or hair-like structures, that is capable of causing disease in humans. Balantidiasis occurs most commonly in areas with poor sanitation and in settings where humans live in close contact with pigs, sheep, or goats.

Causes and symptoms

Balantidiasis is transmitted primarily by eating food or drinking water that has been contaminated by human or animal feces containing *B. coli* cysts. During its life cycle, this organism exists in two very different forms: the infective cyst or capsuled form, which cannot move but can survive outside the human body because of its thick, protective covering; and the disease-producing form, the trophozoite, which although capable of moving, cannot survive once excreted in the feces and, therefore, cannot infect others. In the digestive tract, the cysts are transported to the intestine where the walls of the cysts are broken open by digestive secretions, releasing the mobile trophozoites. Once released within the intestine, the trophozoites multiply by feeding on intestinal bacteria or by invading the lining of the large intestine. Within the lining of the large intestine, the trophozoites secrete a substance that destroys intestinal tissue and creates sores (ulcers) or abscesses. Trophozoites eventually form new cysts that are carried through the digestive tract and excreted in the feces. Under favorable temperature and humidity conditions, the cysts can survive in soil or water for weeks to months, ready to begin the cycle again.

Most individuals with balantidiasis have no noticeable symptoms. Even though these individuals may not feel ill, they are still capable of infecting others by person-to-person contact or by contaminating food or water with cysts that others may ingest, for example, by preparing food with unwashed hands.

The most common symptoms of balantidiasis are chronic diarrhea or severe colitis with abdominal cramps, pain, and bloody stools. Complications may include intestinal perforation in which the intestinal wall becomes torn, but the organisms do not spread to other parts of the body in the blood stream.

Diagnosis

Diagnosis of balantidiasis, as with other similar diseases, can be complicated, partly because symptoms may or may not be present. A diagnosis of balantidiasis may be considered when a patient has diarrhea combined with a possible history of recent exposure to **amebiasis** through travel, contact with infected persons, or anal intercourse.

Specifically, a diagnosis of balantidiasis is made by finding *B. coli* cysts or trophozoites in the patient's stools

or by finding trophozoites in tissue samples (biopsy) taken from the large bowel. A diagnostic blood test has not yet been developed.

Stool examination

This test involves microscopically examining a stool sample for the presence of cysts and/or trophozoites of *B. coli*.

Sigmoidoscopy

To take a tissue sample from the large intestine, a procedure called a **sigmoidoscopy** is performed. During a sigmoidoscopy, a thin, flexible instrument is used to visually examine the intestinal lining and obtain small tissue specimens.

Treatment

Patients with balantidiasis are treated with prescription medication, typically consisting of a ten day course of either tetracycline or metronidazole. Alternative drugs that have proven effective in treating balantidiasis include iodoquinol or paromomycin.

Prognosis

Although somewhat dependent on the patient's overall health, in general, the prognosis for most patients with balantidiasis is good. Severely infected patients occasionally die as a result of a tear in the intestinal wall (intestinal perforation) and consequent loss of blood.

Prevention

There are no immunization procedures or medications that can be taken prior to potential exposure to prevent balantidiasis. Moreover, people who have had the disease can become reinfected. Prevention requires effective personal and community hygiene. Specific safeguards include the following:

- Purification of drinking water. Water can be purified by filtering, boiling, or treatment with iodine.
- Proper food handling. Measures include protecting food from contamination by flies, cooking food properly, washing one's hands after using the bathroom and before cooking or eating, and avoiding foods that cannot be cooked or peeled when traveling in countries with high rates of balantidiasis.
- Careful disposal of human feces.
- Monitoring the contacts of balantidiasis patients. The stools of family members and sexual partners of infected persons should be tested for the presence of cysts or trophozoites.

KEY TERMS

Asymptomatic—Persons who carry a disease and are usually capable of transmitting the disease but who do not exhibit symptoms of the disease are said to be asymptomatic.

Biopsy—The removal of a tissue sample for diagnostic purposes.

Ciliated—Covered with short, hair-like protrusions, like *B. coli* and certain other protozoa. The cilia or hairs help the organism to move.

Colitis—An inflammation of the large intestine that occurs in some cases of balantidiasis. It is marked by cramping pain and the passing of bloody mucus.

Protozoan—A single-celled, usually microscopic organism, such as *B. coli*, that is eukaryotic and, therefore, different from bacteria (prokaryotic).

Sigmoidoscopy—A procedure in which a thin, flexible, lighted instrument, called a sigmoidoscope, is used to visually examine the lower part of the large intestine.

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Rebecca J. Frey

Baldness see **Alopecia**

Balloon angioplasty see **Angioplasty**

Balloon valvuloplasty

Definition

Balloon valvuloplasty is a procedure in which a narrowed heart valve is stretched open using a procedure that does not require open heart surgery.

Purpose

There are four valves in the heart, which are located at the exit of each of the four chambers of the heart. They are called aortic valve, pulmonary valve, mitral valve, and tricuspid valve. The valves open and close to regulate the blood flow from one chamber to the next. They are vital to the efficient functioning of the heart.

In some people the valves are too narrow (a condition called stenosis). Balloon valvuloplasty is performed on children and adults to improve valve function and blood flow by enlarging the valve opening. It is a treatment for aortic, mitral, and pulmonary stenosis. Balloon valvuloplasty has the best results as a treatment for narrowed pulmonary valves. Results in treating narrowing of the mitral valve are generally good. It is more difficult to perform and less successful in treating narrowing of the aortic valve.

Description

Balloon valvuloplasty is a procedure in which a thin tube (catheter) that has a small deflated balloon at the tip is inserted through the skin in the groin area into a blood vessel, and then is threaded up to the opening of the narrowed heart valve. The balloon is inflated, which stretches the valve open. This procedure cures many valve obstructions. It is also called balloon enlargement of a narrowed heart valve.

The procedure is performed in a **cardiac catheterization** laboratory and takes up to four hours. The patient is usually awake, but is given local anesthesia to make the area where the catheter is inserted numb. After the site where the catheter will be inserted is prepared and anesthetized, the cardiologist inserts a catheter into the appropriate blood vessel, then passes a balloon-tipped catheter through the first catheter. Guided by a video monitor and an x ray, the physician slowly threads the catheter into the heart. The deflated balloon is positioned in the valve opening, then is inflated repeatedly. The inflated balloon widens the valve's opening by splitting the valve leaflets apart. Once the valve is widened, the balloon-tipped catheter is removed. The other catheter remains in place for 6 to 12 hours because in some cases the procedure must be repeated.

Preparation

For at least six hours before balloon valvuloplasty, the patient will have to avoid eating or drinking anything. An intravenous line is inserted so that medications can be administered. The patient's groin area is shaved and cleaned with an antiseptic. About an hour before the procedure, the patient is given an oral sedative such as diazepam (Valium).

Aftercare

After balloon valvuloplasty, the patient is sent to the recovery room for several hours, where he or she is monitored for vital signs (such as pulse and breathing) and heart sounds. An electrocardiogram, which is a record of the electrical impulses in the heart, is done. The leg in which the catheter was inserted is temporarily prevented from moving. The skin condition is monitored. The insertion site, which will be covered by a sandbag, is observed for bleeding until the catheter is removed. Intravenous fluids will be given to help eliminate the x-ray dye; intravenous blood thinners or other medications to dilate the coronary arteries may be given. **Pain** medication is available.

For at least 30 minutes after removal of the catheter, direct pressure is applied to the site of insertion; after this a pressure dressing will be applied. Following discharge from the hospital, the patient can usually resume normal activities. After balloon valvuloplasty lifelong follow-up is necessary because valves sometimes degenerate or narrowing recurs, making surgery necessary.

Risks

Balloon valvuloplasty can have serious complications. For example, the valve can become misshapen so that it doesn't close completely, which makes the condition worse. **Embolism**, where pieces of the valve break off and travel to the brain or the lungs, is another possible risk. If the procedure causes severe damage to the valve leaflets, immediate surgery is required. Less frequent complications are bleeding and hematoma (a local collection of clotted blood) at the puncture site, abnormal heart rhythms, reduced blood flow, **heart attack**, heart puncture, infection, and circulatory problems.

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ORGANIZATIONS

- American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <<http://www.americanheart.org>>.

KEY TERMS

Cardiac catheterization—A technique used to evaluate the heart and fix certain problems. Catheterization is far less invasive than traditional surgery.

Stenosis—The narrowing of any valve, especially one of the heart valves or the opening into the pulmonary artery from the right ventricle.

Valve—Tissue in the passageways between the heart’s upper and lower chambers that controls passage of blood and prevents regurgitation.

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Lori De Milto

Bancroftian filariasis see **Elephantiasis**

Bang’s disease see **Brucellosis**

Barbiturate-induced coma

Definition

A barbiturate-induced **coma**, or barb coma, is a temporary state of unconsciousness brought on by a controlled dose of a barbiturate drug, usually pentobarbital or thiopental.

Purpose

Barbiturate comas are used to protect the brain during major brain surgery, such as the removal of **arteriovenous malformations** or aneurysms. Coma may also be induced to control intracranial **hypertension** caused by brain injury.

Precautions

Barbiturate-induced comas are used when conventional therapy to reduce intracranial hypertension has failed. Barbiturate dosing is geared toward burst suppression—that is, reducing brain activity as measured by **electroencephalography**. This reduction in brain activity has to be balanced against the potential side effects of **barbiturates**, which include allergic reactions and effects on the cardiovascular system.

KEY TERMS

Aneurysm—A bulge or sack-like projection from a blood vessel.

Arteriovenous malformation—An abnormal tangle of arteries and veins in which the arteries feed directly into the veins without a normal intervening capillary bed.

Diuretic agent—A drug which increases urine output.

Electroencephalography—The recording of electrical potentials produced by the brain. These potentials indicate brain activity.

Hyperventilation—A respiratory therapy involving deeper and/or faster breathing to keep the carbon dioxide pressure in the blood below normal.

Intracranial hypertension—Abnormally high blood pressure within the skull.

Osmotherapy—Intravenous injection or oral administration of an agent that induces dehydration. The goal of dehydration is to reduce the amount of accumulated fluid in the brain.

Steroid—A type of drug used to reduce swelling.

Description

One of the greatest hazards associated with brain injury is intracranial hypertension. Brain injury may be caused by an accidental **head injury** or a medical condition, such as **stroke**, tumor, or infection. When the brain is injured, fluids accumulate in the brain, causing it to swell. The skull does not allow for the expansion of the brain; in effect, the brain becomes compressed.

If the pressure does not abate, oxygenated blood may not reach all areas of the brain. Also, the brain tissue may be forced against hard, bony edges on the interior of the skull. In either case, the brain tissue may die, causing permanent brain damage or **death**.

Barbiturates reduce the metabolic rate of brain tissue, as well as the cerebral blood flow. With these reductions, the blood vessels in the brain narrow, decreasing the amount of swelling in the brain. With the swelling relieved, the pressure decreases and some or all brain damage may be averted.

Controversy exists, however, over the benefits of using barbiturates to control intracranial hypertension. Some studies have shown that barbiturate-induced coma can reduce intracranial hypertension but does not neces-

sarily prevent brain damage. Furthermore, the reduction in intracranial hypertension may not be sustained.

Preparation

Inducing a barbiturate coma is usually kept in reserve for cases in which conventional treatments for controlling intracranial hypertension have failed. Before coma is induced, intracranial hypertension may be treated by hyperventilation; by facilitation of blood flow from the brain; by decompressive surgical procedures, such as draining excess fluids from under the skull or from the chambers within the brain (ventricles); or by drug therapy, including osmotherapy, diuretic agents, or steroids.

Risks

An estimated 25% of barbiturate-induced comas are accompanied by severe side effects. The side effects of barbiturates, especially the depressive effect on the cardiovascular system, can be too risky for some patients. Other side effects include impaired gastrointestinal motility and impaired immune response and infection. Since barbiturates depress activity in the brain, measurements of brain activity may be unreliable. Careful monitoring of the patient is required to ensure nutritional needs are being met and to guard against complications, such as lung infection, fevers, or deep vein blood clots.

Normal results

In many patients who do not respond to conventional therapy, barbiturate-induced coma can achieve the necessary control of intracranial hypertension.

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Julia Barrett

Barbiturate withdrawal see **Withdrawal syndromes**

Barbiturates

Definition

Barbiturates are medicines that act on the central nervous system and cause drowsiness and can control seizures.

Purpose

Barbiturates are in the group of medicines known as **central nervous system depressants** (CNS). Also known as sedative-hypnotic drugs, barbiturates make people very relaxed, calm, and sleepy. These drugs are sometimes used to help patients relax before surgery. Some may also be used to control seizures (convulsions). Although barbiturates have been used to treat nervousness and sleep problems, they have generally been replaced by other medicines for these purposes.

These medicines may become habit forming and should not be used to relieve everyday **anxiety** and tension or to treat sleeplessness over long periods.

Description

Barbiturates are available only with a physician's prescription and are sold in capsule, tablet, liquid, and injectable forms. Some commonly used barbiturates are phenobarbital (Barbita) and secobarbital (Seconal).

Recommended dosage

Recommended dosage depends on the type of barbiturate and other factors such as the patient's age and the condition for which the medicine is being taken. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Always take barbiturates exactly as directed. Never take larger or more frequent doses, and do not take the drug for longer than directed. If the medicine does not seem to be working, even after taking it for several weeks, do not increase the dosage. Instead, check with the physician who prescribed the medicine.

Do not stop taking this medicine suddenly without first checking with the physician who prescribed it. It may be necessary to taper down gradually to reduce the chance of withdrawal symptoms. If it is necessary to stop taking the drug, check with the physician for instructions on how to stop.

Precautions

See a physician regularly while taking barbiturates. The physician will check to make sure the medicine is working as it should and will note unwanted side effects.

Because barbiturates work on the central nervous system, they may add to the effects of alcohol and other drugs that slow the central nervous system, such as **antihistamines**, cold medicine, allergy medicine, sleep aids, medicine for seizures, tranquilizers, some **pain** relievers, and **muscle relaxants**. They may also add to the effects of anesthetics, including those used for dental procedures. The combined effects of barbiturates and alcohol or other CNS depressants (drugs that slow the central nervous system) can be very dangerous, leading to unconsciousness or even **death**. Anyone taking barbiturates should not drink alcohol and should check with his or her physician before taking any medicines classified as CNS depressants.

Taking an overdose of barbiturates or combining barbiturates with alcohol or other central nervous system depressants can cause unconsciousness and even death. Anyone who shows signs of an overdose or a reaction to combining barbiturates with alcohol or other drugs should get emergency medical help immediately. Signs include:

- severe drowsiness
- breathing problems
- slurred speech
- staggering
- slow heartbeat
- severe confusion
- severe weakness

Barbiturates may change the results of certain medical tests. Before having medical tests, anyone taking this medicine should alert the health care professional in charge.

People may feel drowsy, dizzy, lightheaded, or less alert when using these drugs. These effects may even occur the morning after taking a barbiturate at bedtime. Because of these possible effects, anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Barbiturates may cause physical or mental dependence when taken over long periods. Anyone who shows these signs of dependence should check with his or her physician right away:

- the need to take larger and larger doses of the medicine to get the same effect
- a strong desire to keep taking the medicine
- withdrawal symptoms, such as anxiety, nausea or vomiting, convulsions, trembling, or sleep problems, when the medicine is stopped

Children may be especially sensitive to barbiturates. This may increase the chance of side effects such as unusual excitement.

Older people may also be more sensitive than others to the effects of this medicine. In older people, barbiturates may be more likely to cause confusion, depression, and unusual excitement. These effects are also more likely in people who are very ill.

Special conditions

People with certain medical conditions or who are taking certain other medicines can have problems if they take barbiturates. Before taking these drugs, be sure to let the physician know about any of these conditions:

ALLERGIES. Anyone who has had unusual reactions to barbiturates in the past should let his or her physician know before taking the drugs again. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY. Taking barbiturates during **pregnancy** increases the chance of **birth defects** and may cause other problems such as prolonged labor and withdrawal effects in the baby after birth. Pregnant women who must take barbiturates for serious or life-threatening conditions should thoroughly discuss with their physicians the benefits and risks of taking this medicine.

BREASTFEEDING. Barbiturates pass into breast milk and may cause problems such as drowsiness, breathing problems, or slow heartbeat in nursing babies whose mothers take the medicine. Women who are breastfeeding should check with their physicians before using barbiturates.

OTHER MEDICAL CONDITIONS. Before using barbiturates, people with any of these medical problems should make sure their physicians are aware of their conditions:

- alcohol or drug abuse
- depression
- hyperactivity (in children)
- pain
- kidney disease
- liver disease
- diabetes
- overactive thyroid
- underactive adrenal gland
- chronic lung diseases such as **asthma** or **emphysema**
- severe anemia
- porphyria

USE OF CERTAIN MEDICINES. Taking barbiturates with certain other drugs may affect the way the drugs work or may increase the chance of side effects.

Side effects

The most common side effects are **dizziness**, lightheadedness, drowsiness, and clumsiness or unsteadiness. These problems usually go away as the body adjusts to the drug and do not require medical treatment unless they persist or interfere with normal activities.

More serious side effects are not common, but may occur. If any of the following side effects occur, check with the physician who prescribed the medicine immediately:

- **fever**
- muscle or joint pain
- sore throat
- chest pain or tightness in the chest
- wheezing
- skin problems, such as rash, **hives**, or red, thickened, or scaly skin
- bleeding sores on the lips
- sores or painful white spots in the mouth
- swollen eyelids, face, or lips

In addition, check with a physician as soon as possible if confusion, depression, or unusual excitement occur after taking barbiturates.

Patients who take barbiturates for a long time or at high doses may notice side effects for some time after they stop taking the drug. These effects usually appear within 8–16 hours after the patient stops taking the medicine. Check with a physician if these or other troublesome symptoms occur after stopping treatment with barbiturates:

- dizziness, lightheadedness or faintness
- anxiety or restlessness
- **hallucinations**
- vision problems
- nausea and vomiting
- seizures (convulsions)
- muscle twitches or trembling hands
- weakness
- sleep problems, nightmares, or increased dreaming

Other side effects may occur. Anyone who has unusual symptoms during or after treatment with barbiturates should get in touch with his or her physician.

KEY TERMS

Adrenal glands—Two glands located next to the kidneys. The adrenal glands produce the hormones epinephrine and norepinephrine and the corticosteroid (cortisone-like) hormones.

Anemia—A lack of hemoglobin—the compound in blood that carries oxygen from the lungs throughout the body and brings waste carbon dioxide from the cells to the lungs, where it is released.

Central nervous system—The brain, spinal cord, and nerves throughout the body.

Hallucination—A false or distorted perception of objects, sounds, or events that seems real. Hallucinations usually result from drugs or mental disorders.

Hypnotic—A medicine that causes sleep.

Porphyria—A disorder in which porphyrins build up in the blood and urine.

Porphyrin—A type of pigment found in living things, such as chlorophyll which makes plants green and hemoglobin which makes blood red.

Sedative—Medicine that has a calming effect and may be used to treat nervousness or restlessness.

Seizure—A sudden attack, spasm, or convulsion.

Withdrawal symptoms—A group of physical or mental symptoms that may occur when a person suddenly stops using a drug to which he or she has become dependent.

Interactions

Birth control pills may not work properly when taken while barbiturates are being taken. To prevent pregnancy, use additional or additional methods of birth control while taking barbiturates.

Barbiturates may also interact with other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Anyone who takes barbiturates should let the physician know all other medicines he or she is taking. Among the drugs that may interact with barbiturates are:

- Other central nervous system (CNS) depressants such as medicine for allergies, colds, hay fever, and asthma; sedatives; tranquilizers; prescription pain medicine; muscle relaxants; medicine for seizures; sleep aids; barbiturates; and anesthetics.

- Blood thinners.
- Adrenocorticoids (cortisone-like medicines).
- Antiseizure medicines such as valproic acid (Depakote and Depakene), and carbamazepine (Tegretol).

The list above does not include every drug that may interact with barbiturates. Be sure to check with a physician or pharmacist before combining barbiturates with any other prescription or nonprescription (over-the-counter) medicine.

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Nancy Ross-Flanigan

Barium enema

Definition

A barium enema, also known as a lower GI (gastrointestinal) exam, is a test that uses x-ray examination to view the large intestine. There are two types of this test: the single-contrast technique where barium sulfate is injected into the rectum in order to gain a profile view of the large intestine; and the double-contrast (or "air contrast") technique where air is inserted into the rectum.

Purpose

A barium enema may be performed for a variety of reasons, including to aid in the diagnosis of colon and **rectal cancer** (or **colorectal cancer**), and inflammatory disease. Detection of polyps (a benign growth in the tissue lining of the colon and rectum), diverticula (a pouch pushing out from the colon), and structural changes in the large intestine can also be established with this test. The double-contrast barium enema is the best method for detecting small tumors (such as polyps), early inflammatory disease, and bleeding caused by ulcers.

The decision to perform a barium enema is based on a person's history of altered bowel habits. These can include **diarrhea**, **constipation**, any lower abdominal **pain** they are currently exhibiting, blood, mucus, or pus in their stools. It is also recommended that this exam be used every five to 10 years to screen healthy people for colorectal cancer, the second most deadly type of tumor in the United States. Those who have a close relative with colorectal cancer or have had a precancerous polyp are considered to be

at an increased risk for the disease and should be screened more frequently to look for abnormalities.

Precautions

While barium enema is an effective screening method in the detection of symptoms and may lead to a timely diagnosis of several diseases, it is not the only method to do this. As of 1997, some studies have shown that the **colonoscopy** procedure performed by experienced gastroenterologists is a more accurate initial diagnostic tool for detecting early signs of colorectal cancer. A colonoscopy is the most accurate way for the physician to examine the entire colon and rectum for polyps. If abnormalities are seen at this time the procedure is accompanied by a biopsy. Some physicians use **sigmoidoscopy** plus a barium enema instead of colonoscopy.

Description

To begin a barium enema, the patient will lie with their back down on a tilting radiographic table in order to have x rays of the abdomen taken. After being assisted to a different position, a well-lubricated rectal tube is inserted through the anus. This tube allows the physician or assistant to slowly administer the barium into the intestine. While this filling process is closely monitored, it is important for the patient to keep the anus tightly contracted against the rectal tube to help maintain its position and prevent the barium from leaking. This step is emphasized to the patient due to the inaccuracy that may be caused if the barium leaks. A rectal balloon may also be inflated to help retain the barium. The table may be tilted or the patient moved to a different position to aid in the filling process.

As the barium fills the intestine, x rays of the abdomen are taken to distinguish significant findings. There are many ways to perform a barium enema. One way is that shortly after filling, the rectal tube is removed and the patient expels as much of the barium as possible. Upon completing this, an additional x ray is taken, and a double-contrast enema may follow. If this is done immediately, a thin film of barium will remain in the intestine, and air is then slowly injected to expand the bowel lumen. Sometimes no x rays will be taken until after the air is injected.

Preparation

In order to conduct the most accurate barium enema test, the patient must follow a prescribed diet and bowel preparation instructions prior to the test. This preparation commonly includes restricted intake of dairy products and a liquid diet for 24 hours prior to the test, in addition

to drinking large amounts of water or clear liquids 12–24 hours before the test. Patients may also be given **laxatives**, and asked to give themselves a cleansing enema.

In addition to the prescribed diet and bowel preparation prior to the test, the patient can expect the following during a barium enema:

- They will be well draped with a gown as they are secured to a tilting x-ray table.
- As the barium or air is injected into the intestine, they may experience cramping pains or the urge to defecate.
- The patient will be instructed to take slow, deep breaths through the mouth to ease any discomfort.

Aftercare

Patients should follow several steps immediately after undergoing a barium enema, including:

- Drink plenty of fluids to help counteract the dehydrating effects of bowel preparation and the test.
- Take time to rest. A barium enema and the bowel preparation taken before it can be exhausting.
- A cleansing enema may be given to eliminate any remaining barium. Lightly colored stools will be prevalent for the next 24–72 hours following the test.

Risks

While a barium enema is considered a safe screening test used on a routine basis, it can cause complications in certain people. The following indications should be kept in mind before a barium enema is performed:

- Those who have a rapid heart rate, severe **ulcerative colitis**, toxic megacolon, or a presumed perforation in the intestine should not undergo a barium enema.
- The test can be cautiously performed if the patient has a blocked intestine, ulcerative colitis, diverticulitis, or severe bloody diarrhea.
- Complications that may be caused by the test include perforation of the colon, water intoxication, barium granulomas (inflamed nodules), and allergic reaction. These are all very rare.

Normal results

When the patient undergoes a single-contrast enema, their intestine is steadily filled with barium to differentiate the colon's markings. A normal result displays uniform filling of the colon. As the barium is expelled, the intestinal walls collapse. A normal result on the x ray after defecation will show the intestinal lining as having a standard, feathery appearance.

KEY TERMS

Barium sulfate—A barium compound used during a barium enema to block the passage of x rays during the exam.

Bowel lumen—The space within the intestine.

Colonoscopy—An examination of the upper portion of the rectum performed with a colonoscope or elongated speculum.

Diverticula—A diverticulum of the colon is a sac or pouch in the colon walls which is usually asymptomatic (without symptoms) but may cause difficulty if it becomes inflamed.

Diverticulitis—A condition of the diverticulum of the intestinal tract, especially in the colon, where inflammation may cause distended sacs extending from the colon and pain.

Ulcerative colitis—An ulceration or erosion of the mucosa of the colon.

Proctosigmoidoscopy—A visual examination of the rectum and sigmoid colon using a sigmoidoscope.

Accordingly, the double-contrast enema expands the intestine which is already lined with a thin layer of barium, but with air to display a detailed image of the mucosal pattern. Varying positions taken by the patient allow the barium to collect on the dependent walls of the intestine by way of gravity.

Abnormal results

A barium enema allows abnormalities to appear on an x ray that may aid in the diagnosis of several different conditions. Although most colon cancers occur in the rectosigmoid region, or upper part of the rectum and adjoining portion of the sigmoid colon, and are better detected with a different test called a proctosigmoidoscopy, an enema can identify other early signs of cancer.

Identification of polyps, diverticulosis, inflammatory disease, such as diverticulitis and ulcerative colitis is attainable through a barium x ray. Structural changes in the intestine, **gastroenteritis**, and some cases of acute **appendicitis** may also be apparent by viewing this x ray.

Resources

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"Detecting Colon Cancer: Colonoscopy Superior To Barium Enema." *Geriatrics* (Apr. 1997): 101.

"Screening Tests." *US News & World Report* 10 (Feb. 1997): 64.

ORGANIZATIONS

American Cancer Society. 1599 Clifton Rd., NE, Atlanta, GA 30329-4251. (800) 227-2345. <<http://www.cancer.org>>.

Beth A. Kapes

Barium swallow see **Upper GI exam**

Barlow's syndrome see **Mitral valve prolapse**

Bartholin's gland cyst

Definition

A Bartholin's gland cyst is a swollen fluid-filled lump that develops from a blockage of one of the Bartholin's glands, which are small glands located on each side of the opening to the vagina. Bartholin's gland cysts and abscesses are commonly found in women of reproductive age, developing in approximately 2% of all women.

Description

The Bartholin's glands are located in the lips of the labia that cover the vaginal opening. The glands (normally the size of a pea) provide moisture for the vulva area. A Bartholin's gland cyst may form in the gland itself or in the duct draining the gland. A cyst normally does not cause **pain**, grows slowly, and may go away without treatment. It usually ranges in size from 0.4-1.2 in (1-3 cm), although some may grow much larger.

If infected, a Bartholin's gland cyst can form an **abscess** that will increase in size over several days and is very painful. In order to heal, a Bartholin's gland cyst usually must be drained.

Causes and symptoms

A Bartholin's gland cyst occurs if the duct becomes blocked for any reason, such as infection, injury, or chronic inflammation. Very rarely a cyst is caused by **cancer**, which usually occurs only in women over the age of 40. In many cases, the cause of a Bartholin's gland cyst is unknown.

Symptoms of an uninfected Bartholin's gland cyst include a painless lump on one side of the vulva area (most common symptom) and redness or swelling in the vulva area.

KEY TERMS

Marsupialization—Cutting out a wedge of the cyst wall and putting in stitches so the cyst cannot reoccur.

Sitz bath—A warm bath in which just the buttocks and genital area soak in water; used to reduce pain and aid healing in the genital area.

Window operation—Cutting out a large oval-shaped piece of the cyst wall and putting in stitches to create a window so the cyst cannot reoccur.

Word catheter—A small rubber catheter with an inflatable balloon tip that is inserted into a stab incision in the cyst, after the contents of the cyst have been drained.

Symptoms of an abscessed Bartholin's gland include:

- pain that occurs with walking, sitting, physical activity, or sexual intercourse
- fever and chills
- increased swelling in the vulva area over a two- to four-day period
- drainage from the cyst, normally occurring four to five days after the swelling starts

Abscesses may be caused by sexually transmitted bacteria, such as those causing chlamydial or gonococcal infections, while others are caused by bacteria normally occurring in the vagina. Over 60 types of bacteria have been found in Bartholin's gland abscesses.

Diagnosis

A Bartholin's gland cyst or abscess is diagnosed by a gynecological **pelvic exam**. If the cyst appears to be infected, a culture is often performed to identify the type of bacteria causing the abscess.

Treatment

Treatment for this condition depends on the size of the cyst, whether it is painful, and whether the cyst is infected.

If the cyst is not infected, treatment options include:

- watchful waiting by the woman and her health care professional
- soaking of the genital area with warm towel compresses
- soaking of the genital area in a sitz bath

- use of non-prescription pain medication to relieve mild discomfort

If the Bartholin's gland is infected, there are several treatments available to treat the abscess, including:

- soaking of the genital area in a sitz bath
- treatment with **antibiotics**
- use of prescription or non-prescription pain medication
- incision and drainage, i.e., cutting into the cyst and draining the fluid (not usually successful, as the cyst often reoccurs)
- placement of a drain (Word catheter) in the cyst for two to four weeks so fluid can drain and prevent reoccurrence of the cyst
- marsupialization
- window operation
- use of a carbon dioxide laser to open the cyst and heat the cyst wall tissue so that the cyst cannot form a sac and reoccur
- incision and drainage, followed by treatment with silver nitrate to burn the cyst wall so the cyst cannot form a sac and reoccur
- removal of the entire Bartholin's gland cyst, if the cyst has reoccurred several times after use of other treatment methods

During surgical treatment, the area will be numbed with a local anesthetic to reduce pain. General anesthesia may be used for treatment of an abscess, as the procedure can be painful.

In a pregnant woman, surgical treatment of cysts that are asymptomatic should be delayed until after delivery to avoid the possibility of excessive bleeding. However, if the Bartholin's gland is infected and must be drained, antibiotics and local anesthesia are generally considered safe.

If the cyst is caused by cancer, the gland must be excised, and the woman should be under the care of a gynecologist familiar with the treatment of this type of cancer.

Alternative treatment

If a Bartholin's gland cyst has no or mild symptoms, or has opened on its own to drain, a woman may decide to use watchful waiting, warm sitz baths, and non-prescription pain medication. If symptoms become worse or do not improve, a health care professional should then be consulted.

Infected Bartholin's glands should be evaluated and treated by a health care professional.

Prognosis

A Bartholin's gland cyst should respond to treatment in a few days. If an abscess requires surgery, healing may take days to weeks, depending on the size of the abscess and the type of surgical procedure used. Most of the surgical procedures, except for incision and drainage, should be effective in preventing recurring infections.

Prevention

There are few ways to prevent the formation of Bartholin's gland cysts or abscesses. However, as a Bartholin's gland abscess may be caused by a sexually transmitted disease, the practice of safe sex is recommended. Using good hygiene, i.e., wiping front to back after a bowel movement, is also recommended to prevent bacteria from the bowels from contaminating the vaginal area.

Resources

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PERIODICALS

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Judith Sims

Bartonella bacilliformis infection see
Bartonellosis

Bartonellosis

Definition

Bartonellosis is an infectious bacterial disease with an acute form (which has a sudden onset and short course) and a chronic form (which has more gradual onset and longer duration). The disease is transmitted by sandflies and occurs in western South America. Characterized by a form of red blood cell deficiency (**hemolytic anemia**) and **fever**, the potentially fatal acute form is called Oroya fever or Carrion's disease. The chronic form is identified by **painful skin lesions**.

Description

The acute form of the disease gets its name from an outbreak that occurred in 1871 near La Oroya, Peru.

KEY TERMS

Acute—Referring to the course of a disease, or a phase of a disease, the short-term experience of prominent symptoms.

Chronic—Referring to the course of a disease, or a phase of a disease, the long-term experience of prominent symptoms.

Erythrocytes—Red blood cells.

Hemolytic anemia—A form of erythrocyte deficiency caused by the destruction of the red blood cells.

Host—The organism that harbors or nourishes another organism (parasite). In bartonellosis, the person infected with *Bartonella bacilliformis*.

Vector—An organism, such as insects or rodents, that can transmit disease to humans.

More than 7,000 people perished. Some survivors later developed a skin disease, called verruga peruana (Peruvian **warts**). These skin lesions were observed prior to the 1871 outbreak—perhaps as far back as the pre-Columbian era—but a connection to Oroya fever was unknown. In 1885, a young medical researcher, Daniel Carrion, inoculated himself with blood from a lesion to study the course of the skin disease. When he became ill with Oroya fever, the connection became apparent. Oroya fever is often called Carrion's disease in honor of his fatal experiment.

The bacteria, *Bartonella bacilliformis*, was isolated by Alberto Barton in 1909, but wasn't identified as the cause of the fever until 1940. The *Bartonella* genus includes at least 11 bacteria species, four of which cause human diseases, including **cat-scratch disease** and **bacillary angiomatosis**. However, bartonellosis refers exclusively to the disease caused by *B. bacilliformis*. The disease is limited to a small area of the Andes Mountains in western South America; nearly all cases have been in Peru, Colombia, and Ecuador. A large outbreak involving thousands of people occurred in 1940–41, but bartonellosis has since occurred sporadically. Control of sandflies, the only known disease carrier (vector), has been credited with managing the disease.

Causes and symptoms

Bartonellosis is transmitted by the nocturnal sandfly and arises from infection with *B. bacilliformis*. The sandfly, *Lutzomyia verrucarum*, dines on human blood and, in so doing, can inject bacteria into the bloodstream. The

sandfly is found only in certain areas of the Peruvian Andes; other, as-yet-unidentified vectors are suspected in Ecuador and Colombia.

Once in the bloodstream, the bacteria latch onto red blood cells (erythrocytes), burrow into the cells, and reproduce. In the process, up to 90% of the host's erythrocytes are destroyed, causing severe hemolytic anemia. The anemia is accompanied by high fever, muscle and joint **pain, delirium**, and possibly **coma**.

Two to eight weeks after the acute phase, an infected individual develops *verruga peruana*. However, individuals may exhibit the characteristic lesions without ever experiencing the acute phase. Left untreated, the lesions may last months or years. These lesions resemble blood-filled blisters, up to 1.6 in (4 cm) in diameter, and appear primarily on the head and limbs. They can be painful to the touch and may bleed or ulcerate.

Diagnosis

Bartonellosis is identified by symptoms and the patient's history, such as recent travel in areas where bartonellosis occurs. **Isolation** of *B. bacilliformis* from the bloodstream or lesions can confirm the diagnosis.

Treatment

Antibiotics are the mainstay of bartonellosis treatment. The bacteria are susceptible to several antibiotics, including chloramphenicol, **penicillins**, and **aminoglycosides**. Blood transfusions may be necessary to treat the anemia caused by bartonellosis.

Prognosis

Antibiotics have dramatically decreased the fatality associated with bartonellosis. Prior to the development of antibiotics, the fever was fatal in 40% of cases. With antibiotic treatment, that rate has dropped to 8%. Fatalities can result from complications associated with severe anemia and secondary infections. Once the infection is halted, an individual can recover fully.

Prevention

Avoiding sandfly bites is the primary means of prevention. Sandfly eradication programs have been helpful in decreasing the sandfly population, and insect repellent can be effective in preventing sandfly bites.

Resources

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Julia Barrett

Basal cell cancer see **Skin cancer, non-melanoma**

Basal gastric secretion test see **Gastric acid determination**

Battered child syndrome

Definition

Battered child syndrome refers to injuries sustained by a child as a result of physical **abuse**, usually inflicted by an adult caregiver. Alternative terms include: shaken baby; **shaken baby syndrome**; **child abuse**; and non-accidental trauma (NAT).

Description

Internal injuries, cuts, **burns**, **bruises** and broken or fractured bones are all possible signs of battered child syndrome. Emotional damage to a child is also often the by-product of child abuse, which can result in serious behavioral problems such as substance abuse or the physical abuse of others. Approximately 14% of children in the United States are physically abused each year, and an estimated 2,000 of those children die as a result of the abuse. Between 1994–1995, 1.1 million cases of child abuse were recorded in the United States; of that number, 55% of the victims were less than a year old.

Causes and symptoms

Battered child syndrome (BCS) is found at every level of society, although the incidence may be higher in low-income households where adult caregivers suffer greater **stress** and social difficulties, without having had the benefit of higher education. The child abuser most often injures a child in the heat of anger, and was often abused as a child himself. The incessant crying of an

infant or child may trigger abuse. Symptoms may include a delayed visit to the emergency room with an injured child; an implausible explanation of the cause of a child's injury; bruises that match the shape of a hand, fist or belt; cigarette burns; scald marks; bite marks; black eyes; unconsciousness; bruises around the neck; and a bulging fontanel in infants.

Diagnosis

Battered child syndrome is most often diagnosed by an emergency room physician or pediatrician, or by teachers or social workers. **Physical examination** will detect bruises, burns, swelling, retinal hemorrhages. X rays, and other imaging techniques, such as MRI or scans may confirm **fractures** or other internal injuries. The presence of injuries at different stages of healing (i.e. having occurred at different times) is nearly always indicative of BCS. Establishing the diagnosis is often hindered by the excessive cautiousness of caregivers or by actual concealment of the true origin of the child's injuries, as a result of fear, shame and avoidance or denial mechanisms.

Treatment

Medical treatment for battered child syndrome will vary according to the type of injury incurred. Counseling and the implementation of an intervention plan for the child's parents or guardians is necessary. The child abuser may be incarcerated, and/or the abused child removed from the home to prevent further harm. Reporting child abuse to authorities is mandatory for doctors, teachers, and childcare workers in most states as a way to prevent continued abuse. Both physical and psychological therapy are often recommended as treatment for the abused child.

Prognosis

The prognosis for battered child syndrome will depend on the severity of injury, actions taken by the authorities to ensure the future safety of the injured child, and the willingness of parents or guardians to seek counseling for themselves as well as for the child.

Prevention

Recognizing the potential for child abuse in a situation, and the seeking or offering of intervention and counseling before battered child syndrome occurs is the best way to prevent it. Signs that physical abuse may be forthcoming include parental alcohol or substance abuse; previous abuse of the child or the child's siblings; history of mental or emotional problems in parents; parents

KEY TERMS

Fontanel—Soft spot on top of an infant's skull.

Subdural hematoma—Bleeding over the brain.

Multiple retinal hemorrhages—Bleeding in the back of the eye.

abused as children; absence of visible parental love or concern for the child; child's hygiene neglected.

Resources

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ORGANIZATIONS

Childhelp National Abuse Hotline. (800)422-4453.

Mary Jane Tenerelli

Becker muscular dystrophy see **Muscular dystrophy**

Bed-wetting

Definition

Bed-wetting is the unintentional (involuntary) discharge of urine during the night. Although most children between the ages of three and five begin to stay dry at night, the age at which children are physically and emotionally ready to maintain complete bladder control varies. Enuresis is a technical term that refers to the continued, usually involuntary, passage of urine during the night or the day after the age at which control is expected.

Description

Most children wet the bed occasionally, and definitions of the age and frequency at which bed-wetting becomes a medical problem vary somewhat. Many researchers consider bed-wetting normal until age 6.

About 10% of 6-year-old children wet the bed about once a month. More boys than girls have this problem. The American Psychiatric Association, however, defines enuresis as repeated voiding of urine into the bed or clothes at age five or older. The wetting is usually involuntary but in some cases it is intentional. For a diagnosis of enuresis, wetting must occur twice a week for at least three months with no underlying physiological cause. Enuresis, both nighttime (nocturnal) and daytime (diurnal), at age five affects 7% of boys and 3% of girls. By age 10, it affects 3% of boys and 2% of girls; only 1% of adolescents experience enuresis.

Enuresis is divided into two classes. A child with primary enuresis has never established bladder control. A child with secondary enuresis begins to wet after a prolonged dry period. Some children have both nocturnal and diurnal enuresis.

Causes and symptoms

The causes of bed-wetting are not entirely known. It tends to run in families. Most children with primary enuresis have a close relative—a parent, aunt, or uncle—who also had the disorder. About 70% of children with two parents who wet the bed will also wet the bed. Twin studies have shown that both of a pair of identical twins experience enuresis more often than both of a pair of fraternal twins.

Sometimes bed-wetting can be caused by a serious medical problem like diabetes, sickle-cell anemia, or epilepsy. **Snoring** and episodes of interrupted breathing during sleep (**sleep apnea**) occasionally contribute to bed-wetting problems. Enlarged adenoids can cause these conditions. Other physiological problems, such as urinary tract infection, severe **constipation**, or **spinal cord injury**, can cause bed-wetting.

Children who wet the bed frequently may have a smaller than normal functional bladder capacity. Functional bladder capacity is the amount of urine a person can hold in the bladder before feeling a strong urge to urinate. When functional capacity is small, the bladder will not hold all the urine produced during the night. Tests have shown that bladder size in these children is normal. Nevertheless, they experience frequent strong urges to urinate. Such children urinate often during the daytime and may wet several times at night. Although a small functional bladder capacity may be caused by a developmental delay, it may also be that the child's habit of voiding frequently slows bladder development.

Parents often report that their bed-wetting child is an extremely sound sleeper and difficult to wake. However, several research studies found that bed-wetting children have normal sleep patterns and that bed-wetting can occur in any stage of sleep.

Recent medical research has found that many children who wet the bed may have a deficiency of an important hormone known as antidiuretic hormone (ADH). ADH helps to concentrate urine during sleep hours, meaning that the urine contains less water and therefore takes up less space. This decreased volume of water usually prevents the child's bladder from overfilling during the night, unless the child drank a lot just before going to bed. Testing of many bed-wetting children has shown that these children do not have the usual increase in ADH during sleep. Children who wet the bed, therefore, often produce more urine during the hours of sleep than their bladders can hold. If they do not wake up, the bladder releases the excess urine and the child wets the bed.

Research demonstrates that in most cases bed-wetting does not indicate that the child has a physical or psychological problem. Children who wet the bed usually have normal-sized bladders and have sleep patterns that are no different from those of non-bed-wetting children. Sometimes emotional **stress**, such as the birth of a sibling, a **death** in the family, or separation from the family, may be associated with the onset of bed-wetting in a previously toilet-trained child. Daytime wetting, however, may indicate that the problem has a physical cause.

While most children have no long-term problems as a result of bed-wetting, some children may develop psychological problems. Low self-esteem may occur when these children, who already feel embarrassed, are further humiliated by angry or frustrated parents who punish them or who are overly aggressive about toilet training. The problem can be aggravated when playmates tease or when social activities such as sleep-away camp are avoided for fear of teasing.

Diagnosis

If a child continues to wet the bed after the age of six, parents may feel the need to seek evaluation and diagnosis by the family doctor or a children's specialist (pediatrician). Typically, before the doctor can make a diagnosis, a thorough medical history is obtained. Then the child receives a **physical examination**, appropriate laboratory tests, including a urine test (**urinalysis**), and, if necessary, radiologic studies (such as x rays).

If the child is healthy and no physical problem is found, which is the case 90% of the time, the doctor may not recommend treatment but rather may provide the parents and the child with reassurance, information, and advice.

Treatment

Occasionally a doctor will determine that the problem is serious enough to require treatment. Standard

treatments for bed-wetting include **bladder training** exercises, motivational therapy, drug therapy, psychotherapy, and diet therapy.

Bladder training exercises are based on the theory that those who wet the bed have small functional bladder capacity. Children are told to drink a large quantity of water and to try to prolong the periods between urinations. These exercises are designed to increase bladder capacity but are only successful in resolving bed-wetting in a small number of patients.

In motivational therapy, parents attempt to encourage the child to combat bed-wetting, but the child must want to achieve success. Positive reinforcement, such as praise or rewards for staying dry, can help improve self-image and resolve the condition. Punishment for "wet" nights will hamper the child's self-esteem and compound the problem.

The following motivational techniques are commonly used:

- Behavior modification. This method of therapy is aimed at helping children take responsibility for their nighttime bladder control by teaching new behaviors. For example, children are taught to use the bathroom before bedtime and to avoid drinking fluids after dinner. While behavior modification generally produces good results, it is long-term treatment.
- Alarms. This form of therapy uses a sensor placed in the child's pajamas or in a bed pad. This sensor triggers an alarm that wakes the child at the first sign of wetness. If the child is awakened, he or she can then go to the bathroom and finish urinating. The intention is to condition a response to awaken when the bladder is full. Bed-wetting alarms require the motivation of both parents and children. They are considered the most effective form of treatment now available.

A number of drugs are also used to treat bed-wetting. These medications are usually fast acting; children often respond to them within the first week of treatment. Among the drugs commonly used are a nasal spray of desmopressin acetate (DDAVP), a substance similar to the hormone that helps regulate urine production; and imipramine hydrochloride, a drug that helps to increase bladder capacity. Studies show that imipramine is effective for as many as 50% of patients. However, children often wet the bed again after the drug is discontinued, and it has some side effects. Some bed-wetting with an underlying physical cause can be treated by surgical procedures. These causes include enlarged adenoids that cause sleep apnea, physical defects in the urinary system, or a spinal tumor.

Psychotherapy is indicated when the child exhibits signs of severe emotional distress in response to events

such as a death in the family, the birth of a new child, a change in schools, or divorce. Psychotherapy is also indicated if a child shows signs of persistently low self-esteem or depression.

In rare cases, **allergies** or intolerances to certain foods—such as dairy products, citrus products, or chocolate—can cause bed-wetting. When children have food sensitivities, bed-wetting may be helped by discovering the substances that trigger the allergic response and eliminating these substances from the child's diet.

Alternative treatment

A number of alternative treatments are available for bed-wetting.

Massage

According to practitioners of this technique, pressure applied to various points on the body may help alleviate the condition. **Acupressure** or massage, when done by a trained therapist, may also be helpful in bed-wetting caused by a neurologic problem.

Herbal and homeopathic remedies

Some herbal remedies, such as horsetail (*Equisetum arvense*) have also been used to treat bed-wetting. A trained homeopathic practitioner, working at the constitutional level, will seek to rebalance the child's vital force, eliminating the imbalanced behavior of bed-wetting. Common homeopathic remedies used in this treatment include *Causticum*, *Lycopodium*, and *Pulsatilla*.

Hypnosis

Hypnosis is another approach that is being used successfully by practitioners trained in this therapy. It trains the child to awaken and go to the bathroom when his or her bladder feels full. Hypnosis is less expensive, less time-consuming, and less dangerous than most approaches; it has virtually no side effects. Recent medical studies show that **hypnotherapy** can work quickly—within four to six sessions.

Prognosis

Occasional bed-wetting is not a disease and it does not have a "cure." If the child has no underlying physical or psychological problem that is causing the bed-wetting, in most cases he or she will outgrow the condition without treatment. About 15% of bedwetters become dry each year after age 6. If bed-wetting is frequent, accompanied by daytime wetting, or falls into the American Psychiatric Association's diagnostic definition of enuresis, a doctor

KEY TERMS

Acupressure—A technique using pressure to various points on the body to alleviate health problems.

ADH—Antidiuretic hormone, or the hormone that helps to concentrate urine during the night.

Behavior modification—Techniques used to change harmful behavior patterns.

Bladder—The muscular sac or container that stores urine until it is released from the body through the tube that carries urine from the bladder to the outside of the body (urethra).

DDAVP—Desmopressin acetate, a drug used to regulate urine production.

Hypnosis—The technique by which a trained professional relaxes the subject and then asks questions or gives suggestions.

Imipramine hydrochloride—A drug used to increase bladder capacity.

Kidneys—A pair of organs located on each side of the spine in the lower back area. They excrete, or get rid of, urine.

Nocturnal enuresis—Involuntary discharge of urine during the night.

Urinalysis—A urine test.

Urine—The fluid excreted by the kidneys, stored in the bladder, then discharged from the body through the tube that carries urine from the bladder to the outside of the body (urethra).

Void—To empty the bladder.

should be consulted. If treatment is indicated, it usually successfully resolves the problem. Marked improvement is seen in about 75% of cases treated with wetness alarms.

Prevention

Although preventing a child from wetting the bed is not always possible, parents can take steps to help the child keep the bed dry at night. These steps include:

- Encouraging and praising the child for staying dry instead of punishing when the child wets.
- Reminding the child to urinate before going to bed, if he or she feels the need.
- Limiting liquid intake at least two hours before bedtime.

Resources

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ORGANIZATIONS

Association for the Care of Children's Health (ACCH). 7910 Woodmont Ave., Suite 300, Bethesda, MD 20814. 800-808-2224.

National Association of Continence. P.O. Box 8310, Spartanburg, SC 29305. (800) 252-3337. <<http://www.nafc.org>>.

National Enuresis Society. 7777 Forest Lane, Suite C-737, Dallas, TX 75230-2518. (800) 697-8080. <<http://www.peds.umn.edu/Centers/NES>>.

Genevieve Slomski, PhD

Beclomethasone see **Corticosteroids**

Bedsores

Definition

Bedsores are also called decubitus ulcers, pressure ulcers, or pressure sores. These tender or inflamed patches develop when skin covering a weight-bearing part of the body is squeezed between bone and another body part, or a bed, chair, splint, or other hard object.

Description

Each year, about one million people in the United States develop bedsores ranging from mild inflammation to deep **wounds** that involve muscle and bone. This often painful condition usually starts with shiny red skin that quickly blisters and deteriorates into open sores that can harbor life-threatening infection.

Bedsores are not cancerous or contagious. They are most likely to occur in people who must use wheelchairs or who are confined to bed. In 1992, the federal Agency for Health Care Policy and Research reported that bedsores afflict:

- 10% of hospital patients
- 25% of nursing home residents
- 60% of quadriplegics

The Agency also noted that 65% of elderly people hospitalized with broken hips develop bedsores and that doctors fees for treatment of bedsores amounted to \$2,900 per person.

Bedsores are most apt to develop on the:

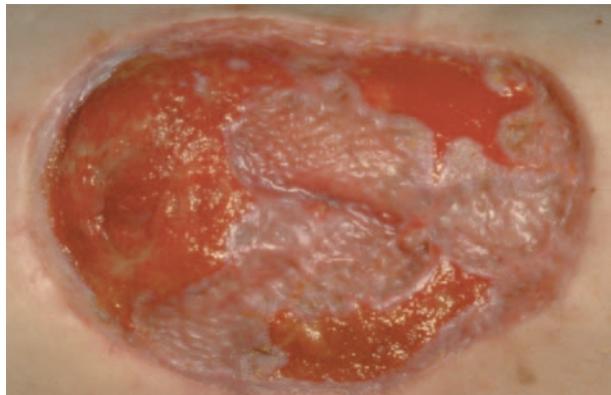
- ankles
- back of the head
- heels
- hips
- knees
- lower back
- shoulder blades
- spine

People over the age of 60 are more likely than younger people to develop bedsores. Risk is also increased by:

- atherosclerosis (hardening of arteries)
- diabetes or other conditions that make skin more susceptible to infection
- diminished sensation or lack of feeling
- heart problems
- incontinence (inability to control bladder or bowel movements)
- malnutrition
- obesity
- paralysis or immobility
- poor circulation
- prolonged bed rest, especially in unsanitary conditions or with wet or wrinkled sheets
- spinal cord injury

Causes and symptoms

Bedsores most often develop when constant pressure pinches tiny blood vessels that deliver oxygen and nutrients to the skin. When skin is deprived of oxygen and nutrients for as little as an hour, areas of tissue can die and bedsores can form.



Bedsore. (Photograph by Michael English, M.D., Custom Medical Stock Photo. Reproduced by permission.)

Slight rubbing or friction against the skin can cause minor pressure ulcers. They can also develop when a patient stretches or bends blood vessels by slipping into a different position in a bed or chair.

Urine, feces, or other moisture increases the risk of skin infection, and people who are unable to move or recognize internal cues to shift position have a greater than average risk of developing bedsores.

Other risk factors include:

- malnutrition
- anemia (lack of red blood cells)
- disuse atrophy (muscle loss or weakness from lack of use)
- infection

Diagnosis

Physical examination, medical history, and patient and caregiver observations are the basis of diagnosis. Special attention must be paid to physical or mental problems, like incontinence or confusion, that could complicate a patient's recovery.

Bedsores usually follow six stages:

- redness of skin
- redness, swelling, and possible peeling of outer layer of skin
- dead skin, draining wound, and exposed layer of fat
- tissue **death** through skin and fat, to muscle
- inner fat and muscle death
- destruction of bone, bone, infection, fracture, and blood infection

Treatment

Prompt medical attention can prevent surface pressure sores from deepening into more serious infections. For mild bedsores, treatment involves relieving pressure, keeping the wound clean and moist, and keeping the area around the ulcer clean and dry. **Antiseptics**, harsh soaps, and other skin cleansers can damage new tissue, so a saline solution should be used to cleanse the wound whenever a fresh non-stick dressing is applied.

The patient's doctor may prescribe infection-fighting **antibiotics**, special dressings or drying agents, or lotions or ointments to be applied to the wound in a thin film three or four times a day. Warm whirlpool treatments are sometimes recommended for sores on the arm, hand, foot, or leg.

In a procedure called debriding, a scalpel may be used to remove dead tissue or other debris from the wound. Deep, ulcerated sores that don't respond to other therapy may require skin grafts or plastic surgery.

A doctor should be notified whenever a person:

- will be bedridden or immobilized for an extended time
- is very weak or unable to move
- develops bedsores

Immediate medical attention is required whenever:

- skin turns black or becomes inflamed, tender, swollen, or warm to the touch.
- the patient develops a **fever** during treatment.
- the sore contains pus or has a foul-smelling discharge.

With proper treatment, bedsores should begin to heal two to four weeks after treatment begins.

Alternative treatment

Zinc and **vitamins A, C, E, and B complex** help skin repair injuries and stay healthy, but large doses of vitamins or **minerals** should never be used without a doctor's approval.

A poultice made of equal parts of powdered slippery elm (*Ulmus fulva*), marsh mallow (*Althaea officinalis*), and **echinacea** (*Echinacea* spp.) blended with a small amount of hot water can relieve minor inflammation. An infection-fighting rinse can be made by diluting two drops of essential tea tree oil (*Melaleuca* spp.) in eight ounces of water. An herbal tea made from the calendula (*Calendula officinalis*) can act as an antiseptic and wound healing agent. Calendula cream can also be used.

Contrasting hot and cold local applications can increase circulation to the area and help flush out waste products, speeding the healing process. The temperatures

should be extreme (hot hot and ice cold), yet tolerable to the skin. Hot compresses should be applied for three minutes, followed by 30 seconds of cold compress application, repeating the cycle three times. The cycle should always end with the cold compress.

Prevention

It is usually possible to prevent bedsores from developing or worsening. The patient should be inspected regularly; should bathe or shower every day, using warm water and mild soap; and should avoid cold or dry air. A bedridden patient should be repositioned at least once every two hours while awake. A person who uses a wheelchair should shift his weight every 10 or 15 minutes, or be helped to reposition himself at least once an hour. It is important to lift, rather than drag, a person being repositioned. Bony parts of the body should not be massaged. Even slight friction can remove the top layer of skin and damage blood vessels beneath it.

If the patient is bedridden, sensitive body parts can be protected by:

- sheepskin pads
- special cushions placed on top of a mattress
- a water-filled mattress
- a variable-pressure mattress whose sections can be individually inflated or deflated to redistribute pressure

Pillows or foam wedges can prevent a bedridden patient's ankles from irritating each other, and pillows placed under the legs from mid-calf to ankle can raise the heels off the bed. Raising the head of the bed slightly and briefly can provide relief, but raising the head of the bed more than 30 degrees can cause the patient to slide, thereby causing damage to skin and tiny blood vessels.

A person who uses a wheelchair should be encouraged to sit up as straight as possible. Pillows behind the head and between the legs can help prevent bedsores, as can a special cushion placed on the chair seat. Donut-shaped cushions should not be used because they restrict blood flow and cause tissues to swell.

Prognosis

Bedsores can usually be cured, but about 60,000 deaths a year are attributed to complications caused by bedsores. Bedsores can be slow to heal. Without proper treatment, they can lead to:

- gangrene (tissue death)
- osteomyelitis (infection of the bone beneath the bed-sore)
- sepsis (tissue-destroying bacterial infection)

- other localized or systemic infections that slow the healing process, increase the cost of treatment, lengthen hospital or nursing home stays, or cause death

Resources

BOOKS

The Editors of Time-Life Books. *The Medical Advisor: The Complete Guide to Alternative and Conventional Treatments*. Alexandria, VA: Time Life, Inc., 1996.

ORGANIZATIONS

International Association of Enterostomal Therapy. 27241 La Paz Road, Suite 121, Laguna Niguel, CA 92656. (714) 476-0268.

National Pressure Ulcer Advisory Panel. SUNY at Buffalo, Beck Hall, 3435 Main St., Buffalo, NY 14214. (716) 881-3558. <<http://www.npuap.org>>.

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“Treatment of Bed Sores.” U. S. Department of Health and Human Services. 15 Mar. 1998 <<http://www.os.dhhs.gov>>.

Maureen Haggerty

Beef tapeworm infection see **Tapeworm diseases**

Behavior therapy see **Cognitive-behavioral therapy**

■ Behcet's syndrome

Definition

A group of symptoms that affect a variety of body systems, including musculoskeletal, gastrointestinal, and the central nervous system. These symptoms include ulceration of the mouth or the genital area, **skin lesions**, and inflammation of the uvea (an area around the pupil of the eye).

Description

Behcet's syndrome is a chronic disease that involves multiple body systems. The disease is named for a Turk-

ish dermatologist, Hulusi Behcet, who first reported a patient with recurrent mouth and genital ulcers along with **uveitis** in 1937. The disease occurs worldwide, but is most prevalent in Japan, the Middle East, and in the Mediterranean region. There is a wider prevalence among males than females in a ratio of two to one.

Causes and symptoms

The cause of Behcet's syndrome is unknown. Symptoms include recurring ulcers in the mouth or the genital area, skin lesions, arthritis that affects mainly the knees and ankles, **pain** and irritation in the eyes, and **fever**. The mouth and genital ulcers tend to occur in multiples and can be quite painful. In the mouth, these ulcers are generally found on the tongue, gums, and the inside of the lips or jaws. In the genital area, the ulcers usually occur on the penis and scrotum in males and on the vulva of women. The eye inflammation can lead to blindness.

Diagnosis

Because Behcet's syndrome is a multisystem disease, it is difficult to diagnose. International criteria have been proposed to assist in classifying this disease. There is no one diagnostic feature of this disease, so diagnosis depends on grouping together enough symptoms in order to identify the disease. Symptoms of Behcet's syndrome also occur in other diseases, so it is often necessary to rule out the other diseases before a definitive diagnosis can be reached.

Treatment

Some of the current drugs used to treat Behcet's syndrome include:

- corticosteroids
- cyclosporin
- azathioprine
- chlorambucil
- interferon alpha
- thalidomide
- levamisole
- pulse cyclophosphamide
- cyclosporine

Prognosis

The prognosis for Behcet's syndrome is generally poor. There has been a documented case of Behcet's lasting for 17 years. Although the disease is considered painful but not fatal, when the central nervous system is involved there is usually severe disability and **death** often occurs. The condition is usually chronic, although there can be remissions during the course of the disease.

KEY TERMS

Remission—When active symptoms of a chronic disease are absent.

Uveitis—Inflammation of the area of the eye around the pupil.

There is no predictable method to determine which patients will progress into the more serious symptoms, and which might move into remission.

Prevention

There is no known prevention for Behcet's syndrome.

Resources

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 Shed, L. P. "Thalomid Responsiveness in an Infant with Behcet's Syndrome." *Pediatrics* (June 1999): 1295-1297.

ORGANIZATIONS

- American Behcet's Disease Association. P.O. Box 280240, Memphis, TN 38168-0240. <<http://www.behcets.com>>.
 Behcet's Organization Worldwide, Head Office. P.O. Box 27, Watchet, Somerset TA23 0YJ, United Kingdom. <<http://www.behcets.org>>.
 National Eye Institute. National Institute of Health. Bldg. 31, Rm. 6A32, Bethesda, MD 30892-2510. (800) 869-2020. <<http://www.nei.nih.gov>>.
 National Organization for Rare Disorders. P.O. Box 8923, New Fairfield, CT 06812-8923. (800) 999-6673. <<http://www.rarediseases.org>>.

Kim Sharp, M.Ln.

Bejel

Definition

Bejel, also known as endemic **syphilis**, is a chronic but curable disease, seen mostly in children in arid

regions. Unlike the better-known venereal syphilis, endemic syphilis is not a **sexually transmitted disease**.

Description

Bejel has many other names depending on the locality: siti, dichuchwa, njoovera, belesh, and skerljevo are some of the names. It is most commonly found in the Middle East (Syria, Saudi Arabia, Iraq), Africa, central Asia, and Australia. Bejel is related to **yaws** and **pinta**, but has different symptoms.

Causes and symptoms

Treponema pallidum, the bacteria that causes bejel, is very closely related to the one that causes the sexually transmitted form of syphilis, but transmission is very different. In bejel, transmission is by direct contact, with broken skin or contaminated hands, or indirectly by sharing drinking vessels and eating utensils. *T. pallidum* is passed on mostly between children living in poverty in very unsanitary environments and with poor hygiene.

The skin, bones, and mucous membranes are affected by bejel. Patches and ulcerated sores are common in the mouth, throat, and nasal passages. Gummy lesions may form, even breaking through the palate. Other findings may include a region of swollen lymph nodes and deep bone **pain** in the legs. Eventually, bones may become deformed.

Diagnosis

T. pallidum can be detected by microscopic study of samples taken from the sores or lymph fluid. However, since antibody tests don't distinguish between the types of syphilis, specific diagnosis of the type of syphilis depends on the patient's history, symptoms, and environment.

Treatment

Large doses of benzathine penicillin G given by injection into the muscle can cure this disease in any stage, although it may take longer and require additional doses in later stages. If penicillin cannot be given, the alternative is tetracycline. Since tetracycline can permanently discolor new teeth still forming, it is usually not prescribed for children unless no viable alternative is available.

Prognosis

Bejel is completely curable with antibiotic treatment.

Prevention

The World Health Organization (WHO) has worked with many countries to prevent this and other diseases, and

KEY TERMS

Endemic disease—An infectious disease that occurs frequently in a specific geographical locale. The disease often occurs in cycles. Influenza is an example of an endemic disease.

Lymph—This is a clear, colorless fluid found in lymph vessels and nodes. The lymph nodes contain organisms that destroy bacteria and other disease causing organisms (also called pathogens).

Syphilis—This disease occurs in two forms. One is a sexually transmitted disease caused by a bacteria. The second form is not sexually transmitted, but passed on by direct contact with the patient or through use of shared food dishes and utensils.

the number of cases has been reduced somewhat. Widespread use of penicillin has been responsible for reducing the number of existing cases, but the only way to eliminate bejel is by improving living and sanitation conditions.

Resources

BOOKS

Harrison's Principles of Internal Medicine. Ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.

Jill S Lasker

symptoms. Facial palsies have been linked to conditions such as **Lyme disease**, ear infection, **meningitis**, **syphilis**, German measles (**rubella**), **mumps**, **chickenpox** (varicella), and infection with Epstein-Barr virus (e.g., **infectious mononucleosis**). True Bell's palsy is an idiopathic facial palsy, meaning the root cause cannot be identified. Although Bell's palsy is not life-threatening, it can present symptoms similar to truly serious conditions, such as a **stroke**, ruptured aneurysm, or tumors.

Every year, approximately 40,000–65,000 Americans are stricken with Bell's palsy. Worldwide, there is an annual incidence of 20–30 cases per 100,000 individuals. An individual can be affected at any age, but young and middle-aged adults are the most likely to be affected. It is unusual to see Bell's palsy in people less than 10 years old. Bell's palsy can affect either side of the face, and neither gender seems to be at a greater risk. Pregnant women and individuals with diabetes, **influenza**, a cold, or an upper respiratory infection seem to be at a greater risk. Although it cannot be considered a serious condition from a health standpoint, it can cause extreme **stress**, embarrassment, and inconvenience for those affected.

In the large majority of cases (80–85%), the facial weakness or paralysis is temporary. However, individuals who experience complete paralysis seem to have a poorer recovery rate with only 60% returning to normal. Approximately 4–6% of all Bell's palsy cases result in permanent facial deformity, and another 10–15% experience permanent problems with spasms, twitching, or contracted muscles. Between 2% and 7.3% of individuals who have experienced Bell's palsy will have a recurrence. On average, the first recurrence happens 9.8 years after the first episode; the second, 6.7 years later. One recurrence is very infrequent, and a second is extremely rare.

Bell's palsy

Definition

Bell's palsy describes an unexplained weakness or **paralysis** of the muscles on one side of the face. Afflicted individuals may be unable to close the eye on the affected side of the face, and may also experience tearing, drooling, and hypersensitive hearing. The onset can be quite sudden, sometimes occurring overnight. Although Bell's palsy is unsettling and inconvenient, it is typically not indicative of a serious health problem. The weakness and paralysis resolve completely in the majority of cases.

Description

Bell's palsy has been described as a diagnosis of exclusion because several other disorders present similar

Causes and symptoms

The symptoms of Bell's palsy arise from an inflammation or swelling of the seventh cranial nerve, otherwise called the facial nerve. Both sides of the face have a facial nerve which controls the muscles on that side of the face. The course of the facial nerve passes through a bony canal in the skull. When the nerve becomes swollen, it is compressed since the canal does not allow for any expansion. As further swelling increases the compression, nerve signal conduction is impeded or even prevented. The interference with the nerve signals is seen in the loss of muscle control and tone.

Why the facial nerve becomes inflamed in Bell's palsy is a matter of some debate, and medical researchers and doctors are not in complete agreement. The best-supported evidence implicates the herpes simplex virus (HSV), which is responsible for cold sores and **fever**



This boy's facial paralysis was caused by a tick-borne meningopadiculitis. (*Photo Researchers, Inc. Reproduced by permission.*)

blisters. HSV infection has been discovered in up to 70% of Bell's palsy cases. Most people harbor this virus, although they may not exhibit symptoms.

The major symptom of Bell's palsy is one-sided facial weakness or paralysis. Muscle control is either inadequate or completely missing. There may also be involuntary facial movements, such as twitches, that accompany certain facial expressions. Afflicted individuals frequently have difficulty shutting the affected eye and may not be able to close it at all.

Diagnosis

Although Bell's palsy is not life-threatening, it shares symptoms in common with serious conditions, such as stroke. Therefore, emergency medical attention is a wise and necessary precaution. Bell's palsy affects the facial nerve, unlike most strokes associated with facial weakness which affect higher nerve centers ultimately supplying the facial nerve. These two disorders can be distinguished clinically because most strokes do not cause weakness of the forehead or eyelid muscles.

The fact that Bell's palsy is a diagnosis of exclusion becomes apparent in the course of the medical examina-

tion—the usual mode of examination is to rule out other disorders until only Bell's palsy is left. Disorders that need to be excluded include demyelinating disease (e.g., **multiple sclerosis**), stroke, tumors, bacterial or viral infection, and bone fracture.

During the **physical examination**, the afflicted individual is asked about recent illnesses, accidents, infections, and any other symptoms. A visual exam of the ears, throat, and sinus is done, and hearing is tested. The extent of the symptoms is assessed by grading the symmetry of the face at rest and during voluntary movements, such as wrinkling the forehead, puckering the lips, and closing the affected eye. Involuntary movements are assessed in combination with the voluntary movements. **Neurologic exam** is done to rule out involvement of other parts of the nervous system except for the facial muscles, which would exclude the diagnosis of Bell's palsy.

In response to the individual's medical history, blood tests and possibly a **cerebrospinal fluid (CSF) analysis** are ordered. The results of these tests help determine the presence of a bacterial or viral infection or an inflammatory disease. Electrophysiological tests, in which a muscle or nerve is artificially stimulated, may be used to assess the condition of facial muscles and the facial nerve. Common tests include **electromyography**, which measures voluntary muscle movement, and nerve conduction velocity, which determines the extent of nerve degeneration. Radiological tests may also be included, such as an x ray, as well as imaging tests, such as **magnetic resonance imaging (MRI)** and computed tomography. These tests—especially MRI—allow an excellent view of the nerve itself.

Once all other possibilities are exhausted, a diagnosis of Bell's palsy is made. The following weeks are a period of watchful waiting. Further examinations are done to track recovery. Results from nerve conduction tests may be used to predict an outcome. However, this use is questioned by some doctors and medical researchers since evidence for their predictive value is inconclusive.

If facial movement, even a small amount, has not returned within 3-4 months, the diagnosis of Bell's palsy may need to be reevaluated.

Treatment

Many doctors prescribe an antiviral and/or a steroid for Bell's palsy, but there is some controversy about whether these drugs actually help. The consensus opinion seems to be that, although drugs might not be necessary, they are not dangerous, and they may help in some

cases, especially if there is complete paralysis. If drugs are used, they need to be taken as soon as possible following the onset of symptoms. **Antiviral drugs**, such as acyclovir, famciclovir, or valacyclovir, are prescribed to destroy actively replicating viruses and prevent further damage to the facial nerve. Steroids, such as prednisone, are thought to be useful in reducing swelling and, therefore, compression on the nerve.

In the past, surgery was performed to relieve the compression on the nerve. However, this treatment option is now used very infrequently because it does not guarantee recovery, and it carries the risk of permanent nerve damage.

The need to protect the affected eye is universally promoted. Since the individual may not be able to lower the affected eyelid, the eye may become dry, particularly at night. Excessive dryness can damage the cornea. Daytime treatment includes artificial tears and may include an eye patch or other protective measures. Nighttime treatment involves a more intense effort at keeping the eye protected. Eye lubricants or viscous ointments, along with taping the eye shut, are frequently recommended.

In cases of permanent nerve damage, cosmetic treatment options, such as therapeutic injections of **botulism** toxin or surgery, may be sought or suggested.

Alternative treatment

Practitioners of **traditional Chinese medicine** have historically used **acupuncture** to treat Bell's palsy. There are also some indications that facial massage and **chiropractic** manipulation may help treat the symptoms and improve the outcome. There are also claims of therapeutic value for local injections or ingestion of vitamin B₁₂ supplements.

Prognosis

Most individuals with Bell's palsy begin to notice improvement in their condition within 2-3 weeks of the symptoms' onset. At least 80% of them will be fully recovered within three months. Among the other 20% of afflicted individuals, symptoms may take longer to resolve or they may be permanent. Individuals suffering permanent nerve damage may not regain control of the muscles on the affected side of the face. These muscles may remain weak or paralyzed. If the nerve recovers imperfectly, they may experience involuntary facial twitches or spasms that accompany normal facial expressions.

Prevention

Bell's palsy is not preventable.

KEY TERMS

Antiviral—A drug that prevents viruses from replicating and therefore spreading infection.

Computed tomography—Cross-sectional x rays of the body are compiled to create a three-dimensional image of the body's internal structures.

Electromyography—A recording of the electrical activity generated in the muscle.

Facial nerve—A cranial nerve that controls the muscles in the face.

Magnetic resonance imaging (MRI)—This imaging technique uses a large circular magnet and radio waves to generate signals from atoms in the body. These signals are used to construct images of internal structures.

Nerve conduction velocity—A recording of how well a nerve conducts electrical impulses.

Steroid—A drug used to reduce swelling and fluid accumulation.

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ORGANIZATIONS

Bell's Palsy Research Foundation. 9121 E. Tanque Verde, Suite 105-286, Tucson, AZ 85749. (520) 749-4614.

Julia Barrett

Benazepril see **Angiotensin-converting enzyme inhibitors**

Bence Jones protein test

Definition

Bence Jones proteins are small proteins (light chains of immunoglobulin) found in the urine. Testing for these proteins is done to diagnose and monitor **multiple myeloma** and other similar diseases.

KEY TERMS

Bence Jones protein—Small protein, composed of a light chain of immunoglobulin, made by plasma cells.

Multiple myeloma—A tumor of the plasma cells.

Plasma cells—A type of white blood cell.

Purpose

Bence Jones proteins are considered the first tumor marker. A tumor marker is a substance, made by the body, that is linked to a certain **cancer**, or malignancy. Bence Jones proteins are made by plasma cells, a type of white blood cell. The presence of these proteins in a person's urine is associated with a malignancy of plasma cells.

Multiple myeloma, a tumor of plasma cells, is the disease most often linked with Bence Jones proteins. The amount of Bence Jones proteins in the urine indicates how much tumor is present. Physicians use Bence Jones proteins testing to diagnose the disease as well as to check how well the disease is responding to treatment.

Other diseases involving cancerous or excessive growth of plasma cells or cells similar to plasma cells can cause Bence Jones proteins in the urine. These diseases include: Waldenström's macroglobulinemia, some lymphomas and leukemias, osteogenic sarcoma, cryoglobulinemia, malignant B-cell disease, **amyloidosis**, light chain disease, and cancer that has spread to bone.

Description

Urine is the best specimen in which to look for Bence Jones proteins. Proteins are usually too large to move through a healthy kidney, from the blood into the urine. Bence Jones proteins are an exception. They are small enough to move quickly and easily through the kidney into the urine.

A routine **urinalysis** will not detect Bence Jones proteins. There are several methods used by laboratories to detect and measure these proteins. The classic Bence Jones reaction involves heating urine to 140°F (60°C). At this temperature, the Bence Jones proteins will clump. The clumping disappears if the urine is further heated to boiling and reappears when the urine is cooled. Other clumping procedures using salts, acids, and other chemicals are also used to detect these proteins. These types of

test will reveal whether or not Bence Jones proteins are present, but not how much is present.

A more complex procedure is done to measure the exact amount of Bence Jones proteins. This procedure—immunoelectrophoresis—is usually done on urine that has been collected for 24-hours.

The test is covered by insurance when medically necessary. Results are usually available within several days.

Preparation

Urine is usually collected throughout a 24-hour time period. A person is given a large container in which to collect the urine. The urine should be refrigerated until it is brought to the laboratory or physician's office.

Normal results

Bence Jones proteins normally are not present in the urine.

Abnormal results

Bence Jones proteins are present in 50–80% of people with multiple myeloma. People with other malignancies also can have a positive Bence Jones proteins test, but less frequently.

Certain nonmalignant diseases, such as **rheumatoid arthritis**, **systemic lupus erythematosus**, and chronic renal insufficiency, can have Bence Jones proteins in the urine. High doses of penicillin or **aspirin** before collecting the urine can give a false positive result.

Resources

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Clinical Diagnosis and Management by Laboratory Methods. 19th ed. Philadelphia: W. B. Saunders Co., 1996.

Mosby's Manual of Diagnostic and Laboratory Tests. St. Louis: Mosby, Inc., 1998.

Nancy J. Nordenson

Bender-Gestalt test

Definition

The Bender Visual Motor Gestalt test (or Bender-Gestalt test) is a psychological assessment used to evaluate

ate visual-motor functioning, visual-perceptual skills, neurological impairment, and emotional disturbances in children and adults ages three and older.

Purpose

The Bender-Gestalt is used to evaluate visual-motor maturity and to screen children for developmental delays. The test is also used to assess brain damage and neurological deficits. Individuals who have suffered a traumatic brain injury may be given the Bender-Gestalt as part of a battery of neuropsychological measures, or tests.

The Bender-Gestalt is sometimes used in conjunction with other personality tests to determine the presence of emotional and psychiatric disturbances such as schizophrenia.

Precautions

Psychometric testing requires a clinically trained examiner. The Bender Visual Motor Gestalt Test should be administered and interpreted by a trained psychologist or psychiatrist. The Bender-Gestalt should always be employed as only one element of a complete battery of psychological or developmental tests, and should never be used alone as the sole basis for a diagnosis.

Description

The original Bender Visual Motor Gestalt test was developed in 1938 by psychiatrist Lauretta Bender. There are several different versions of the Bender-Gestalt available today (i.e., the Bender-Gestalt test; Modified Version of the Bender-Gestalt test for Preschool and Primary School Children; the Hutt Adaptation of the Bender-Gestalt test; the Bender Visual Motor Gestalt test for Children; the Bender-Gestalt test for Young Children; the Watkins Bender-Gestalt Scoring System; the Canter Background Interference Procedure for the Bender-Gestalt test). All use the same basic test materials, but vary in their scoring and interpretation methods.

The standard Bender Visual Motor Gestalt test consists of nine figures, each on its own 3×5 card. An examiner presents each figure to the test subject one at a time and asks the subject to copy it onto a single piece of blank paper. The only instruction given to the subject is that he or she should make the best reproduction of the figure possible. The test is not timed, although standard administration time is typically 10–20 minutes. After testing is complete, the results are scored based on accuracy and organization. Interpretation depends on the form of the test in use. Common features considered in evaluating the drawings are rotation, distortion, symme-

KEY TERMS

Neuropsychological test—A test or assessment given to diagnose a brain disorder or disease.

Perseveration—The persistence of a repetitive response after the cause of the response has been removed, or the response continues to different stimuli.

Visual-motor skills—Hand-eye coordination; in the Bender-Gestalt test, visual-motor skills are measured by the subject's ability to accurately perceive and then reproduce figures.

Visual-perceptual skills—The capacity of the mind and the eye to "see" something as it objectively exists.

try, and perseveration. As an example, a patient with frontal lobe injury may reproduce the same pattern over and over (perseveration).

The Bender-Gestalt can also be administered in a group setting. In group testing, the figures are shown to test subjects with a slide projector, in a test booklet, or on larger versions of the individual test cards. Both the individual and group-administered Bender-Gestalt evaluation may take place in either an outpatient or hospital setting. Patients should check with their insurance plans to determine if these or other mental health services are covered.

Normal results

Children normally improve in this test as they age, but, because of the complexity of the scoring process, results for the Bender-Gestalt should only be interpreted by a clinically trained psychologist or psychiatrist.

Resources

BOOKS

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Piotrowski, C. "A Review of the Clinical and Research Use of the Bender-Gestalt Test." *Perceptual Motor Skills* 81, no. 3, pt. 2 (Dec. 1995): 1271-74.

ORGANIZATIONS

American Psychological Association (APA). 750 First St. NE, Washington, DC 20002-4242. (202) 336-5700. <<http://www.apa.org>>.

Paula Anne Ford-Martin

Bends see **Decompression sickness**

Benign see **Uterine fibroids**

Benign prostatic hyperplasia see **Enlarged prostate**

Benign prostatic hypertrophy see **Enlarged prostate**

Benzocaine see **Antiseptics**

Benzodiazepines

Definition

Benzodiazepines are medicines that help relieve nervousness, tension, and other symptoms by slowing the central nervous system.

Purpose

Benzodiazepines are a type of **antianxiety drugs**. While **anxiety** is a normal response to stressful situations, some people have unusually high levels of anxiety that can interfere with everyday life. For these people, benzodiazepines can help bring their feelings under control. The medicine can also relieve troubling symptoms of anxiety, such as pounding heartbeat, breathing problems, irritability, nausea, and faintness.

Physicians may sometimes prescribe these drugs for other conditions, such as muscle spasms, epilepsy and other seizure disorders, **phobias**, **panic disorder**, withdrawal from alcohol, and sleeping problems. However, this medicine should not be used every day for sleep problems that last more than a few days. If used this way, the drug loses its effectiveness within a few weeks.

Benzodiazepines should not be used to relieve the nervousness and tension of normal everyday life.

Description

The family of antianxiety drugs known as benzodiazepines includes alprazolam (Xanax), chlordiazepoxide (Librium), diazepam (Valium), and lorazepam (Ativan). These medicines take effect fairly quickly, starting to work within an hour after they are taken. Benzodiazepines are

available only with a physician's prescription and are available in tablet, capsule, liquid, or injectable forms.

Recommended dosage

The recommended dosage depends on the type of benzodiazepine, its strength, and the condition for which it is being taken. Doses may be different for different people. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Always take benzodiazepines exactly as directed. Never take larger or more frequent doses, and do not take the drug for longer than directed. If the medicine does not seem to be working, check with the physician who prescribed it. *Do not increase the dose or stop taking the medicine unless the physician says to do so.* Stopping the drug suddenly may cause withdrawal symptoms, especially if it has been taken in large doses or over a long period. People who are taking the medicine for seizure disorders may have seizures if they stop taking it suddenly. If it is necessary to stop taking the medicine, check with a physician for directions on how to stop. The physician may recommend tapering down gradually to reduce the chance of withdrawal symptoms or other problems.

Precautions

Seeing a physician regularly while taking benzodiazepines is important, especially during the first few months of treatment. The physician will check to make sure the medicine is working as it should and will note unwanted side effects.

People who take benzodiazepines to relieve nervousness, tension, or symptoms of panic disorder should check with their physicians every two to three months to make sure they still need to keep taking the medicine.

Patients who are taking benzodiazepines for sleep problems should check with their physicians if they are not sleeping better within 7-10 days. Sleep problems that last longer than this may be a sign of another medical problem.

People who take this medicine to help them sleep may have trouble sleeping when they stop taking the medicine. This effect should last only a few nights.

Some people, especially older people, feel drowsy, dizzy, lightheaded, or less alert when using benzodiazepines. The drugs may also cause clumsiness or unsteadiness. When the medicine is taken at bedtime, these effects may even occur the next morning. Anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Benzodiazepines may also cause behavior changes in some people, similar to those seen in people who act differently when they drink alcohol. More extreme changes, such as confusion, agitation, and **hallucinations**, also are possible. Anyone who starts having strange or unusual thoughts or behavior while taking this medicine should get in touch with his or her physician.

Because benzodiazepines work on the central nervous system, they may add to the effects of alcohol and other drugs that slow down the central nervous system, such as **antihistamines**, cold medicine, allergy medicine, sleep aids, medicine for seizures, tranquilizers, some **pain** relievers, and **muscle relaxants**. They may also add to the effects of anesthetics, including those used for dental procedures. These effects may last several days after treatment with benzodiazepines ends. *The combined effects of benzodiazepines and alcohol or other CNS depressants (drugs that slow the central nervous system) can be very dangerous, leading to unconsciousness or, rarely, even death.* Anyone taking benzodiazepines should not drink alcohol and should check with his or her physician before using any CNS depressants. *Taking an overdose of benzodiazepines can also cause unconsciousness and possibly death.* Anyone who shows signs of an overdose or of the effects of combining benzodiazepines with alcohol or other drugs should get immediate emergency help. Warning signs include slurred speech or confusion, severe drowsiness, staggering, and profound weakness.

Some benzodiazepines may change the results of certain medical tests. Before having medical tests, anyone taking this medicine should alert the health care professional in charge.

Children are generally more sensitive than adults to the effects of benzodiazepines. This sensitivity may increase the chance of side effects.

Older people are more sensitive than younger adults to the effects of this medicine and may be at greater risk for side effects. Older people who take these drugs to help them sleep may be drowsy during the day. Older people also increase their risk of falling and injuring themselves when they take these drugs.

Special conditions

People with certain medical conditions or who are taking certain other medicines can have problems if they take benzodiazepines. Before taking these drugs, be sure to let the physician know about any of these conditions:

ALLERGIES. Anyone who has had unusual reactions to benzodiazepines or other mood-altering drugs in the past should let his or her physician know before taking the drugs again. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY. Some benzodiazepines increase the likelihood of **birth defects**. Using these medicines during **pregnancy** may also cause the baby to become dependent on them and to have withdrawal symptoms after birth. When taken late in pregnancy or around the time of labor and delivery, these drugs can cause other problems in the newborn baby, such as weakness, breathing problems, slow heartbeat, and body temperature problems.

Women who are pregnant or who may become pregnant should not use benzodiazepines unless their anxiety is so severe that it threatens their pregnancy. Any woman who must take this medicine while pregnant should be sure to thoroughly discuss its risks and benefits with her physician.

BREASTFEEDING. Benzodiazepines may pass into breast milk and cause problems in babies whose mothers taken the medicine. These problems include drowsiness, breathing problems, and slow heartbeat. Women who are breastfeeding their babies should not use this medicine without checking with their physicians.

OTHER MEDICAL CONDITIONS. Before using benzodiazepines, people with any of these medical problems should make sure their physicians are aware of their conditions:

- current or past drug or alcohol abuse
- depression
- severe mental illness
- epilepsy or other seizure disorders
- swallowing problems
- chronic lung disease such as **emphysema**, **asthma**, or **chronic bronchitis**
- kidney disease
- liver disease
- brain disease
- **glaucoma**
- hyperactivity
- myasthenia gravis
- porphyria
- sleep apnea

USE OF CERTAIN MEDICINES. Taking benzodiazepines with certain other drugs may affect the way the drugs work or may increase the chance of side effects.

Side effects

The most common side effects are **dizziness**, light-headedness, drowsiness, clumsiness, unsteadiness, and

KEY TERMS

Anxiety—Worry or tension in response to real or imagined stress, danger, or dreaded situations. Physical reactions, such as fast pulse, sweating, trembling, fatigue, and weakness may accompany anxiety.

Asthma—A disease in which the air passages of the lungs become inflamed and narrowed.

Bronchitis—Inflammation of the air passages of the lungs.

Central nervous system—The brain, spinal cord and the nerves throughout the body.

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

Emphysema—An irreversible lung disease in which breathing becomes increasingly difficult.

Epilepsy—A brain disorder with symptoms that include seizures.

Glaucoma—A condition in which pressure in the eye is abnormally high. If not treated, glaucoma may lead to blindness.

Myasthenia gravis—A chronic disease with symptoms that include muscle weakness and sometimes paralysis.

Panic disorder—A disorder in which people have sudden and intense attacks of anxiety in certain situations. Symptoms such as shortness of breath, sweating, dizziness, chest pain, and extreme fear often accompany the attacks.

Phobia—An intense, abnormal, or illogical fear of something specific, such as heights or open spaces.

Porphyria—A disorder in which porphyrins build up in the blood and urine.

Porphyrin—A type of pigment found in living things.

Seizure—A sudden attack, spasm, or convulsion.

Sleep apnea—A condition in which a person temporarily stops breathing during sleep.

Withdrawal symptoms—A group of physical or mental symptoms that may occur when a person suddenly stops using a drug to which he or she has become dependent.

slurred speech. These problems usually go away as the body adjusts to the drug and do not require medical treatment unless they persist or they interfere with normal activities.

More serious side effects are not common, but may occur. If any of the following side effects occur, check with the physician who prescribed the medicine as soon as possible:

- behavior changes
- memory problems
- difficulty concentrating
- confusion
- depression
- seizures (convulsions)
- hallucinations
- sleep problems
- increased nervousness, excitability, or irritability
- involuntary movements of the body, including the eyes
- low blood pressure

- unusual weakness or tiredness
- skin rash or **itching**
- unusual bleeding or bruising
- yellow skin or eyes
- sore throat
- sores in the mouth or throat
- **fever** and chills

Patients who take benzodiazepines for a long time or at high doses may notice side effects for several weeks after they stop taking the drug. They should check with their physicians if these or other troublesome symptoms occur:

- irritability
- nervousness
- sleep problems

Other rare side effects may occur. Anyone who has unusual symptoms during or after treatment with benzodiazepines should get in touch with his or her physician.

Interactions

Benzodiazepines may interact with a variety of other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Anyone who takes benzodiazepines should let the physician know all other medicines he or she is taking. Among the drugs that may interact with benzodiazepines are:

- Central nervous system (CNS) depressants such as medicine for allergies, colds, hay fever, and asthma; sedatives; tranquilizers; prescription pain medicine; muscle relaxants; medicine for seizures; sleep aids; **barbiturates**; and anesthetics.

Medicines other than those listed above may interact with benzodiazepines. Be sure to check with a physician or pharmacist before combining benzodiazepines with any other prescription or nonprescription (over-the-counter) medicine.

Resources

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Nancy Ross-Flanigan

Benzoyl peroxide see **Antiacne drugs**

Benztropine see **Antiparkinson drugs**

Berger's disease see **Idiopathic primary renal hematuric/proteinuric syndrome**

caused by something in food. Not until the early 1900s did scientists discover that rice bran, the outer covering that was removed to create the polished white rice preferred by Asians, actually contained something that prevented the disease. Thiamine was the first vitamin identified. In the 1920s, extracts of rice polishings were used to treat the disease.

In adults, there are different forms of beriberi, classified according to the body systems most affected. Dry beriberi involves the nervous system; wet beriberi affects the heart and circulation. Both types usually occur in the same patient, with one set of symptoms predominating.

A less common form of cardiovascular, or wet beriberi, is known as "shoshin." This condition involves a rapid appearance of symptoms and acute **heart failure**. It is highly fatal and is known to cause sudden **death** in young migrant laborers in Asia whose diet consists of white rice.

Cerebral beriberi, also known as Wernicke-Korsakoff syndrome, usually occurs in chronic alcoholics and affects the central nervous system (brain and spinal cord). It can be caused by a situation that aggravates a chronic thiamine deficiency, like an alcoholic binge or severe vomiting.

Infantile beriberi is seen in breastfed infants of thiamine-deficient mothers, who live in developing nations.

Although severe beriberi is uncommon in the United States, less severe thiamine deficiencies do occur. About 25% of all alcoholics admitted to a hospital in the United States show some evidence of thiamine deficiency.

Causes and symptoms

Thiamine is one of the **B vitamins** and plays an important role in energy metabolism and tissue building. It combines with phosphate to form the coenzyme *thiamine pyrophosphate (TPP)*, which is essential in reactions that produce energy from glucose or that convert glucose to fat for storage in the tissues. When there is not enough thiamine in the diet, these basic energy functions are disturbed, leading to problems throughout the body.

Special situations, such as an over-active metabolism, prolonged **fever**, **pregnancy**, and breastfeeding, can increase the body's thiamine requirements and lead to symptoms of deficiency. Extended periods of **diarrhea** or chronic liver disease can result in the body's inability to maintain normal levels of many nutrients, including thiamine. Other persons at risk are patients with kidney failure on dialysis and those with severe digestive problems who are unable to absorb nutrients. Alcoholics are susceptible because they may substitute alcohol for food and their frequent intake of alcohol decreases the body's ability to absorb thiamine.

Beriberi

Definition

Beriberi is a disease caused by a deficiency of thiamine (vitamin B₁) that affects many systems of the body, including the muscles, heart, nerves, and digestive system. Beriberi literally means "I can't, I can't" in Singhalese, which reflects the crippling effect it has on its victims. It is common in parts of southeast Asia, where white rice is the main food. In the United States, beriberi is primarily seen in people with chronic **alcoholism**.

Description

Beriberi puzzled medical experts for years as it ravaged people of all ages in Asia. Doctors thought it was

The following systems are most affected by beriberi:

- Gastrointestinal system. When the cells of the smooth muscles in the digestive system and glands do not get enough energy from glucose, they are unable to produce more glucose from the normal digestion of food. There is a loss of appetite, **indigestion**, severe **constipation**, and a lack of hydrochloric acid in the stomach.
- Nervous System. Glucose is essential for the central nervous system to function normally. Early deficiency symptoms are **fatigue**, irritability, and poor memory. If the deficiency continues, there is damage to the peripheral nerves that causes loss of sensation and muscle weakness, which is called **peripheral neuropathy**. The legs are most affected. The toes feel numb and the feet have a burning sensation; the leg muscles become sore and the calf muscles cramp. The individual walks unsteadily and has difficulty getting up from a squatting position. Eventually, the muscles shrink (atrophy) and there is a loss of reflexes in the knees and feet; the feet may hang limp (footdrop).
- Cardiovascular system. There is a rapid heartbeat and sweating. Eventually the heart muscle weakens. Because the smooth muscle in the blood vessels is affected, the arteries and veins relax, causing swelling, known as **edema**, in the legs.
- Musculoskeletal system. There is widespread muscle **pain** caused by the lack of TPP in the muscle tissue.

Infants who are breastfed by a thiamine-deficient mother usually develop symptoms of deficiency between the second and fourth month of life. They are pale, restless, unable to sleep, prone to diarrhea, and have muscle wasting and edema in their arms and legs. They have a characteristic, sometimes silent, cry and develop heart failure and nerve damage.

Diagnosis

A **physical examination** will reveal many of the early symptoms of beriberi, such as fatigue, irritation, nausea, constipation, and poor memory, but the deficiency may be difficult to identify. Information about the individual's diet and general health is also needed.

There are many biochemical tests based on thiamine metabolism or the functions of TPP that can detect a thiamine deficiency. Levels of thiamine can be measured in the blood and urine and will be reduced if there is a deficiency. The urine can be collected for 24 hours to measure the level of thiamine excreted. Another reliable test measures the effect of TPP on red blood cell activity since all forms of beriberi affect the metabolism of red blood cells.

An electroencephalogram (EEG), which measures electrical activity in the brain, may be done to rule out other causes of neurologic changes. Observing improvements in the patient after giving thiamine supplements will also confirm the diagnosis.

Treatment

Treatment with thiamine reverses the deficiency in the body and relieves most of the symptoms. Severe thiamine deficiency is treated with high doses of thiamine given by injection into a muscle (intramuscular) or in a solution that goes into a vein (intravenously) for several days. Then smaller doses can be given either by injection or in pill form until the patient recovers. Usually there are other deficiencies in the B vitamins that will also need treatment.

The cardiovascular symptoms of wet beriberi can respond to treatment within a few hours if they are not too severe. Heart failure may require additional treatment with **diuretics** that help eliminate excess fluid and with heart-strengthening drugs like digitalis.

Recovery from peripheral neuropathy and other symptoms of dry beriberi may take longer and patients frequently become discouraged. They should stay active; physical therapy will also help in recovery.

Infantile beriberi is treated by giving thiamine to both the infant and the breast feeding mother until levels are normal.

In Wernicke-Korsakoff syndrome, thiamine should be given intravenously or by injection at first because the intestinal absorption of thiamine is probably impaired and the patient is very ill. Most of the symptoms will be relieved by treatment, though there may be residual memory loss.

Excess thiamine is excreted by the body in the urine, and negative reactions to too much thiamine are rare. Thiamine is unstable in alkali solutions, so it should not be taken with **antacids** or **barbiturates**.

Alternative treatment

Alternative treatments for beriberi deal first with correcting the thiamine deficiency. As in conventional treatments, alternative treatments for beriberi stress a diet rich in foods that provide thiamine and other B vitamins, such as brown rice, whole grains, raw fruits and vegetables, legumes, seeds, nuts, and yogurt. Drinking more than one glass of liquid with a meal should be avoided, since this may wash out the vitamins before they can be absorbed by the body. Thiamine should be taken daily, with the dose depending on the severity of

the disease. Additional supplements of B vitamins, a multivitamin and mineral complex, and Vitamin C are also recommended. Other alternative therapies may help relieve the person's symptoms after the thiamine deficiency is corrected.

Prognosis

Beriberi is fatal if not treated and the longer the deficiency exists, the sicker the person becomes. Most of the symptoms can be reversed and full recovery is possible when thiamine levels are returned to normal and maintained with a balanced diet and vitamin supplements as needed.

Prevention

A balanced diet containing all essential nutrients will prevent a thiamine deficiency and the development of beriberi. People who consume large quantities of junk food like soda, pretzels, chips, candy, and high carbohydrate foods made with unenriched flours may be deficient in thiamine and other vital nutrients. They may need to take vitamin supplements and should improve their diets.

Dietary Requirements

The body's requirements for thiamine are tied to carbohydrate metabolism and expressed in terms of total intake of calories. The current recommended dietary allowances (RDA) are 0.5 mg for every 1,000 calories, with a minimum daily intake of 1 mg even for those who eat fewer than 2,000 calories in a day. The RDA for children and teenagers is the same as for adults: 1.4 mg daily for males over age eleven, and 1.1 mg for females. During pregnancy, an increase to 1.5 mg daily is needed. Because of increased energy needs and the secretion of thiamine in breast milk, breast feeding mothers need 1.5 mg every day. In infants, 0.4 mg is advised.

Food Sources

The best food sources of thiamine are lean pork, beef, liver, brewer's yeast, peas and beans, whole or enriched grains, and breads. The more refined the food, as in white rice, white breads, and some cereals, the lower the thiamine. Many food products are enriched with thiamine, along with riboflavin, niacin, and iron, to prevent dietary deficiency.

During the milling process, rice is polished and all the vitamins in the exterior coating of bran are lost. Boiling the rice before husking preserves the vitamins by distributing them throughout the kernel. Food enrichment programs have eliminated beriberi in Japan and the Phillipines

KEY TERMS

B vitamins—This family of vitamins consists of thiamine (B_1), riboflavin (B_2), niacin (B_3), pantothenic acid (B_5), pyridoxine (B_6), biotin, folic acid (B_9), and cobalamin (B_{12}). They are interdependent and involved in converting glucose to energy.

Coenzyme—A substance needed by enzymes to produce many of the reactions in energy and protein metabolism in the body.

Edema—An excess accumulation of fluid in the cells and tissues.

Enzyme—A protein that acts as a catalyst to produce chemical changes in other substances without being changed themselves.

Metabolism—All the physical and chemical changes that take place within an organism.

Peripheral neuropathy—A disease affecting the portion of the nervous system outside the brain and spinal chord. One or more nerves can be involved, causing sensory loss, muscle weakness and shrinkage, and decreased reflexes.

Thiamine pyrophosphate (TPP)—The coenzyme containing thiamine that is essential in converting glucose to energy.

Like all B vitamins, thiamine is water soluble, which means it is easily dissolved in water. It will leach out during cooking in water and is destroyed by high heat and overcooking.

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Karen Ericson, RN

Berry aneurysm see **Cerebral aneurysm**

Berylliosis

Definition

Berylliosis is lung inflammation caused by inhaling dust or fumes that contain the metallic element beryllium. Found in rocks, coal, soil, and volcanic dust, beryllium is used in the aerospace industry and in many types of manufacturing. Berylliosis occurs in both acute and chronic forms. In some cases, appearance of the disease may be delayed as much as 20 years after exposure to beryllium.

Description

In the 1930s, scientists discovered that beryllium could make fluorescent light bulbs last longer. During the following decade, the hard, grayish metal was identified as the cause of a potentially debilitating, sometimes deadly disease characterized by **shortness of breath** and inflammation, swelling, and scarring of the lungs.

The manufacture of fluorescent light bulbs is no longer a source of beryllium exposure, but serious health hazards are associated with any work environment or process in which beryllium fumes or particles become airborne. Working with pure beryllium, beryllium compounds (e.g. beryllium oxide), or beryllium alloys causes occupational exposure. So do jobs involving:

- electronics
- fiber optics
- manufacturing ceramics, bicycle frames, golf clubs, mirrors, and microwave ovens
- mining
- nuclear weapons and reactors
- reclaiming scrap metal
- space and atomic engineering.
- dental and laboratory technology

Beryllium dust and fumes are classified as toxic air pollutants by the Environmental Protection Agency (EPA). It is estimated that 2–6% of workers exposed to these contaminants eventually develop berylliosis.

Causes and symptoms

Coughing, shortness of breath, and weight loss that begin abruptly can be a symptom of acute berylliosis. This condition is caused by beryllium air pollution that inflames the lungs making them rigid; it can affect the eyes and skin as well. People who have acute berylliosis are usually very ill. Most recover, but some die of the disease.

Chronic berylliosis is an allergic reaction to long-term exposure to even low levels of beryllium dust or fumes. A systemic disease that causes formation of

abnormal lung tissue and enlargement of the lymph nodes, chronic berylliosis also may affect other parts of the body. The symptoms of chronic berylliosis are largely the same as those seen in acute berylliosis, but they develop more slowly.

Diagnosis

Berylliosis is initially suspected if a patient with symptoms of the disease has a history of beryllium exposure. A **chest x ray** shows characteristic changes in the lungs. However, since these changes can resemble those caused by other lung diseases, further testing may be necessary.

The beryllium lymphocyte proliferation test (BeLPT), a blood test that can detect beryllium sensitivity (i.e. an allergic reaction to beryllium), is used to screen individuals at risk of developing berylliosis. When screening results reveal a high level of sensitivity, BeLPT is performed on cells washed from the lungs. This test is now considered the most definitive diagnostic test for berylliosis.

Treatment

Individuals with beryllium sensitivity or early-stage berylliosis should be transferred from tasks that involve beryllium exposure and regularly examined to determine whether the disease has progressed.

Acute berylliosis is a serious disease that occasionally may be fatal. Ventilators can help patients with acute berylliosis breathe. Prompt corticosteroid therapy is required to lessen lung inflammation.

Chronic beryllium disease is incurable. Corticosteroid therapy is often prescribed, but it is not certain that steroids can alter the progression of the disease, and they have no effect on scarring of lung tissue. Cleansing the lungs of beryllium is a slow process, so long-term therapy may be required. **Chelation therapy** is currently under investigation as a treatment for the disease.

Prognosis

Most patients with acute berylliosis recover fully 7–10 days after treatment begins, and the disease usually causes no after effects.

Patients whose lungs are severely damaged by chronic berylliosis may experience fatal **heart failure** because of the strain placed on the heart.

Prevention

Eliminating exposure to beryllium is the surest way to prevent berylliosis. Screening workers who are exposed to beryllium fumes or dust or who develop an allergic reaction to these substances is an effective way to control symptoms and prevent disease progression.

KEY TERMS

Beryllium—A steel-grey, metallic mineral used in the aerospace and nuclear industries and in a variety of manufacturing processes.

Chelation therapy—A treatment using chelating agents, compounds that surround and bind to target substances allowing them to be excreted from the body.

Corticosteroids—A group of anti-inflammatory drugs.

Resources

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ORGANIZATIONS

American Lung Association. 1740 Broadway, New York, NY 10019. (800) 586-4872. <<http://www.lungusa.org>>.

Beryllium Support Group. P.O. Box 2021, Broomfield, CO 80038-2021. (303) 412-7065. <<http://wwwdimensional.com/~mhj>>.

Environmental Health Center. 1025 Connecticut Ave., NW, Washington, DC 20036 (202) 293-2270.

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Maureen Haggerty

Beryllium pneumonosis see **Berylliosis**

Beryllium poisoning see **Berylliosis**

Beta-adrenergic blockers see **Beta blockers**

Beta-thalassemia see **Thalassemia**

Beta₂-microglobulin test

Definition

Beta₂-microglobulin is a protein found on the surface of many cells. Testing is done primarily when evaluating a person for certain kinds of **cancer** affecting white blood cells including chronic lymphocytic leukemia, non-Hodgkin's lymphoma, and **multiple myeloma** or kidney disease.

Purpose

Beta₂-microglobulin is plentiful on the surface of white blood cells. Increased production or destruction of these cells causes Beta₂-microglobulin levels in the blood to increase. This increase is seen in people with cancers involving white blood cells, but it is particularly meaningful in people newly diagnosed with multiple myeloma. Multiple myeloma is a malignancy (cancer) of a certain kind of white blood cell, called a plasma cell. At the time of diagnosis, the Beta₂-microglobulin levels reflect how advanced the disease is and the likely prognosis for that person.

When kidney disease is suspected, comparing blood and urine levels helps identify where the kidney is damaged. Beta₂-microglobulin normally is filtered out of the blood by the kidney's glomeruli (a round mass of capillary loops leading to each kidney tubule), only to be partially reabsorbed back into the blood when it reaches the kidney's tubules. In glomerular kidney disease, the glomeruli can't filter it out of the blood, so levels increase in the blood and decrease in the urine. In tubular kidney disease, the tubules can't reabsorb it back into the blood, so urine levels rise and blood levels fall. After a kidney transplant, increased blood levels may be an early sign of rejection.

Increased urinary levels are found in people with kidney damage caused by high exposure to the heavy metals cadmium and mercury. Periodic testing of workers exposed to these metals helps to detect beginning kidney damage.

Beta₂-microglobulin levels also rise during infection with some viruses, including cytomegalovirus and human **immunodeficiency** virus (HIV). Studies show that as HIV disease advances, beta₂-microglobulin levels rise.

Description

Testing methods vary, but most involve adding the person's serum—the yellow, liquid part of blood—or urine to one or more substances that bind to beta₂-microglobulin in the serum or urine. The amount of the substance(s) bound to beta₂-microglobulin is measured and the original amount of beta₂-microglobulin is determined.

The test is covered by insurance when medically necessary. Results are usually available the next day.

KEY TERMS

Beta₂-microglobulin—A protein found on the surface of many cells, particularly white blood cells.

Chronic lymphocytic leukemia—A cancer of the blood cells characterized by large numbers of cancerous, mature white blood cells and enlarged lymph nodes.

Glomerular kidney disease—Disease of the kidney that affects the glomeruli, the part of the kidney that filters certain substances out of the blood.

Multiple myeloma—A malignancy (cancer) of a certain kind of white blood cell, called a plasma cell.

Non-Hodgkin's lymphoma—Cancer that originates in the lymphatic system and typically spreads throughout the body.

Tubular kidney disease—Disease of the kidney that affect the tubules, the part of the kidney that allows certain substances to be reabsorbed back into the blood.

Preparation

The blood test requires 5 mL of blood. A healthcare worker ties a tourniquet on the person's upper arm, locates a vein in the inner elbow region, and inserts a needle into that vein. Vacuum action draws the blood through the needle into an attached tube. Collection of the sample takes only a few minutes.

Urine may be a single collection or collected throughout a 24-hour time period. The urine should be refrigerated until it is brought to the laboratory and must not become acidic.

Aftercare

Discomfort or bruising may occur at the puncture site or the person may feel dizzy or faint. Pressure to the puncture site until the bleeding stops reduces bruising. Warm packs on the puncture site relieve discomfort.

Normal results

- Serum: less than or equal to 2.7 g/mL
- Urine: less than 1 mg/24 hours or 0–160 g/L

Abnormal results

The meaning of an abnormal result varies with the clinical condition of the person tested. In a person with

multiple myeloma, a higher level means a poorer prognosis than a lower level. In a person with kidney disease, an increased blood level means the problem is tubular, not glomerular. In a kidney transplant patient, an increase may be a sign of rejection, toxic amounts of antirejection medication, or a viral infection. An increased level in a worker exposed to cadmium or mercury may signal beginning kidney damage and in a person with HIV, advancing disease.

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Beta blockers

Definition

Beta blockers are medicines that affect the body's response to certain nerve impulses. This, in turn, decreases the force and rate of the heart's contractions, which lowers blood pressure and reduces the heart's demand for oxygen.

Purpose

The main use of beta blockers is to treat high blood pressure. Some also are used to relieve the type of chest pain called **angina** or to prevent heart attacks in people who already have had one **heart attack**. These drugs may also be prescribed for other conditions, such as migraine, **tremors**, and irregular heartbeat. In eye drop form, they are used to treat certain kinds of **glaucoma**.

Description

Beta blockers, also known as beta-adrenergic blockers, are available only with a physician's prescription.

The come in capsule, tablet, liquid, and injectable forms. Some common beta blockers are atenolol (Tenormin), metoprolol (Lopressor), nadolol (Corgard), propranolol (Inderal), and timolol (Blocadren). Timolol and certain other beta blockers are also sold in eye drop form for treating glaucoma. Eye drops that contain beta blockers include betaxolol (Betoptic), carteolol (Ocupress), and timolol (Timoptic).

Recommended dosage

The recommended dosage depends on the type, strength, and form of beta blocker and the condition for which it is prescribed. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

This medicine may take several weeks to noticeably lower blood pressure. Taking it exactly as directed is important.

Do not stop taking this medicine without checking with the physician who prescribed it. Some conditions may get worse when patients stop taking beta blockers abruptly. This may also increase the risk of heart attack in some people. Because of these possible effects, it is important to keep enough medicine on hand to get through weekends, holidays, and vacations.

Physicians may recommend that patients check their pulse before and after taking this medicine. If the pulse becomes too slow, circulation problems may result.

Precautions

Seeing a physician regularly while taking beta blockers is important. The physician will check to make sure the medicine is working as it should and will watch for unwanted side effects. People who have high blood pressure often feel perfectly fine. However, they should continue to see their physicians even when they feel well so that the physician can keep a close watch on their condition. Patients also need to keep taking their medicine even when they feel fine.

Beta blockers will not cure high blood pressure, but will help control the condition. To avoid the serious health problems that high blood pressure can cause, patients may have to take medicine for the rest of their lives. Furthermore, medicine alone may not be enough. Patients with high blood pressure may also need to avoid certain foods and keep their weight under control. The health care professional who is treating the condition can offer advice on what measures may be necessary. Patients being treated for high blood pressure should not change their **diets** without consulting their physicians.

Anyone taking beta blockers for high blood pressure should not take any other prescription or over-the-counter medicine without first checking with his or her physician. Some medicines may increase blood pressure.

Anyone who is taking beta blockers should be sure to tell the health care professional in charge before having any surgical or dental procedures or receiving emergency treatment.

Some beta blockers may change the results of certain medical tests. Before having medical tests, anyone taking this medicine should alert the health care professional in charge.

Some people feel drowsy, dizzy, or lightheaded when taking beta blockers. Anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Beta blockers may increase sensitivity to cold, especially in older people or people who have poor circulation. Anyone who takes this medicine should dress warmly in cold weather and should be careful not to be exposed to the cold for too long.

People who usually have chest pain when they **exercise** or exert themselves may not have the pain when they are taking beta blockers. This could lead them to be more active than they should be. Anyone taking this medicine should ask his or her physician how much exercise and activity is safe.

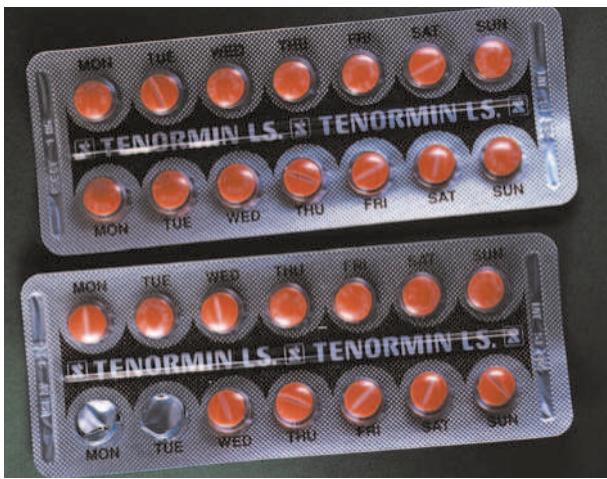
Older people may be unusually sensitive to the effects of beta blockers. This may increase the chance of side effects.

Physicians may advise people taking beta blockers to wear or carry medical identification indicating that they are taking this medicine.

Special conditions

People who have certain medical conditions or who are taking certain other medicines may have problems if they take beta blockers. Before taking these drugs, be sure to let the physician know about any of these conditions:

ALLERGIES. Anyone who has had unusual reactions to beta blockers in the past should let his or her physician know before taking the drugs again. The physician should also be told about any **allergies** to insect stings, medicines, foods, dyes, preservatives, or other substances. In people with allergies to medicines, foods, or insect stings, beta blockers may make the allergic reactions more severe and harder to treat. Anyone who has an allergic reaction while taking beta blockers should get medical attention right away and should make sure the



Blister packs of Tenormin LS (atenolol), a type of beta-receptor blocking drug or beta blocker. This type of drug is widely used to treat angina, to lower blood pressure, or to correct abnormal heart rhythms. (Photograph by Adam Hart-Davis, Photo Researchers, Inc. Reproduced by permission.)

physician in charge knows that he or she is taking this medicine.

Beta blockers may also cause serious reactions in people who take allergy shots. Anyone taking this medicine should be sure to alert the physician before having any allergy shots.

DIABETES. Beta blockers may make blood sugar levels rise and may hide some symptoms of low blood sugar. Diabetic patients should discuss these possible problems with their physicians.

PREGNANCY. Some studies of beta blockers show that these drugs cause problems in newborns whose mothers use them during **pregnancy**. Other studies do not show such effects. Women who are pregnant or who may become pregnant should check with their physicians about the use of beta blockers.

BREASTFEEDING. Some beta blockers pass into breast milk and may cause breathing problems, slow heartbeat, and low blood pressure in nursing babies whose mothers take the drugs. Women who need to take beta blockers and who want to breastfeed their babies should check with their physicians.

OTHER MEDICAL CONDITIONS. Beta blockers may increase breathing problems or make allergic reactions more severe in people who have allergies, **bronchitis**, or **emphysema**.

In people with an overactive thyroid, stopping beta blockers suddenly may cause an increase in symptoms.

Also, taking this medicine may hide a fast heartbeat, which is one of the symptoms of overactive thyroid.

Effects of these drugs may be greater in people with kidney or liver disease because the medicine is cleared from the body more slowly.

Beta blockers may also make the following medical conditions worse:

- Heart or blood vessel disease
- Unusually slow heartbeat (bradycardia)
- Myasthenia gravis (chronic disease causing muscle weakness and possibly **paralysis**)
- Psoriasis (itchy, scaly, red patches of skin)
- Depression (now, or in the past).

Before using beta blockers, people with any of the medical problems listed in this section should make sure their physicians are aware of their conditions.

USE OF CERTAIN MEDICINES. Taking beta blockers with certain other drugs may affect the way the drugs work or may increase the chance of side effects.

Side effects

The most common side effects are **dizziness**, drowsiness, lightheadedness, sleep problems, unusual tiredness or weakness, and decreased sexual ability. In men, this can occur as **impotence** or delayed ejaculation. These problems usually go away as the body adjusts to the drug and do not require medical treatment unless they persist or they interfere with normal activities.

More serious side effects are possible. If any of the following side effects occur, check with the physician who prescribed the medicine as soon as possible:

- Breathing problems
- Slow heartbeat
- Cold hands and feet
- Swollen ankles, feet, or lower legs.
- Mental depression.

Other side effects may occur. Anyone who has unusual symptoms after taking beta blockers should get in touch with his or her physician.

Interactions

Beta blockers may interact with a number of other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Anyone who takes beta blockers should let the physician know all other medicines he or she is taking. Among the drugs that may interact with beta blockers are:

KEY TERMS

Angina pectoris—A feeling of tightness, heaviness, or pain in the chest, caused by a lack of oxygen in the muscular wall of the heart.

Glaucoma—A condition in which pressure in the eye is abnormally high. If not treated, glaucoma may lead to blindness.

Migraine—A throbbing headache that usually affects only one side of the head. Nausea, vomiting, increased sensitivity to light, and other symptoms often accompany migraine.

- Calcium channel blockers and other blood pressure drugs. Using these drugs with beta blockers may cause unwanted effects on the heart.
- Insulin and diabetes medicines taken by mouth. Beta blockers cause high blood sugar or hide the symptoms of low blood sugar.
- Monoamine oxidase inhibitors (MAO) such as phenelzine (Nardil) or tranylcypromine (Parnate), used to treat conditions including depression and **Parkinson's disease**. Taking beta blockers at the same time or within two weeks of taking MAO inhibitors may cause severe high blood pressure.
- Airway-opening drugs (**bronchodilators**) such as aminophylline (Somophyllin), dyphylline (Lufyllin) oxtriphylline (Choledyl), or theophylline (Somo-phyllin-T). When combined with beta blockers, the effects of both the beta blockers and the airway-opening drugs may be lessened.
- **Cocaine**. High blood pressure, fast heartbeat, and heart problems are possible when cocaine and beta blockers are combined. Also, cocaine may interfere with the effects of beta blockers.
- Allergy shots or allergy skin tests. Beta blockers may increase the chance of serious reactions to these medicines.

The list above may not include every drug that interacts with beta blockers. Be sure to check with a physician or pharmacist before combining beta blockers with any other prescription or nonprescription (over-the-counter) medicine.

Nancy Ross-Flanigan

Betamethasone see **Corticosteroids**

Bile duct atresia see **Biliary atresia**

Bile duct cancer

Definition

Bile duct **cancer**, or cholangiocarcinoma, is a malignant tumor of the bile ducts within the liver (intrahepatic), or leading from the liver to the small intestine (extrahepatic). It is a rare tumor with poor outcome for most patients.

Description

Bile is a substance manufactured by the liver that aids in the digestion of food. Bile ducts are channels that carry the bile from the liver to the small intestine. Like the tributaries of a river, the small bile ducts in the liver converge into two large bile ducts called the left and right hepatic ducts. These exit the liver and join to form the common hepatic duct. The gallbladder, which concentrates and stores the bile, empties into the common hepatic duct to form the common bile duct. Finally, this large duct connects to the small intestine where the bile can help digest food. Collectively, this network of bile ducts is called the biliary tract.

Bile duct cancer originates from the cells that line the inner surface of the bile ducts. A tumor may arise anywhere along the biliary tract, either within or outside of the liver. Bile duct tumors are typically slow-growing tumors that spread by local invasion of neighboring structures and by way of lymphatic channels.

Bile duct cancer is an uncommon malignancy. In the United States, approximately one case arises per 100,000 people per year, but it is more common in Southeast Asia. It occurs in men only slightly more often than in women, and it is most commonly diagnosed in people in their 50s and 60s.

Causes and symptoms

A number of risk factors are associated with the development of bile duct cancer:

- Primary sclerosing **cholangitis**. This disease is characterized by extensive scarring of the biliary tract, sometimes associated with inflammatory bowel disease.
- Choledochal cysts. These are abnormal dilatations of the biliary tract that usually form during fetal development. There is evidence that these cysts may rarely arise during adulthood.
- Hepatolithiasis. This is the condition of stone formation within the liver (not including gallbladder stones).
- Liver flukes. Parasitic infection with certain worms is thought to be at least partially responsible for the higher prevalence of bile duct cancer in Southeast Asia.

KEY TERMS

Angiography—Radiographic examination of blood vessels after injection with a special dye

Cholangiography—Radiographic examination of the bile ducts after injection with a special dye

Computed tomography—Radiographic examination by which images of cross-sectional planes of the body are obtained

Jaundice—Yellowish staining of the skin and eyes due to excess bilirubin in the bloodstream

Lymphatic—Pertaining to lymph, the clear fluid that is collected from tissues, flows through special vessels, and joins the venous circulation

Metastasis—The spread of tumor cells from one part of the body to another

Resection—To surgically remove a part of the body

Stent—Slender hollow catheter or rod placed within a vessel for duct to provide support or maintain patency

Ultrasound—Radiographic imaging technique utilizing high frequency sound waves

- Thorotrust. This is a chemical that was previously injected intravenously during certain types of x rays. It is not in use anymore. Exposure to Thorotrust has been implicated in the development of cancer of the liver as well as the bile ducts.

Symptoms

Jaundice is the first symptom in 90% of patients. This occurs when the bile duct tumor causes an obstruction in the normal flow of bile from the liver to the small intestine. Bilirubin, a component of bile, builds up within the liver and is absorbed into the bloodstream in excess amounts. This can be detected in a blood test, but it can also manifest as yellowish discoloring of the skin and eyes. The bilirubin in the bloodstream also makes the urine appear dark. Additionally, the patient may experience generalized **itching** due to the deposition of bile components in the skin. Normally, a portion of the bile is excreted in stool; bile actually gives stool its brown color. But when the biliary tract is obstructed by tumor, the stools may appear pale.

Abdominal pain, fatigue, weight loss, and poor appetite are less common symptoms. Occasionally, if obstruction of the biliary tract causes the gallbladder to

swell enormously yet without causing pain, the physician may be able to feel the gallbladder during a **physical examination**. Sometimes the biliary tract can become infected, but this is normally a rare consequence of invasive tests. Infection causes **fever**, chills, and pain in the right upper portion of the abdomen.

Diagnosis

Certain laboratory tests of the blood may aid in the diagnosis. The most important one is the test for elevated bilirubin levels in the bloodstream. Levels of alkaline phosphatase and CA 19-9 may also be elevated.

When symptoms, physical signs, and blood tests point toward an abnormality of the biliary tract, then the next step involves radiographic tests. Ultrasound and computed tomography (CT scan) are noninvasive and rapid. These tests can often detect the actual tumor as well as dilatation of the obstructed biliary tract. If these tests indicate the presence of a tumor, then cholangiography is required. This procedure involves injecting dye into the biliary tract to obtain anatomic images of the bile ducts and the tumor. The specialist that performs this test can also insert small tubes, or stents, into a partially obstructed portion of the bile duct to prevent further obstruction by growth of the tumor. This is vitally important since it may be the only intervention that is possible in certain patients. Cholangiography is an invasive test that carries a small risk of infection of the biliary tract. The objective of these radiological tests is to determine the size and location of the tumor, as well as the extent of spread to nearby structures.

The treatment of bile duct tumors is usually not affected by the specific type of cancer cells that comprise the tumor. For this reason, some physicians forego biopsy of the tumor.

Treatment

The treatment is with surgical resection (removal) of the tumor and all involved structures. Unfortunately, sometimes the cancer has already spread too far when the diagnosis is made. Thus, in the treatment of bile duct cancer, the first question to answer is if the tumor may be safely resected by surgery with reasonable benefit to the patient. If the cancer involves certain blood vessels or has spread widely throughout the liver, then resection may not be possible. Sometimes further invasive testing is required.

Angiography can determine if the blood vessels are involved. **Laparoscopy** is a surgical procedure that allows the surgeon to directly assess the tumor and nearby lymph nodes without making a large incision in the abdomen. Only about 45% of bile duct cancers are ultimately resectable.

If the tumor is resectable, and the patient is healthy enough to tolerate the operation, then the specific type of surgery performed depends on the location of the tumor. For tumors within the liver or high up in the biliary tract, resection of part of the liver may be required. Tumors in the middle portion of the biliary tract can be removed alone. Tumors of the lower end of the biliary tract may require extensive resection of part of the pancreas, small intestine, and stomach to ensure complete resection.

Unfortunately, sometimes the cancer appears resectable by all the radiological and invasive tests, but is found to be unresectable during surgery. In this scenario, a bypass operation can relieve the biliary tract obstruction, but does not remove the tumor itself. This does not produce a cure but it can offer a better quality of life for the patient.

Chemotherapy and **radiation therapy** have not been proven effective in the treatment of bile duct cancer.

Prognosis

Prognosis depends on the stage and resectability of the tumor. If the patient cannot undergo surgical resection, then the survival rate is commonly less than one year. If the tumor is resected, the survival rate improves, with 20% of these patients surviving past five years.

Clinical trials

Studies of new treatments in patients are known as clinical trials. These trials seek to compare the standard method of care with a new method, or the trials may be trying to establish whether one treatment is more beneficial for certain patients than others. Sometimes, a new treatment that is not being offered on a wide scale may be available to patients participating in clinical trials, but participating in the trials may involve some risk. To learn more about clinical trials, patients can call the National Cancer Institute (NCI) at 1-800-4-CANCER or visit the NCI web site for patients at <<http://www.cancertrials.nci.nih.gov>>.

Prevention

Other than the avoidance of infections caused by liver flukes, there are no known preventions for this cancer.

Resources

BOOKS

Ahrendt, Steven A. and Henry A. Pitt. "Biliary Tract." In *Sabiston Textbook of Surgery*, Edited by Courtney Townsend Jr., 16th ed. Philadelphia: W.B. Saunders Company, 2001, pp. 1076-1111.

Callery, Mark P. and William C. Meyers. "Bile Duct Cancer." In *Current Surgical Therapy*, Edited by John L. Cameron, sixth ed. St Louis: Mosby, 1998, pp.455-161.

"Cholangiocarcinoma." In *Clinical Oncology*, Edited by Abeloff, Martin D., second ed. New York: Churchill Livingstone, 2000, pp.1722-1723.

ORGANIZATIONS

The American Cancer Society. 1-800-ACS 2345. <<http://www.cancer.org>>.

National Cancer Institute Cancer Information Service. 1-800-4-CANCER. <<http://www.nci.nih.gov>>.

American Liver Foundation. 1-800-GO-LIVER (1-800-465-4837). <<http://www.liverfoundation.org>>.

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Bile duct infection see **Cholangitis**

Bile flow obstruction see **Cholestasis**

Bilharziasis see **Schistosomiasis**

Biliary atresia

Definition

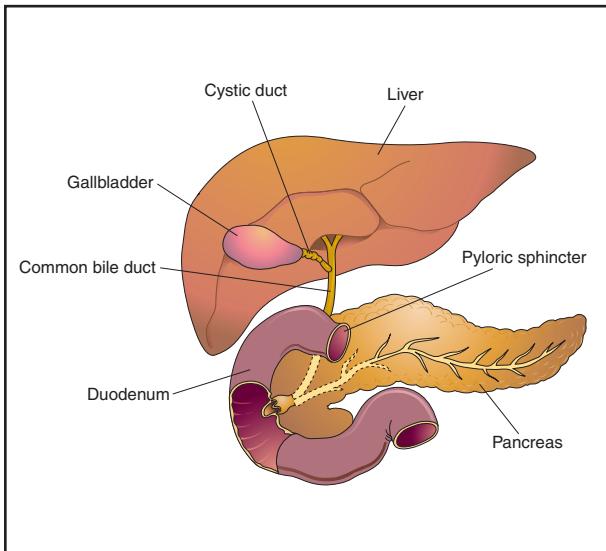
Biliary atresia is the failure of a fetus to develop an adequate pathway for bile to drain from the liver to the intestine.

Description

Biliary atresia is the most common lethal liver disease in children, occurring once every 10,000–15,000 live births. Half of all liver transplants are done for this reason.

The normal anatomy of the bile system begins within the liver, where thousands of tiny bile ducts collect bile from liver cells. These ducts merge into larger and larger channels, like streams flowing into rivers, until they all pour into a single duct that empties into the duodenum (first part of the small intestine). Between the liver and the duodenum this duct has a side channel connected to the gall bladder. The gall bladder stores bile and concentrates it, removing much of its water content. Then, when a meal hits the stomach, the gall bladder contracts and empties its contents.

Bile is a mixture of waste chemicals that the liver removes from the circulation and excretes through the biliary system into the intestine. On its way out, bile assists in the digestion of certain nutrients. If bile cannot get out because the channels are absent or blocked, it backs up into the liver and eventually into the rest of the body. The major pigment in bile is a chemical called bilirubin, which is yellow. Bilirubin is a breakdown product of hemoglobin (the red chemical in blood that carries oxygen). If the body accumulates an excess of bilirubin,



Biliary atresia is a congenital condition in which the pathway for bile to drain from the liver to the intestine is undeveloped. It is the most common lethal liver disease in children. (Illustration by Electronic Illustrators Group).

it turns yellow (jaundiced). Bile also turns the stool brown. Without it, stools are the color of clay.

Causes and symptoms

It is possible that a viral infection is responsible for this disease, but evidence is not yet convincing. The cause remains unknown.

The affected infant will appear normal at birth and during the newborn period. After two weeks the normal **jaundice** of the newborn will not disappear, and the stools will probably be clay-colored. At this point, the condition will come to the attention of a physician. If not, the child's abdomen will begin to swell, and the infant will get progressively more ill. Nearly all untreated children will die of liver failure within two years.

Diagnosis

The persistence of jaundice beyond the second week in a newborn with clay-colored stools is a sure sign of obstruction to the flow of bile. An immediate evaluation that includes blood tests and imaging of the biliary system will confirm the diagnosis.

Treatment

Surgery is the only treatment. Somehow the surgeon must create an adequate pathway for bile to escape the liver into the intestine. The altered anatomy of the biliary system is different in every case, calling upon the sur-

KEY TERMS

Duodenum—The first part of the small intestine, beginning at the outlet of the stomach.

Hemoglobin—The red, iron-containing chemical in the blood that carries oxygen to the tissues.

Jaundice—The yellow color taken on by a patient whose liver is unable to excrete bilirubin. A normal condition in the first week of life due to the infant's delayed ability to process certain waste products.

Kernicterus—A potentially lethal disease of newborns caused by excessive accumulation of the bile pigment bilirubin.

geon's skill and experience to select and execute the most effective among several options. If the obstruction is only between the gall bladder and the intestine, it is possible to attach a piece of intestine directly to the gall bladder. More likely, the upper biliary system will also be inadequate, and the surgeon will attach a piece of intestine directly to the liver—the Kasai procedure. In its wisdom, the body will discover that the tiny bile ducts in that part of the liver are discharging their bile directly into the intestine. Bile will begin to flow in that direction, and the channels will gradually enlarge. Survival rates for the Kasai procedure are commonly 50% at five years and 15% at 10 years. Persistent disease in the liver gradually destroys the organ.

Liver transplantation must be anticipated in all but the few patients who continue to do well after a Kasai procedure. Accumulating experience and newer techniques of liver transplantation are producing very gratifying early results.

Prognosis

Before liver transplants became available, even prompt and effective surgery did not cure the whole problem. Biliary drainage can usually be established, but the patients still have a defective biliary system that develops progressive disease and commonly leads to an early **death**. Transplantation now achieves up to 90% one-year survival rates and promises to prevent the chronic disease that used to accompany earlier procedures.

Prevention

The specific cause of this birth defect is unknown, so all that women can do is to practice the many general preventive measures, even before they conceive.

Resources

BOOKS

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- Feldman, Mark, et al. "Diseases of the Bile Ducts." *Sleisenger & Fordtran's Gastrointestinal and Liver Disease*. Philadelphia: W. B. Saunders Co., 1998.

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- Ryckman, F., R. Fisher, and S. Pedersen, et al. "Improved Survival in Biliary Atresia Patients in the Present Era of Liver Transplantation." *Journal of Pediatric Surgery* 28 (1993): 382.

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Biliary duct cancer see **Gallbladder cancer**

Biliary tract cancer see **Bile duct cancer**

Bilirubin test see **Liver function tests**

Individuals who develop BED often come from families who put an unnatural emphasis on the importance of food, for example, as a source of comfort in times of emotional distress. As children, BED patients may have been taught to clean their plate regardless of their appetite, or that finishing a meal made them a "good" girl or boy. Cultural attitudes towards beauty and thinness may also be a factor in the BED equation.

During binge episodes, BED patients experience a definite sense of lost control over their eating. They eat quickly and to the point of discomfort even if they aren't hungry. They typically binge alone two or more times a week, and often feel depressed and guilty once the episode has concluded.

Diagnosis

Binge eating disorder is usually diagnosed and treated by a psychiatrist and/or a psychologist. In addition to an interview with the patient, personality and behavioral inventories, such as the **Minnesota Multiphasic Personality Inventory** (MMPI), may be administered as part of the assessment process. One of several clinical inventories, or scales, may also be used to assess depressive symptoms, including the Hamilton Depression Scale (HAM-D) or Beck Depression Inventory (BDI). These tests may be administered in an outpatient or hospital setting.

Treatment

Many BED individuals binge after long intervals of excessive dietary restraint; therapy helps normalize this pattern. The initial goal of BED treatment is to teach the patient to gain control over his eating behavior by focusing on eating regular meals and avoiding snacking. **Cognitive-behavioral therapy, group therapy**, or interpersonal psychotherapy may be employed to uncover the emotional motives, distorted thinking, and behavioral patterns behind the binge eating.

Because the prevalence of depression in BED patients is high, psychopharmacological treatment with antidepressants may also be prescribed. Once the binge eating behavior is curbed and depressive symptoms are controlled, the physical symptoms of BED can be addressed. The overweight BED patient may be placed on a moderate exercise program and a nutritionist may be consulted to educate the patient on healthy food choices and strategies for weight loss.

Prognosis

The poor dietary habits and **obesity** that are symptomatic of BED can lead to serious health problems, such as high blood pressure, heart attacks, and diabetes, if left

Binge-eating disorder

Definition

Binge eating disorder (BED) is characterized by a loss of control over eating behaviors. The binge eater consumes unnaturally large amounts of food in a short time period, but unlike a bulimic, does not regularly engage in any inappropriate weight-reducing behaviors (for example, excessive **exercise**, vomiting, taking **laxatives**) following the binge episodes.

Description

BED typically strikes individuals sometime between adolescence and the early twenties. Because of the nature of the disorder, most BED patients are overweight or obese. Studies of weight loss programs have shown that an average of 30% of individuals enrolling in these programs report binge eating behavior.

Causes and symptoms

Binge eating episodes may act as a psychological release for excessive emotional **stress**. Other circumstances that may predispose an individual to BED include heredity and affective disorders, such as major depression. BED patients are also more likely to have a comorbid, or co-existing, diagnosis of impulsive behaviors (for example, compulsive buying), **post-traumatic stress disorder** (PTSD), **panic disorder**, or **personality disorders**.

KEY TERMS

Bulimia—An eating disorder characterized by binge eating and inappropriate compensatory behavior, such as vomiting, misusing laxatives, or excessive exercise.

Cognitive behavioral therapy—A therapy that pays particular attention to a patient's behavior and thinking processes rather than underlying psychological causes of an activity.

unchecked. BED is a chronic condition that requires ongoing medical and psychological management. To bring long-term relief to the BED patient, it is critical to address the underlying psychological causes behind binge eating behaviors. It appears that up to 50% of BED patients will stop bingeing with cognitive behavioral therapy (CBT).

Resources

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- Siegel, Michele, Judith Brisman, and Margot Weinshel. *Surviving an Eating Disorder: Strategies for Family and Friends*. 2nd ed. New York: Harper Perennial, 1997.

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- Brewerton, Timothy D. "Binge Eating Disorder: Recognition, Diagnosis, and Treatment." *Medscape Mental Health* 2, no. 5 (1997).
- "Binge Eating Disorder Comes Out of the Closet: Experts Say Leading Obesity Factor Has Long Been Overlooked." *Tufts University Diet & Nutrition Letter*, 14, no. 11 (Jan. 1997): 4-5.

ORGANIZATIONS

- American Psychiatric Association. 1400 K Street NW, Washington DC 20005. (888) 357-7924. <<http://www.psych.org>>.
- American Psychological Association (APA). 750 First St. NE, Washington, DC 20002-4242. (202) 336-5700. <<http://www.apa.org>>.
- Eating Disorders Awareness and Prevention. 603 Stewart St., Suite 803, Seattle, WA 98101. (206) 382-3587.
- National Eating Disorders Organization (NEDO). 6655 South Yale Ave., Tulsa, OK 74136. (918) 481-4044.
- Overeaters Anonymous World Service Office. 6075 Zenith Ct. NE, Rio Rancho, NM 87124. (505) 891-2664. <<http://www.overeatersanonymous.org>>.

Paula Anne Ford-Martin

Biofeedback

Definition

Biofeedback, or applied psychophysiological feedback, is a patient-guided treatment that teaches an individual to control muscle tension, **pain**, body temperature, brain waves, and other bodily functions and processes through relaxation, visualization, and other cognitive control techniques. The name biofeedback refers to the biological signals that are fed back, or returned, to the patient in order for the patient to develop techniques of manipulating them.

Purpose

Biofeedback has been used to successfully treat a number of disorders and their symptoms, including **temporomandibular joint disorder** (TMJ), chronic pain, **irritable bowel syndrome** (IBS), Raynaud's syndrome, epilepsy, attention-deficit hyperactivity disorder (ADHD), migraine headaches, **anxiety**, depression, traumatic brain injury, and **sleep disorders**.

Illnesses that may be triggered at least in part by **stress** are also targeted by biofeedback therapy. Certain types of headaches, high blood pressure, **bruxism** (teeth grinding), **post-traumatic stress disorder**, eating disorders, substance abuse, and some **anxiety disorders** may be treated successfully by teaching patients the ability to relax and release both muscle and mental tension. Biofeedback is often just one part of a comprehensive treatment program for some of these disorders.

NASA has used biofeedback techniques to treat astronauts who suffer from severe space sickness, during which the autonomic nervous system is disrupted. Scientists at the University of Tennessee have adapted these techniques to treat individuals suffering from severe **nausea and vomiting** that is also rooted in autonomic nervous system dysfunction.

Recent research also indicates that biofeedback may be a useful tool in helping patients with **urinary incontinence** regain bladder control. Individuals learning pelvic-floor muscle strengthening exercises can gain better control over these muscles by using biofeedback. Sensors are placed on the muscles to train the patient where they are and when proper contractions are taking place.

Description

Origins

In 1961, Neal Miller, an experimental psychologist, suggested that autonomic nervous system responses (for

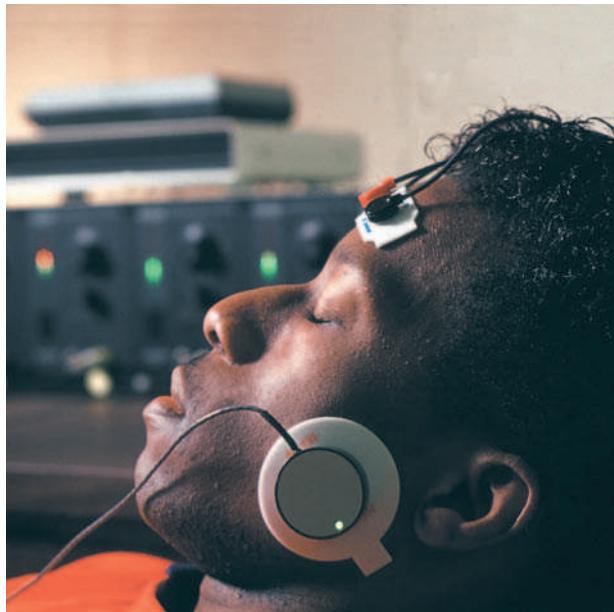
instance, heart rate, blood pressure, gastrointestinal activity, regional blood flow) could be under voluntary control. As a result of his experiments, he showed that such autonomic processes were controllable. This work led to the creation of biofeedback therapy. Willer's work was expanded by other researchers. Thereafter, research performed in the 1970s by UCLA researcher Dr. Barry Sterman established that both cats and monkeys could be trained to control their brain wave patterns. Sterman then used his research techniques on human patients with epilepsy, where he was able to reduce seizures by 60% with the use of biofeedback techniques. Throughout the 1970s, other researchers published reports of their use of biofeedback in the treatment of cardiac **arrhythmias**, headaches, Raynaud's syndrome, and excess stomach acid, and as a tool for teaching deep relaxation. Since the early work of Miller and Sterman, biofeedback has developed into a front-line behavioral treatment for an even wider range of disorders and symptoms.

During biofeedback, special sensors are placed on the body. These sensors measure the bodily function that is causing the patient problem symptoms, such as heart rate, blood pressure, muscle tension (EMG or electromyographic feedback), brain waves (EEG or electroencephalographic feedback), respiration, and body temperature (thermal feedback), and translates the information into a visual and/or audible readout, such as a paper tracing, a light display, or a series of beeps.

While the patient views the instantaneous feedback from the biofeedback monitors, he or she begins to recognize what thoughts, fears, and mental images influence his or her physical reactions. By monitoring this relationship between mind and body, the patient can then use these same thoughts and mental images as subtle cues, as these act as reminders to become deeply relaxed, instead of anxious. These reminders also work to manipulate heart beat, brain wave patterns, body temperature, and other bodily functions. This is achieved through relaxation exercises, mental imagery, and other cognitive therapy techniques.

As the biofeedback response takes place, patients can actually see or hear the results of their efforts instantly through the sensor readout on the biofeedback equipment. Once these techniques are learned and the patient is able to recognize the state of relaxation or visualization necessary to alleviate symptoms, the biofeedback equipment itself is no longer needed. The patient then has a powerful, portable, and self-administered treatment tool to deal with problem symptoms.

Biofeedback that specializes in reading and altering brain waves is sometimes called *neurofeedback*. The brain produces four distinct types of brain waves—delta, theta, alpha, and beta—that all operate at a different fre-



A patient undergoing biofeedback therapy. (Photo Researchers, Inc. Reproduced by permission.)

quency. Delta, the slowest frequency wave, is the brain wave pattern associated with sleep. Beta waves, which occur in a normal, waking state, can range from 12–35 Hz. Problems begin to develop when beta wave averages fall in the low end (underarousal) or the high end (overarousal) of that spectrum. Underarousal might be present in conditions such as depression or attention-deficit disorder, and overarousal may be indicative of an anxiety disorder, obsessive compulsive disorder, or excessive stress. Beta wave neurofeedback focuses on normalizing that beta wave pattern to an optimum value of around 14 Hz. A second type of neurofeedback, alpha-theta, focuses on developing the more relaxing alpha (8–13 Hz) and theta waves (4–9 Hz) that are usually associated with deep, meditative states, and has been used with some success in substance abuse treatment.

Through brain wave manipulation, neurofeedback can be useful in treating a variety of disorders that are suspected or proven to impact brain wave patterns, such as epilepsy, attention-deficit disorder, migraine headaches, anxiety, depression, traumatic brain injury, and sleep disorders. The equipment used for neurofeedback usually uses a monitor as an output device. The monitor displays specific patterns that the patient attempts to change by producing the appropriate type of brain wave. Or, the monitor may reward the patient for producing the appropriate brain wave by producing a positive reinforcer, or reward. For example, children may be rewarded with a series of successful moves in a displayed video game.

Depending on the type of biofeedback, individuals may need up to 30 sessions with a trained professional to learn the techniques required to control their symptoms on a long-term basis. Therapists usually recommend that their patients practice both biofeedback and relaxation techniques on their own at home.

Preparations

Before initiating biofeedback treatment, the therapist and patient will have an initial consultation to record the patients medical history and treatment background and discuss goals for therapy.

Before a neurofeedback session, an EEG is taken from the patient to determine his or her baseline brain-wave pattern.

Biofeedback typically is performed in a quiet and relaxed atmosphere with comfortable seating for the patient. Depending on the type and goals of biofeedback being performed, one or more sensors will be attached to the patient's body with conductive gel and/or adhesives. These may include:

- Electromyographic (EMG) sensors. EMG sensors measure electrical activity in the muscles, specifically muscle tension. In treating TMJ or bruxism, these sensors would be placed along the muscles of the jaw. Chronic pain might be treated by monitoring electrical energy in other muscle groups.
- Galvanic skin response (GSR) sensors. These are electrodes placed on the fingers that monitor perspiration, or sweat gland, activity. These may also be called skin conductance level (SCL).
- Temperature sensors. Temperature, or thermal, sensors measure body temperature and changes in blood flow.
- Electroencephalography (EEG) sensors. These electrodes are applied to the scalp to measure the electrical activity of the brain, or brain waves.
- Heart rate sensors. A pulse monitor placed on the finger tip can monitor pulse rate.
- Respiratory sensors. Respiratory sensors monitor oxygen intake and carbon dioxide output.

Precautions

Individuals who use a pacemaker or other implantable electrical devices should inform their biofeedback therapist before starting treatments, as certain types of biofeedback sensors have the potential to interfere with these devices.

Biofeedback may not be suitable for some patients. Patients must be willing to take a very active role in the

treatment process. And because biofeedback focuses strictly on behavioral change, those patients who wish to gain insight into their symptoms by examining their past might be better served by psychodynamic therapy.

Biofeedback may also be inappropriate for cognitively impaired individuals, such as those patients with organic brain disease or a traumatic brain injury, depending on their levels of functioning.

Patients with specific pain symptoms of unknown origin should undergo a thorough medical examination before starting biofeedback treatments to rule out any serious underlying disease. Once a diagnosis has been made, biofeedback can be used concurrently with conventional treatment.

Biofeedback may only be one component of a comprehensive treatment plan. For illnesses and symptoms that are manifested from an organic disease process, such as **cancer** or diabetes, biofeedback should be an adjunct to (complementary to), and not a replacement for, conventional medical treatment.

Side effects

There are no known side effects to properly administered biofeedback or neurofeedback sessions.

Research and general acceptance

Preliminary research published in late 1999 indicated that neurofeedback may be a promising new tool in the treatment of **schizophrenia**. Researchers reported that schizophrenic patients had used neurofeedback to simulate brain wave patterns that antipsychotic medications produce in the brain. Further research is needed to determine what impact this may have on treatment for schizophrenia.

The use of biofeedback techniques to treat an array of disorders has been extensively described in the medical literature. Controlled studies for some applications are limited, such as for the treatment of menopausal symptoms and premenstrual disorder (PMS). There is also some debate over the effectiveness of biofeedback in ADHD treatment, and the lack of controlled studies on that application. While many therapists, counselors, and mental health professionals have reported great success with treating their ADHD patients with neurofeedback techniques, some critics attribute this positive therapeutic impact to a placebo effect.

There may also be some debate among mental health professionals as to whether biofeedback should be considered a first line treatment for some mental illnesses, and to what degree other treatments, such as medication, should be employed as an adjunct therapy.

KEY TERMS

Autonomic nervous system—The part of the nervous system that controls so-called involuntary functions, such as heart rate, salivary gland secretion, respiratory function, and pupil dilation.

Bruxism—Habitual, often unconscious, grinding of the teeth.

Epilepsy—A neurological disorder characterized by the sudden onset of seizures.

Placebo effect—Placebo effect occurs when a treatment or medication with no known therapeutic value (a placebo) is administered to a patient, and the patient's symptoms improve. The patient believes and expects that the treatment is going to work, so it does. The placebo effect is also a factor to some degree in clinically-effective therapies, and explains why patients respond better than others to treatment despite similar symptoms and illnesses.

Raynaud's syndrome—A vascular, or circulatory system, disorder which is characterized by abnormally cold hands and feet. This chilling effect is caused by constriction of the blood vessels in the extremities, and occurs when the hands and feet are exposed to cold weather. Emotional stress can also trigger the cold symptoms.

Schizophrenia—Schizophrenia is a psychotic disorder that causes distortions in perception (delusions and hallucinations), inappropriate moods and behaviors, and disorganized or incoherent speech and behavior.

Temporomandibular joint disorder—Inflammation, irritation, and pain of the jaw caused by improper opening and closing of the temporomandibular joint. Other symptoms include clicking of the jaw and a limited range of motion.

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Robbins, Jim. "On the Track with Neurofeedback." *Newsweek* 135, no. 25 (June 2000): 76.

ORGANIZATIONS

The Association for Applied Psychotherapy and Biofeedback. 10200 W. 44th Avenue, Suite 304, Wheat Ridge, CO 80033-2840. (303) 422-8436. <<http://www.aapb.org>>

Biofeedback Certification Institute of America. 10200 W. 44th Avenue, Suite 310, Wheat Ridge, CO 80033. (303) 420-2902.

Paula Ford-Martin

Biopsy see **Bone biopsy; Bone marrow aspiration and biopsy; Brain biopsy; Breast biopsy; Cervical conization; CT-guided biopsy; Endometrial biopsy; Joint biopsy; Kidney biopsy; Liver biopsy; Lung biopsy; Lymph node biopsy; Myocardial biopsy; Pleural biopsy; Prostate biopsy; Skin biopsy; Small intestine biopsy; Thyroid biopsy**

Bipolar disorder

Definition

Bipolar, or manic-depressive disorder, is a mood disorder that causes radical emotional changes and mood swings, from manic highs to depressive lows. The majority of bipolar individuals experience alternating episodes of **mania** and depression.

Description

In the United States alone, bipolar disorder afflicts almost two million people at an annual cost of over \$45 billion, according to a report by the National Institutes of Mental Health. The average age of onset of bipolar disorder is from adolescence through the early twenties. However, because of the complexity of the disorder, a correct diagnosis can be delayed for several years or more. In a survey of bipolar patients conducted by the National Depressive and Manic Depressive Association (MDMDA), one-half of respondents reported visiting three or more professionals before receiving a correct diagnosis, and over one-third reported a wait of ten years or more before they were correctly diagnosed.

The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (*DSM-IV*), the diagnostic standard for mental health professionals in the United States, defines four separate categories of bipolar disorder: bipolar I, bipolar II, cyclothymia, and bipolar not-otherwise-specified (NOS).

Bipolar I disorder is characterized by manic episodes, the “high” of the manic-depressive cycle. A bipolar patient experiencing mania often has feelings of self-importance, elation, talkativeness, increased sociability, and a desire to embark on goal-oriented activities, coupled with the characteristics of irritability, impatience, impulsiveness, hyperactivity, and a decreased need for sleep. Usually this manic period is followed by a period of depression, although a few bipolar I individuals may not experience a major depressive episode. Mixed states, where both manic or hypomanic symptoms and depressive symptoms occur at the same time, also occur frequently with bipolar I patients (for example, depression with the racing thoughts of mania). Also, dysphoric mania is common (mania characterized by anger and irritability).

Bipolar II disorder is characterized by major depressive episodes alternating with episodes of hypomania, a milder form of mania. Bipolar depression may be difficult to distinguish from a unipolar major depressive episode. Patients with bipolar depression tend to have extremely low energy, retarded mental and physical processes, and more profound **fatigue** (for example, hypersomnia; a sleep disorder marked by a need for excessive sleep or sleepiness when awake) than unipolar depressives.

Cyclothymia refers to the cycling of hypomanic episodes with depression that does not reach major depressive proportions. A third of patients with cyclothymia will develop bipolar I or II disorder later in life.

A phenomenon known as rapid cycling occurs in up to 20% of bipolar I and II patients. In rapid cycling, manic and depressive episodes must alternate frequently; at least 4 times in 12 months; to meet the diagnostic definition. In some cases of “ultra-rapid cycling,” the patient may bounce between manic and depressive states several times within a 24-hour period. This condition is very hard to distinguish from mixed states.

Bipolar NOS is a category for bipolar states that do not clearly fit into the bipolar I, II, or cyclothymia diagnoses.

Causes and symptoms

The source of bipolar disorder has not been clearly defined. Because two-thirds of bipolar patients have a family history of affective or emotional disorders, researchers have searched for a genetic link to the disorder. Several studies have uncovered a number of possible genetic connections to the predisposition for bipolar disorder. Another possible biological cause under investigation is the presence of an excessive calcium build-up in

the cells of bipolar patients. Also, dopamine and other neurochemical transmitters appear to be implicated in bipolar disorder and these are under intense investigation.

Over half of patients diagnosed with bipolar disorder have a history of substance abuse. There is a high rate of association between **cocaine** abuse and bipolar disorder. Some studies have shown up to 30% of abusers meeting the criteria for bipolar disorder. The emotional and physical highs and lows of cocaine use correspond to the manic depression of the bipolar patient, making the disorder difficult to diagnosis.

For some bipolar patients, manic and depressive episodes coincide with seasonal changes. Depressive episodes are typical during winter and fall, and manic episodes are more probable in the spring and summer months.

Symptoms of bipolar depressive episodes include low energy levels, feelings of despair, difficulty concentrating, extreme fatigue, and psychomotor retardation (slowed mental and physical capabilities). Manic episodes are characterized by feelings of euphoria, lack of inhibitions, racing thoughts, diminished need for sleep, talkativeness, risk taking, and irritability. In extreme cases, mania can induce **hallucinations** and other psychotic symptoms such as grandiose illusions.

Diagnosis

Bipolar disorder is usually diagnosed and treated by a psychiatrist and/or a psychologist with medical assistance. In addition to an interview, several clinical inventories or scales may be used to assess the patient’s mental status and determine the presence of bipolar symptoms. These include the Millon Clinical Multiaxial Inventory III (MCMI-III), **Minnesota Multiphasic Personality Inventory II (MMPI-2)**, the Internal State Scale (ISS), the Self-Report Manic Inventory (SRMI), and the Young Mania Rating Scale (YMR). The tests are verbal and/or written and are administered in both hospital and outpatient settings.

Psychologists and psychiatrists typically use the criteria listed in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* as a guideline for diagnosis of bipolar disorder and other mental illnesses. *DSM-IV* describes a manic episode as an abnormally elevated or irritable mood lasting a period of at least one week that is distinguished by at least three of the mania symptoms: inflated self-esteem, decreased need for sleep, talkativeness, racing thoughts, distractibility, increase in goal-directed activity, or excessive involvement in pleasurable activities that have a high potential for painful consequences. If the mood of

the patient is irritable and not elevated, four of the symptoms are required.

Although many clinicians find the criteria too rigid, a hypomanic diagnosis requires a duration of at least four days with at least three of the symptoms indicated for manic episodes (four if mood is irritable and not elevated). *DSM-IV* notes that unlike manic episodes, hypomanic episodes do not cause a marked impairment in social or occupational functioning, do not require hospitalization, and do not have psychotic features. In addition, because hypomanic episodes are characterized by high energy and goal directed activities and often result in a positive outcome, or are perceived in a positive manner by the patient, bipolar II disorder can go undiagnosed.

Bipolar symptoms often present differently in children and adolescents. Manic episodes in these age groups are typically characterized by more psychotic features than in adults, which may lead to a misdiagnosis of **schizophrenia**. Children and adolescents also tend toward irritability and aggressiveness instead of elation. Further, symptoms tend to be chronic, or ongoing, rather than acute, or episodic. Bipolar children are easily distracted, impulsive, and hyperactive, which can lead to a misdiagnosis of attention deficit hyperactivity disorder (**ADHD**). Furthermore, their aggression often leads to violence, which may be misdiagnosed as a **conduct disorder**.

Substance abuse, thyroid disease, and use of prescription or over-the-counter medication can mask or mimic the presence of bipolar disorder. In cases of substance abuse, the patient must ordinarily undergo a period of **detoxification** and abstinence before a mood disorder is diagnosed and treatment begins.

Treatment

Treatment of bipolar disorder is usually by means of medication. A combination of mood stabilizing agents with antidepressants, antipsychotics, and anticonvulsants is used to regulate manic and depressive episodes.

Mood stabilizing agents such as lithium, carbamazepine, and valproate are prescribed to regulate the manic highs and lows of bipolar disorder:

- Lithium (Cibalith-S, Eskalith, Lithane, Lithobid, Lithonate, Lithotabs) is one of the oldest and most frequently prescribed drugs available for the treatment of bipolar mania and depression. Because the drug takes four to ten days to reach a therapeutic level in the bloodstream, it is sometimes prescribed in conjunction with neuroleptics and/or **benzodiazepines** to provide more immediate relief of a manic episode. Lithium has also been shown to be effective in regulating bipolar depression, but is not recommended for mixed mania. Lithium

may not be an effective long-term treatment option for rapid cyclers, who typically develop a tolerance for it, or may not respond to it. Possible side effects of the drug include weight gain, thirst, nausea, and hand **tremors**. Prolonged lithium use may also cause **hyperthyroidism** (a disease of the thyroid that is marked by heart **palpitations**, nervousness, the presence of **goiter**, sweating, and a wide array of other symptoms.)

- Carbamazepine (Tegretol, Atretol) is an anticonvulsant drug usually prescribed in conjunction with other mood stabilizing agents. The drug is often used to treat bipolar patients who have not responded well to lithium therapy. Blurred vision and abnormal eye movement are two possible side effects of carbamazepine therapy. As of early 1998, carbamazepine did not have an FDA-cleared indication for mania.
- Valproate (divalproex sodium, or Depakote; valproic acid, or Depakene) is one of the few drugs available that has been proven effective in treating rapid cycling bipolar and mixed states patients. Valproate is prescribed alone or in combination with carbamazepine and/or lithium. Stomach cramps, **indigestion**, **diarrhea**, hair loss, appetite loss, nausea, and unusual weight loss or gain are some of the common side effects of valproate. Note: valproate is also approved for the treatment of mania.

Because antidepressants may stimulate manic episodes in some bipolar patients, their use is typically short-term. **Selective serotonin reuptake inhibitors** (SSRIs) or, less often, **monoamine oxidase inhibitors** (MAO inhibitors) are prescribed for episodes of bipolar depression. Tricyclic antidepressants used to treat unipolar depression may trigger rapid cycling in bipolar patients and are, therefore, not a preferred treatment option for bipolar depression.

- SSRIs, such as fluoxetine (Prozac), sertraline (Zoloft), and paroxetine (Paxil), regulate depression by regulating levels of serotonin, a neurotransmitter. **Anxiety**, diarrhea, drowsiness, **headache**, sweating, nausea, sexual problems, and **insomnia** are all possible side effects of SSRIs.
- MAOIs such as tranylcypromine (Parnate) and phenelzine (Nardil) block the action of monoamine oxidase (MAO), an enzyme in the central nervous system. Patients taking MAOIs must cut foods high in tyramine (found in aged cheeses and meats) out of their diet to avoid hypotensive side effects.
- Bupropion (Wellbutrin) is a heterocyclic antidepressant. The exact neurochemical mechanism of the drug is not known, but it has been effective in regulating bipolar depression in some patients. Side effects of bupropion include agitation, anxiety, confusion, tremor, **dry mouth**, fast or irregular heartbeat, headache, and insomnia.

- ECT, or **electroconvulsive therapy**, has a high success rate for treating both unipolar and bipolar depression, and mania. However, because of the convenience of drug treatment and the stigma sometimes attached to ECT therapy, ECT is usually employed after all pharmaceutical treatment options have been explored. ECT is given under anesthesia and patients are given a muscle relaxant medication to prevent convulsions. The treatment consists of a series of electrical pulses that move into the brain through electrodes on the patient's head. Although the exact mechanisms behind the success of ECT therapy are not known, it is believed that this electrical current alters the electrochemical processes of the brain, consequently relieving depression. Headaches, muscle soreness, nausea, and confusion are possible side effects immediately following an ECT procedure. Temporary memory loss has also been reported in ECT patients. In bipolar patients, ECT is often used in conjunction with drug therapy.

Adjunct treatments are used in conjunction with a long-term pharmaceutical treatment plan:

- Long-acting benzodiazepines such as clonazepam (Klonapin) and alprazolam (Xanax) are used for rapid treatment of manic symptoms to calm and sedate patients until mania or hypomania have waned and mood stabilizing agents can take effect. **Sedation** is a common effect, and clumsiness, lightheadedness, and slurred speech are other possible side effects of benzodiazepines.
- Neuroleptics such as chlorpromazine (Thorazine) and haloperidol (Haldol) are also used to control mania while a mood stabilizer such as lithium or valproate takes effect. Because neuroleptic side effects can be severe (difficulty in speaking or swallowing, **paralysis** of the eyes, loss of balance control, muscle spasms, severe restlessness, stiffness of arms and legs, tremors in fingers and hands, twisting movements of body, and weakness of arms and legs), benzodiazepines are generally preferred over neuroleptics.
- Psychotherapy and counseling. Because bipolar disorder is thought to be biological in nature, therapy is recommended as a companion to, but not a substitute for, pharmaceutical treatment of the disease. Psychotherapy, such as **cognitive-behavioral therapy**, can be a useful tool in helping patients and their families adjust to the disorder, in encouraging compliance to a medication regimen, and in reducing the risk of suicide. Also, educative counseling is recommended for the patient and family.

Calcium channel blockers (nimodipine, or Nimotop), typically used to treat **angina** and **hypotension**, have been found effective, in a few small studies, for treating rapid cyclers. Calcium channel blockers stop the excess calcium build up in cells that is thought to be a cause of

bipolar disorder. They are usually used in conjunction with other drug therapies such as carbamazepine or lithium.

Clozapine (Clozaril) is an atypical antipsychotic medication used to control manic episodes in patients who have not responded to typical mood stabilizing agents. The drug has also been a useful prophylactic, or preventative treatment, in some bipolar patients. Common side effects of clozapine include tachycardia (rapid heart rate), hypotension, **constipation**, and weight gain. Agranulocytosis, a potentially serious but reversible condition in which the white blood cells that typically fight infection in the body are destroyed, is a possible side effect of clozapine. Patients treated with the drug should undergo weekly blood tests to monitor white blood cell counts.

Risperidone (Risperdal) is an atypical antipsychotic medication that has been successful in controlling mania in several clinical trials when low doses were administered. The side effects of risperidone are mild compared to many other antipsychotics (constipation, coughing, diarrhea, dry mouth, headache, **heartburn**, increased length of sleep and dream activity, nausea, runny nose, **sore throat**, fatigue, and weight gain).

Lamotrigine (Lamictal, or LTG), an anticonvulsant medication, was found to alleviate manic symptoms in a 1997 trial of 75 bipolar patients. The drug was used in conjunction with divalproex (divalproate) and/or lithium. Possible side effects of lamotrigine include skin rash, **dizziness**, drowsiness, headache, **nausea and vomiting**.

rTMS, or repeated transcranial magnetic stimulation is a new and still experimental treatment for the depressive phase of bipolar disorder. In rTMS, a large magnet is placed on the patient's head and magnetic fields of different frequency are generated to stimulate the left front cortex of the brain. Unlike ECT, rTMS requires no anesthesia and does not induce seizures.

Alternative treatment

General recommendations include maintaining a calm environment, avoiding over stimulation, getting plenty of rest, regular **exercise**, and proper diet. Chinese herbs may soften mood swings. **Biofeedback** is effective in helping some patients control symptoms such as irritability, poor self control, racing thoughts, and sleep problems. A diet low in vanadium (a mineral found in meats and other foods) and high in vitamin C may be helpful in reducing depression.

Prognosis

While most patients will show some positive response to treatment, response varies widely, from full recovery to a complete lack of response to all drug and/or ECT therapy.

KEY TERMS

Affective disorder—An emotional disorder involving abnormal highs and/or lows in mood. Now termed mood disorder.

Anticonvulsant medication—A drug used to prevent convulsions or seizures; often prescribed in the treatment of epilepsy. Several anticonvulsant medications have been found effective in the treatment of bipolar disorder.

Antipsychotic medication—A drug used to treat psychotic symptoms, such as delusions or hallucinations, in which patients are unable to distinguish fantasy from reality.

Benzodiazepines—A group of tranquilizers having sedative, hypnotic, antianxiety, amnestic, anticonvulsant, and muscle relaxant effects.

DSM-IV—Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). This reference book, published by the American Psychiatric Association, is the diagnostic standard for most mental health professionals in the United States.

ECT—Electroconvulsive therapy is sometimes used to treat depression or mania when pharmaceutical treatment fails.

Hypomania—A milder form of mania which is characteristic of bipolar II disorder.

Mixed mania/mixed state—A mental state in which symptoms of both depression and mania occur simultaneously.

Mania—An elevated or euphoric mood or irritable state that is characteristic of bipolar I disorder.

Neurotransmitter—A chemical in the brain that transmits messages between neurons, or nerve cells. Changes in the levels of certain neurotransmitters, such as serotonin, norepinephrine, and dopamine, are thought to be related to bipolar disorder.

Psychomotor retardation—Slowed mental and physical processes characteristic of a bipolar depressive episode.

Drug therapies frequently need adjustment to achieve the maximum benefit for the patient. Bipolar disorder is a chronic recurrent illness in over 90% of those afflicted, and one that requires lifelong observation and treatment after diagnosis. Patients with untreated or inadequately treated bipolar disorder have a suicide rate of 15-25% and a nine-year decrease in life expectancy. With proper treatment, the life expectancy of the bipolar patient will increase by nearly seven years and work productivity increases by ten years.

Prevention

The ongoing medical management of bipolar disorder is critical to preventing relapse, or recurrence, of manic episodes. Even in carefully controlled treatment programs, bipolar patients may experience recurring episodes of the disorder. Patient education in the form of psychotherapy or self-help groups is crucial for training bipolar patients to recognize signs of mania and depression and to take an active part in their treatment program.

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ORGANIZATIONS

American Psychiatric Association. 1400 K Street NW, Washington DC 20005. (888) 357-7924. <<http://www.psych.org>>.

National Alliance for the Mentally Ill (NAMI). Colonial Place Three, 2107 Wilson Blvd., Ste. 300, Arlington, VA 22201-3042. (800) 950-6264. <<http://www.nami.org>>.

National Depressive and Manic-Depressive Association (NDMDA). 730 N. Franklin St., Suite 501, Chicago, IL 60610. (800) 826-3632. <<http://www.ndmda.org>>.

National Institute of Mental Health. Mental Health Public Inquiries, 5600 Fishers Lane, Room 15C-05, Rockville, MD 20857. (888) 826-9438. <<http://www.nimh.nih.gov>>.

Paula Anne Ford-Martin

Birth control see **Condom; Contraception; Diaphragm (birth control)**

Birth control pills see **Oral contraceptives**

oping organism is called an embryo; developmental stages from two months to birth are called fetal. Growth is rapid, and each body organ has a critical period in which it is especially sensitive to outside influences. About 7% of all congenital defects are caused by exposure to teratogens.

DRUGS. Only a few drugs are known to cause birth defects, but all have the potential to cause harm. Thalidomide is known to cause defects of the arms and legs; several other types also cause problems.

- **Alcohol.** Drinking large amounts of alcohol while pregnant causes a cluster of defects called **fetal alcohol syndrome**, which include **mental retardation**, heart problems, and growth deficiency.
- **Antibiotics.** Certain antibiotics are known teratogens. Tetracycline affects bone growth and discolors the teeth. Drugs used to treat **tuberculosis** can lead to hearing problems and damage to a nerve in the head (cranial). Sulfa drugs are associated with abnormally high levels of bilirubin in the newborn, which can cause **death**.
- **Anticonvulsants.** Drugs given to prevent seizures can cause serious problems in the developing fetus, including mental retardation and slow growth.
- **Antipsychotic and antianxiety agents.** Several drugs given for **anxiety** and mental illness are known to cause specific defects.
- **Antineoplastic agents.** Drugs given to treat **cancer** can cause major congenital malformations, especially central nervous system defects. They may also be harmful to the health care worker who is giving them while pregnant.
- **Hormones.** Male hormones may cause masculinization of a female fetus. A synthetic estrogen (DES) given in the 1940s and 1950s causes an increased risk of cancer in the adult female children of the mothers who received the drug.
- **Recreational drugs.** Drugs such as **LSD** have been associated with arm and leg abnormalities and central nervous system problems in infants. Crack **cocaine** has also been associated with birth defects. Since drug abusers tend to use many drugs and have poor **nutrition** and prenatal care, it is hard to determine the effects of individual drugs.

CHEMICALS. Environmental chemicals such as fungicides, food additives, and pollutants are suspected of causing birth defects, though this is difficult to prove.

RADIATION. Exposure of the mother to high levels of radiation can cause small skull size (microcephaly), blindness, **spina bifida**, and cleft palate. How severe the defect depends on the duration and timing of the exposure.

Birth defects

Definition

Birth defects are physical abnormalities that are present at birth; they are also called congenital abnormalities. More than 3,000 have been identified.

Description

Birth defects are found in 2-3% of all newborn infants. This rate doubles in the first year, and reaches 10% by age five, as more defects become evident and can be diagnosed. Almost 20% of deaths in newborns are caused by birth defects.

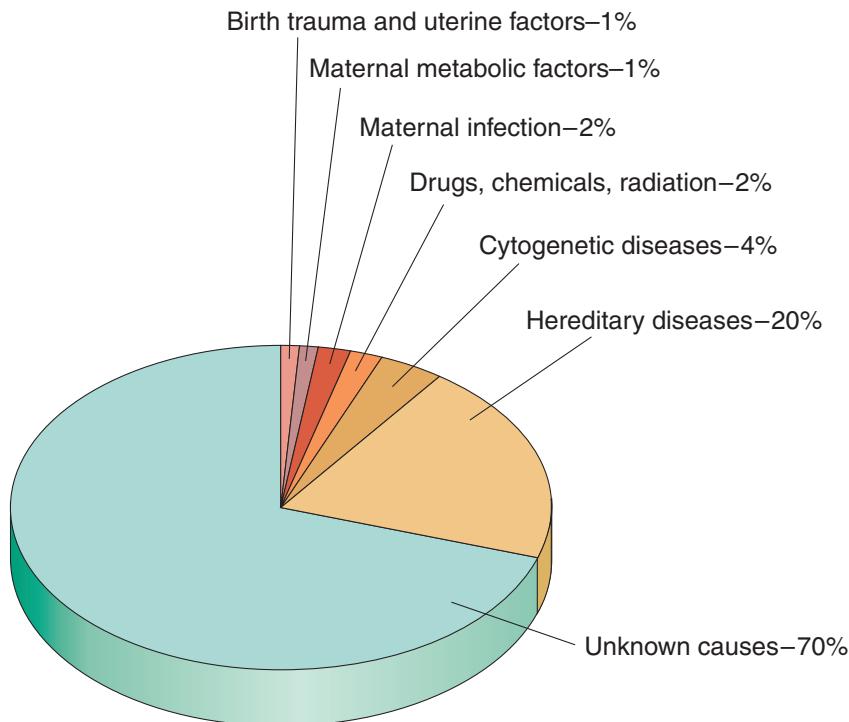
Abnormalities can occur in any major organ or part of the body. Major defects are structural abnormalities that affect the way a person looks and require medical and/or surgical treatment. Minor defects are abnormalities that do not cause serious health or social problems. When multiple birth defects occur together and have a similar cause, they are called syndromes. If two or more defects tend to appear together but do not share the same cause, they are called associations.

Causes and symptoms

The specific cause of many congenital abnormalities is unknown, but several factors associated with **pregnancy** and delivery can increase the risk of birth defects.

Teratogens

Any substance that can cause abnormal development of the egg in the mother's womb is called a teratogen. In the first two months after conception, the devel-



The specific cause of many birth defects is unknown, but several factors associated with pregnancy and delivery can increase the risk of birth defects. These factors include exposure to teratogens, drugs and other chemicals, exposure to radiation, and infections present in the womb. (Illustration by Electronic Illustrators Group.)

INFECTIONS. Three viruses are known to harm a developing baby: **rubella**, cytomegalovirus (CMV), and herpes simplex. *Toxoplasma gondii*, a parasite that can be contracted from undercooked meat, from dirt, or from handling the feces of infected cats, causes serious problems. Untreated **syphilis** in the mother is also harmful.

Genetic factors

A gene is a tiny, invisible unit containing information (DNA) that guides how the body forms and functions. Each individual inherits tens of thousands of genes from each parent, arranged on 46 chromosomes. Genes control all aspects of the body, how it works, and all its unique characteristics, including eye color and body size. Genes are influenced by chemicals and radiation, but sometimes changes in the genes are unexplained accidents. Each child gets half of its genes from each parent. In each pair of genes one will take precedence (dominant) over the other (recessive) in determining each trait, or characteristic. Birth defects caused by dominant inheritance include a form of dwarfism called **achondroplasia**; **high cholesterol**; Huntington's disease, a progres-

sive nervous system disorder; **Marfan syndrome**, which affects connective tissue; some forms of **glaucoma**, and polydactyly (extra fingers or toes).

If both parents carry the same recessive gene, they have a one-in-four chance that the child will inherit the disease. Recessive diseases are severe and may lead to an early death. They include sickle cell anemia, a blood disorder that affects blacks, and **Tay-Sachs disease**, which causes mental retardation in people of eastern European Jewish heritage. Two recessive disorders that affect mostly whites are: **cystic fibrosis**, a lung and digestive disorder, and **phenylketonuria** (PKU), a metabolic disorder. If only one parent passes along the genes for the disorder, the normal gene received from the other parent will prevent the disease, but the child will be a carrier. Having the gene is not harmful to the carrier, but there is the 25% chance of the genetic disease showing up in the child of two carriers.

Some disorders are linked to the sex-determining chromosomes passed along by parents. **Hemophilia**, a condition that prevents blood from clotting, and Duchenne **muscular dystrophy**, which causes muscle weakness, are carried on the X chromosome. Genetic



Congenital absence of three fingers. Deformities such as this are usually caused by damage to the developing fetus *in utero*. (Photograph by Dr. P. Marazzi, Photo Researchers, Inc. Reproduced by permission.)

defects can also take place when the egg or sperm are forming if the mother or father passes along some faulty gene material. This is more common in older mothers. The most common defect of this kind is **Down syndrome**, a pattern of mental retardation and physical abnormalities, often including heart defects, caused by inheriting three copies of a chromosome rather than the normal pair.

A less understood cause of birth defects results from the interaction of genes from one or both parents plus environmental influences. These defects are thought to include:

- Cleft lip and palate, which are malformations of the mouth
- Clubfoot, ankle or foot deformities.
- Spina bifida, an open spine caused when the tube that forms the brain and spinal chord does not close properly.
- Water on the brain (**hydrocephalus**), which causes brain damage.
- **Diabetes mellitus**, an abnormality in sugar metabolism that appears later in life.
- Heart defects.
- Some forms of cancer.

A serious illness in the mother, such as an underactive thyroid, or diabetes mellitus, in which her body can-

not process sugar, can also cause birth defects in the child. An abnormal amount of amniotic fluid may indicate or cause birth defects. Amniotic fluid is the liquid that surrounds and protects the unborn child in the uterus. Too little of this fluid can interfere with lung or limb development. Too much amniotic fluid can accumulate if the fetus has a disorder that interferes with swallowing.

Diagnosis

If there is a family history of birth defects or if the mother is over 35 years old, then screening tests can be done during pregnancy to gain information about the health of the baby.

- Alpha-fetoprotein test. This is a simple blood test that measure the level of a substance called alpha-fetoprotein that is associated with some major birth defects. An abnormally high or low level may indicate the need for further testing.
- Ultrasound. The use of sound waves to examine the shape, function, and age of the fetus is a common procedure. It can also detect many malformations, such as spina bifida, limb defects, and heart and kidney problems.
- Amniocentesis. This test is usually done between the 13th and 15th weeks of pregnancy. A small sample of amniotic fluid is withdrawn through a thin needle inserted into the mother's abdomen. Chromosomal analysis can rule out Down syndrome and other genetic conditions.
- Chorionic villus sampling (CVS). This test can be done as early as the ninth week of pregnancy to identify chromosome disorders and some genetic conditions. A thin needle is inserted through the abdomen or a slim tube is inserted through the vagina that takes a tiny tissue sample for testing.

If a birth defect is suspected after a baby is born, then confirmation of the diagnosis is very important. The patient's medical records and medical history may hold essential information. A careful **physical examination** and laboratory tests should be done. Special diagnostic tests can also provide genetic information in some cases.

Treatment

Treatment depends on the type of birth defect and how serious it is. When an abnormality has been identified before birth, then delivery can be planned at a health care facility that is prepared to offer any special care needed. Some abnormalities can be corrected with surgery. Experimental procedures have been used successfully in correcting some defects, like excessive fluid in the brain (hydrocephalus), even before the baby is

KEY TERMS

Chromosome—One of the bodies in the cell nucleus that carries genes. There are normally 46 chromosomes in humans.

Cleft lip and palate—An opening in the lip, the roof of the mouth (hard palate), or the soft tissue in the back of the mouth (soft palate).

Embryo—The developing baby from conception to the end of the second month.

Gene—The functional unit of heredity that directs all growth and development of an organism. Each human being has over 100,000 genes that determine hair color, body build, and all other traits.

Fetus—In humans, the developing organism from the end of the eighth week to the moment of birth.

Neural tube defects—A group of birth defects that affect the backbone and sometimes the spinal chord.

Rubella—A mild, highly contagious childhood illness caused by a virus; it is also called German measles. It causes severe birth defects if a pregnant woman is not immune and gets the illness in the first three months of pregnancy.

Spina bifida—One of the more common birth defects in which the backbone never closes.

Trait—A distinguishing feature of an individual.

Virus—A very small organism that causes infection and needs a living cell to reproduce.

born. Patients with complicated conditions usually need the help of experienced medical and educational specialists with an understanding of the disorder.

Prognosis

The prognosis for a disorder varies with the specific condition.

Prevention

Pregnant women should eat a nutritious diet. Taking **folic acid** supplements before and during pregnancy reduces the risk of having a baby with serious problems of the brain or spinal chord (neural tube defects). It is important to avoid any teratogen that can harm the developing baby, including alcohol and drugs. When there is a family history of congenital defects in either parent, then **genetic counseling** and testing can help parents plan for

future children. Often, counselors can determine the risk of a genetic condition occurring and the availability of tests for it. Talking to a genetic counselor after a child is born with a defect can provide parents with information about medical management and community resources that are available.

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OTHER

March of Dimes. *Public Health Education Information Sheets*.

Karen Ericson, RN

Birthmarks

Definition

Birthmarks, including angiomas and vascular malformations, are benign (noncancerous) skin growths composed of rapidly growing or poorly formed blood vessels or lymph vessels. Found at birth (congenital) or developing later in life (acquired) anywhere on the body, they range from faint spots to dark swellings covering wide areas.

Description

Skin angiomas, also called vascular (pertaining to vessel) nevi (marks), are composed of blood vessels (hemangiomas) or lymph vessels (lymphangiomas), that lie beneath the skin's surface. Hemangiomas, composed of clusters of cells that line the capillaries, the body's smallest blood vessels, are found on the face and neck

(60%), trunk (25%), or the arms and legs (15%). Congenital hemangiomas, 90% of which appear at birth or within the first month of life, grow quickly, and disappear over time. They are found in 1-10% of full-term infants, and 25% of premature infants. About 65% are capillary hemangiomas (strawberry marks), 15% are cavernous (deep) hemangiomas, and the rest are mixtures. Hemangiomas are three times more common in girls. Usually, only one hemangioma is found, in 20% two are found, while fewer than 5% have three or more. Lymphangiomas are skin bumps caused by enlarged lymph vessels anywhere on the body.

Vascular malformations are poorly formed blood or lymph vessels that appear at birth or later in life. One type, the salmon patch (*nevus simplex*), a pink mark composed of dilated capillaries, is found on the back of the neck (also called a stork bite) in 40% of newborns, and on the forehead and eyelids (also called an angel's kiss) in 20%. Stork bites are found in 70% of white and 60% of black newborns.

Found in fewer than 1% of newborns, port-wine stains (*nevus flammeus*), are vascular malformations composed of dilated capillaries in the upper and lower layers of the skin of the face, neck, arms, and legs. Often permanent, these flat pink to red marks develop into dark purple bumpy areas in later life; 85% appear on only one side of the body.

Acquired hemangiomas include spider angiomas (*nevus araneus*), commonly known as spider veins, and cherry angiomas (*senile angiomas* or *Campbell de Morgan spots*). Found around the eyes, cheekbones, arms, and legs, spider angiomas are red marks formed from dilated blood vessels. They occur during **pregnancy** in 70% of white women and 10% of black women, in alcoholics and liver disease patients, and in 50% of children. Cherry angiomas, dilated capillaries found mainly on the trunk, appear in the 30s, and multiply with **aging**.

Causes and symptoms

There are no known causes for congenital skin angiomas; they may be related to an inherited weakness of vessel walls. Exposure to estrogen causes spider angiomas in pregnant women or those taking **oral contraceptives**. Spider angiomas tend to run in families, and may be associated with liver disease, sun exposure, and trauma.

Hemangiomas

Hemangiomas first appear as single or multiple, white or pale pink marks, ranging from 2-20 cm (average 2-5 cm) in size. Some are symptomless while others cause **pain** or bleeding, or interfere with normal function-

ing when they are numerous, enlarged, infected, or ulcerated. Vision is affected by large marks on the eyelids. Spider and cherry angiomas are unsightly but symptomless.

Each type of hemangioma has a characteristic appearance:

- Capillary hemangiomas (strawberry marks). These round, raised marks are bright red and bumpy like a strawberry, and become white or gray when fading.
- Cavernous hemangiomas. These slightly raised, dome-shaped, blue or purple swellings are sometimes associated with lymphangiomas or involve the soft tissues, bone, or digestive tract.
- Spider angiomas. These are symptomless, reddish blue marks formed from blood-filled capillaries radiating around a central arteriole (small artery) in the shape of a spider web.
- Cherry angiomas. These harmless, dilated capillaries appear as tiny, bright red-to-violet colored bumps.
- Lymphangiomas. These dilated lymph vessels form light pink or yellow cysts (fluid-filled sacs) or swellings.

Vascular malformations

These are faint, flat, pink stains that grow as the child grows into larger dark red or purple marks. Some are symptomless but others bleed if enlarged or injured. Disfiguring port-wine stains can cause emotional and social problems. About 5% of port-wine stains on the forehead and eyelids increase eye pressure due to involvement of the eye and surrounding nerves. Abnormalities of the spinal cord, soft tissues, or bone may be associated with severe port-wine stains.

Each type has a characteristic appearance:

- Salmon patches. These symptomless, light red-to-pink marks usually fade with time.
- Port-wine stains. These flat, pink marks progress to raised, dark red-to-purple grape-like lumps distorting the facial features, arms, or legs.

Diagnosis

Patients are treated by pediatricians (doctors who specialize in the care of children), dermatologists (skin disease specialists), plastic surgeons (doctors who specialize in correcting abnormalities of the appearance), and ophthalmologists (eye disease specialists).

Angiomas and vascular malformations are not difficult to diagnose. The doctor takes a complete medical history and performs a **physical examination** including inspection and palpation of the marks. The skin is examined for discoloration, scarring, bleeding, infection, or

ulceration. The type, location, size, number, and severity of the marks are recorded. The doctor may empty the mark of blood by gentle pressure. Biopsies or specialized x rays or scans of the abnormal vessels and their surrounding areas may be performed. Patients with port-wine stains near the eye may require **skull x rays**, **computed tomography scans**, and vision and central nervous system tests. Most insurance plans pay for diagnosis and treatment of these conditions.

Treatment

Treatment choices for skin angiomas and vascular malformations depend on their type, location, and severity, and whether they cause symptoms, pain, or disfigurement.

Watchful waiting

No treatment is given, but the mark is regularly examined. This continues until the mark disappears, or requires treatment. This approach is particularly appropriate for the treatment of hemangiomas, which often do not require treatment, since they eventually shrink by themselves.

Drugs

CORTICOSTEROIDS. Daily doses of the anti-inflammatory drugs prednisone or prednisolone are given for up to 2 months with gradual reduction of the dose. The marks begin to subside within 7-10 days, but may take up to 2 months to fully disappear. If no response is seen in 2 weeks, the drug is discontinued. Treatment may be repeated. Side effects include growth retardation, increased blood pressure and blood sugar, **cataracts**, glandular disorders, and infection. The **corticosteroids** triamcinolone acetate and betamethasone sodium phosphate or acetate are injected directly into the marks with a response usually achieved within a week; additional injections are given in 4-6 weeks. Side effects include tissue damage at the injection site.

INTERFERON ALPHA-2A. This drug reduces cell growth, and is used for vascular marks that affect vision, and that are unresponsive to corticosteroids. Given in daily injections under the skin, a response rate of 50% is achieved after about 7 months. Side effects include **fever**, chills, muscle and joint pain, vision disorders, low white and red blood cell counts, **fatigue**, elevated liver enzymes, nausea, blood clotting problems, and nerve damage.

ANTIBIOTICS. Oral or topical (applied to the skin) antibiotics are prescribed for infected marks.

Surgery

LASER SURGERY. Lasers create intense heat that destroys abnormal blood vessels beneath the skin, with-



A fading capillary hemangioma on the nose of a child. (Photograph by Dr. P. Marazzi, Custom Medical Stock Photo. Reproduced by permission.)

out damaging normal skin. Two types of lasers are used: the flashlamp-pulsed dye laser (FPDL) and the neodymium:YAG (Nd:YAG) laser. The FPDL, used mainly for strawberry marks and port-wine stains, penetrates to a depth of 1.8 mm and causes little scarring, while the Nd:YAG laser penetrates to a depth of 6 mm, and is used to treat deep hemangiomas. **Laser surgery** is not usually painful, but can be uncomfortable. Anesthetic cream is used for FPDL treatment. Treatment with the Nd:YAG laser requires local or general anesthesia. Children are usually sedated or anesthetized. Healing occurs within 2 weeks. Side effects include bruising, skin discoloration, swelling, crusting, and minor bleeding.

SURGICAL EXCISION. Under local or general anesthesia, the skin is cut with a surgical instrument, and vascular marks or their scars are removed. The cut is repaired with stitches or skin clips.

CRYOSURGERY. Vascular marks are frozen with an extremely cold substance sprayed onto the skin. **Wounds** heal with minimal scarring.

ELECTRODESISSICATION. Affected vessels are destroyed with the current from an electric needle.

Other treatments

These include:

- **Sclerotherapy.** Injection of a special solution causes blood clotting and shrinkage with little scarring. Side effects include stinging, swelling, bruising, scarring, muscle cramping, and allergic reactions. This treatment is used most commonly for spider angiomas.
- **Embolization.** Material injected into the vessel blocks blood flow which helps control blood loss during or reduces the size of inoperable growths. A serious side

KEY TERMS

Angioma—A benign skin tumor composed of rapidly growing, small blood or lymph vessels.

Capillaries—The smallest blood vessels, they connect the arteries and veins.

Corticosteroids—Drugs that fight inflammation.

Hemangioma—A benign skin tumor composed of abnormal blood vessels.

Lymph vessels—Part of the lymphatic system, these vessels connect lymph capillaries with the lymph nodes; they carry lymph, a thin, watery fluid resembling blood plasma and containing white blood cells.

Lymphangioma—A benign skin tumor composed of abnormal lymph vessels.

Nevus—A mark on the skin.

Ulcer—A red, shallow sore on the skin.

Vascular malformation—A poorly formed blood or lymph vessels.

effect, **stroke**, can occur if a major blood vessel becomes blocked.

- Make-up. Special brands are designed to cover birthmarks (Covermark or Dermablend).
- Cleaning and compression. Bleeding marks are cleaned with soap and water or hydrogen peroxide, and compressed with a sterile bandage for 5-10 minutes.

Alternative treatment

Alternative treatments for strengthening weak blood vessels include eating high-fiber foods and those containing bioflavonoids, including citrus fruit, blueberries, and cherries, supplementing the diet with vitamin C, and taking the herbs, ginkgo (*Ginkgo biloba*) and bilberry (*Vaccinium myrtillus*.)

Prognosis

The various types of birthmarks have different prognoses:

- Capillary hemangiomas. Fewer than 10% require treatment. Without treatment, 50% disappear by age 5, 70% by age 7, and 90% by age 9. No skin changes are found in half while others have some discoloration, scarring, or wrinkling. From 30-90% respond to oral corticos-

teroids, and 45% respond to injected corticosteroids; 50% respond to interferon Alpha-2a. About 60% improve after laser surgery.

- Cavernous hemangiomas. Some do not disappear and some are complicated by ulceration or infection. About 75% respond to Nd:YAG laser surgery but have scarring. Severe marks respond to oral corticosteroids, but some require excision.
- Spider angiomas. These fade following **childbirth** and in children, but may recur. About 90% respond to sclerotherapy, electrodesiccation, or laser therapy.
- Cherry angiomas. These are easily removed by electrodesiccation.
- Lymphangiomas. These require surgery.
- Salmon patches. Eyelid marks disappear by 6-12 months of age, and forehead marks fade by age 6; however, 50% of stork bites on the neck persist into adulthood.
- Port-wine stains. Some flat birthmarks are easily covered with make-up. Treatment during infancy or childhood improves results. About 95% of the stains respond to FPDL surgery with minimal scarring; 25% will completely and 70% will partially disappear. For unknown reasons, 5% show no improvement.

Prevention

Congenital hemangiomas or vascular malformations cannot be prevented, but spider angiomas may be prevented by **exercise**, weight control, and a high-fiber diet, as well as avoidance of sun exposure, alcohol drinking, or wearing tight hosiery.

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ORGANIZATIONS

- American Academy of Dermatology. 930 N. Meacham Road, P.O. Box 4014, Schaumburg, IL 60168-4014. (847) 330-0230. <<http://www.aad.org>>.
- American Academy of Pediatrics. 141 Northwest Point Boulevard, Elk Grove Village, IL 60007-1098. (847) 434-4000. <<http://www.aap.org>>.
- Congenital Nevus Support Group. 1400 South Joyce St., Number C-1201, Arlington, VA 22202. (703) 920-3249.
- National Congenital Port Wine Stain Foundation. 123 East 63rd St., New York, NY 10021. (516) 867-5137.

Mercedes McLaughlin

Bismuth subsalicylate see **Antidiarrheal drugs**

Bites and stings

Definition

Humans can be injured by the bites or stings of many kinds of animals, including mammals such as dogs, cats, and fellow humans; arthropods such as spiders, bees, and wasps; snakes; and marine animals such as jellyfish and stingrays.

Description

Mammals

DOGS. In the United States, where the dog population exceeds 50 million, dogs surpass all other mammals in the number of bites inflicted on humans. However, most dog-bite injuries are minor. A telephone survey of U.S. households conducted in 1994 led researchers to estimate that 3,737,000 dog bites not requiring medical attention occurred in the United States that year, versus 757,000 that did require medical treatment. Studies also show that most dog bites are from pets or other dogs known to the bitten person, that males are more likely than females to be bitten, and that children face a greater

risk than adults. Each year, about 10-20 Americans, mostly children under 10 years of age, are killed by dogs.

Dog bites result in an estimated 340,000 emergency-room visits annually throughout the United States. More than half of the bites seen by emergency departments occur at home. Children under 10 years old, especially boys between 5 and 9 years of age, are more likely than older people to visit an emergency room for bite treatment. Children under 10 years old were also much more liable to be bitten on the face, neck, and head. Nearly all of the injuries suffered by people seeking treatment in emergency rooms were of "low severity," and most were treated and released without being admitted to hospital or sent to another facility. Many of the bites resulted from people attempting to break up fights between animals.

CATS. Although cats are found in nearly a third of U.S. households, cat bites are far less common than dog bites. According to one study, cats inflict perhaps 400,000 harmful bites in the United States each year. The tissue damage caused by cat bites is usually limited, but they carry a high risk of infection. Whereas the infection rate for dog bite injuries is 15-20%, the infection rate for cat bites is 30-40%. A typical person who has been bitten is a young girl playing with a pet.

HUMANS. Bites from mammals other than dogs and cats are uncommon, with one exception—human bites. There are approximately 70,000 human bites each year in the United States. Because the human mouth contains a multitude of potentially harmful microorganisms, human bites are more infectious than those of most other animals.

Arthropods

Arthropods are invertebrates belonging to the phylum Arthropoda, which includes insects, arachnids, crustaceans, and other subgroups. There are more than 700,000 species in all. The list of arthropods that bite or sting humans is extensive and includes lice, bedbugs, fleas, mosquitoes, black flies, ants, chiggers, ticks, centipedes, scorpions, and other species. Spiders, bees, and wasps are the three kinds of arthropod that most often bite people.

SPIDERS. In the United States, only two kinds of venomous spider are truly dangerous: widow spiders and brown (violin or fiddle) spiders. The black widow, which is found in every state but Alaska, is probably the most notorious widow spider. It prefers dark, dry places such as barns, garages, and outhouses, and also lives under rocks and logs. Disturbing a female black widow or its web may provoke a bite. Brown spiders also prefer sheltered places, including clothing, and may bite if disturbed.

BEES AND WASPS. Bees and wasps will sting to defend their nests or if they are disturbed. Species common to the United States include honeybees, bumblebees, yellow jackets, bald-faced hornets, brown hornets, and paper wasps. Of note are also Africanized bee species, also called “killer bees” that are now found in the United States since 1990. More than fifty Americans die each year after being stung by a bee, wasp, or ant. Almost all of those deaths are the result of allergic reactions, and not of exposure to the venom itself.

Snakes

There are 20 species of venomous snakes in the United States. These snakes are found in every state except Maine, Alaska, and Hawaii. Each year about 8,000 Americans receive a venomous snakebite, but no more than about 15 die, mostly from rattlesnake bites.

The venomous snakes of the United States are divided into two families, the Crotalidae (pit vipers) and the Elapidae. Pit vipers, named after the small heat-sensing pit that lies between each eye and nostril, are responsible for about 99% of the venomous snakebites suffered by Americans. Rattlesnakes, copperheads, and cottonmouths (also called water moccasins) are pit vipers. This family of snakes delivers its venom through two long, hinged fangs in the upper jaw. Some pit vipers carry a potent venom that can threaten the brain and spinal cord. The venom of others, such as the copperheads, is less harmful.

The Elapidae family includes two kinds of venomous coral snakes indigenous to the southern and western states. Because coral snakes are bashful creatures that come out only at night, they almost never bite humans, and are responsible for approximately 25 bites a year in the United States. Coral snakes also have short fangs and a small mouth, which lowers the risk of a bite actually forcing venom into a person’s body. However, their venom is quite poisonous.

Marine animals

Several varieties of marine animal may bite or sting. Jellyfish and stingrays are two kinds that pose a threat to people who live or vacation in coastal communities.

Causes and symptoms

Mammals

DOGS. A typical dog bite results in a laceration, tear, puncture, or crush injury. Bites from large, powerful dogs may even cause **fractures** and dangerous internal injuries. Also, dogs trained to attack may bite repeatedly during a single episode. Infected bites usually cause **pain**, **cellulitis** (inflammation of the connective tissues), and a

pus-filled discharge at the wound site within 8-24 hours. Most infections are confined to the wound site, but many of the microorganisms in the mouths of dogs can cause systemic and possibly life-threatening infections. Examples are **bacteremia** and **meningitis**, especially severe in people diagnosed with acquired **immunodeficiency syndrome (AIDS)** or other health condition that increases their susceptibility to infection. **Rabies** is rare among pet dogs in the United States, most of which have been vaccinated against the disease. **Tetanus** is also rare but can be transmitted by a dog bite if the victim is not immunized.

CATS. The mouths of cats and dogs contain many of the same microorganisms. Cat scratches and bites are also capable of transmitting the *Bartonella henselae* bacterium, which can lead to **cat-scratch disease**, an unpleasant but usually not life-threatening illness.

Cat bites are mostly found on the arms and hands. Sharp cat teeth typically leave behind a deep puncture wound that can reach muscles, tendons, and bones, which are vulnerable to infection because of their comparatively poor blood supply. This is why cat bites are much more likely to become infected than dog bites. Also, people are less inclined to view cat bites as dangerous requiring immediate attention; the risk that infection has set in by the time a medical professional is consulted is thus greater.

HUMANS. Humans bites result from fights, sexual activity, medical and dental treatment, and seizures. Bites also raise the possibility of spousal or **child abuse**. Children often bite other children, but those bites are hardly ever severe. Human bites are capable of transmitting a wide range of dangerous diseases, including **hepatitis B**, **syphilis**, and **tuberculosis**.

Human bites fall into two categories: occlusional (true) bites and clenched-fist injuries. The former present a lower risk of infection. The latter, which are very infectious and can permanently damage the hand, usually result from a fist hitting teeth during a fight. People often wait before seeking treatment for a clenched-fist injury, with the result that about half of such injuries are infected by the time they are seen by a medical professional.

Arthropods

SPIDERS. As a rule, people rarely see a black widow bite, nor do they feel the bite as it occurs. The first (and possibly only) evidence that a person has been bitten may be a mild swelling of the injured area and two red puncture marks. Within a short time, however, some victims begin to experience severe muscle cramps and rigidity of the abdominal muscles. Other possible symptoms include excessive sweating, nausea, vomiting, headaches, and vertigo as well as breathing, vision, and speech problems.

A brown spider's bite can lead to necrotic arachnidism, in which the tissue in an area of up to several inches around the bite becomes necrotic (dies), producing an open sore that can take months or years to disappear. In most cases, however, the bite simply produces a hard, painful, itchy, and discolored area that heals without treatment in 2-3 days. The bite may also be accompanied by a **fever**, chills, **edema** (an accumulation of excess tissue fluid), **nausea and vomiting**, **dizziness**, muscle and joint pain, and a rash.

BEES AND WASPS. The familiar symptoms of bee and wasp stings include pain, redness, swelling, and itchiness in the area of the sting. Multiple stings can have much more severe consequences, such as **anaphylaxis**, a life-threatening allergic reaction that occurs in hypersensitive persons.

Snakes

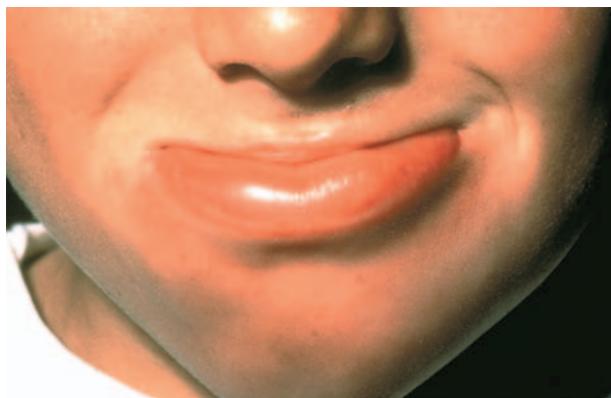
Venomous pit viper bites usually begin to swell within 10 minutes and sometimes are painful. Other symptoms include skin blisters and discoloration, weakness, sweating, nausea, faintness, dizziness, bruising, and tender lymph nodes. Severe **poisoning** can also lead to tingling in the scalp, fingers, and toes, muscle contractions, an elevated heart rate, rapid breathing, large drops in body temperature and blood pressure, vomiting of blood, and **coma**.

Many pit viper and coral snake bites (20-60%) fail to poison (envenomate) their victim, or introduce only a small amount of venom into the victim's body. The **wounds**, however, can still become infected by the harmful microorganisms that snakes carry in their mouths.

Coral snake bites are painful but may be hard to see. One to seven hours after the bite, a bitten person begins to experience the effects of the venom, which include tingling at the wound site, weakness, nausea, vomiting, excessive salivation, and irrational behavior. Major nerves of the body can become paralyzed for 6-14 days, causing double vision, difficulty swallowing and speaking, **respiratory failure**, and other problems. Six to eight weeks may be needed before normal muscular strength is regained.

Marine animals

JELLYFISH. Jellyfish venom is delivered by barbs called nematocysts, which are located on the creature's tentacles and penetrate the skin of people who brush up against them. Instantly painful and itchy red lesions usually result. The pain can continue up to 48 hours. Severe cases may lead to skin necrosis, **muscle spasms and cramps**, vomiting, nausea, **diarrhea**, headaches, excess-



An insect bite caused this person's lower lip to swell. (Custom Medical Stock Photo. Reproduced by permission.)

sive sweating, and other symptoms. In rare instances, cardiorespiratory failure may also occur.

STINGRAYS. Tail spines are the delivery mechanism for stingray venom. Deep puncture wounds result that can cause an infection if pieces of spine become embedded in the wound. A typical stingray injury scenario involves a person who inadvertently steps on a resting stingray and is lashed in the ankle by its tail. Stingray venom produces immediate, excruciating pain that lasts several hours. Sometimes the victim suffers a severe reaction, including vomiting, diarrhea, hemorrhage (bleeding), a drop in blood pressure, and cardiac arrhythmia (disordered heart beat).

Diagnosis

Mammals

DOGS. Gathering information on the circumstances of a dog attack is a crucial part of treatment. Medical professionals need to know when the attack occurred (the chances of infection increase dramatically if the wound has been left untreated for more than eight hours) and what led to the attack (unprovoked attacks are more likely to be associated with rabies). A person's general health must also be assessed, including the tetanus immunization history if any, as well as information concerning possible **allergies** to medication and pre-existing health problems that may increase the risk of infection.

A **physical examination** requires careful scrutiny of the wound, with special attention to possible bone, joint, ligament, muscle, tendon, nerve, or blood-vessel damage caused by deep punctures or severe crush injuries. Serious hand injuries should be evaluated by a specialized surgeon. Most of the time, laboratory tests for identifying the microorganisms in bite wounds are performed if infection is present. X rays and other diagnostic procedures may also be necessary.



A close-up view of lacerations on the shin of an adult woman inflicted by a Rottweiler dog. (*Custom Medical Stock Photo. Reproduced by permission.*)

CATS. The diagnostic procedures used for dog bites also apply to cat bites.

HUMANS. Testing the blood of a person who has been bitten for immunity to hepatitis B and other diseases is always necessary after a human bite. Ideally, the biter should be tested as well for the presence of transmissible disease. Clenched-fist injuries often require evaluation by a hand surgeon or orthopedist. Because many people will deny having been in a fight, medical professionals usually consider lacerations over the fourth and fifth knuckles—the typical result of a clenched-fist injury—to be evidence of a bite wound. Medical professionals also look for indications of spousal or child abuse when evaluating human bites.

Arthropods

SPIDERS. Because bites from widow spiders and brown spiders require different treatments, capturing and identifying the spider helps to establish diagnosis.

Snakes

Diagnosis relies on a physical examination of the victim, information about the circumstances of the bite, and a look at the snake itself (if it can safely be killed and brought in for identification). Blood tests and **urinalysis** supply important data on the victim's condition. Chest x-rays and **electrocardiography** (a procedure for measuring heart activity) may also be necessary.

Treatment

Mammals

DOGS. Minor dog bites can be treated at home. The American Academy of Family Physicians recommends gently washing the wound with soap and water and then

applying pressure to the injured area with a clean towel to stop the bleeding. The next step is to apply antibiotic ointment and a sterile bandage to the wound. To reduce swelling and fend off infection, ice should be applied and the injured area kept elevated above the level of the heart. The wound should be cleaned and covered with ointment twice a day until it heals.

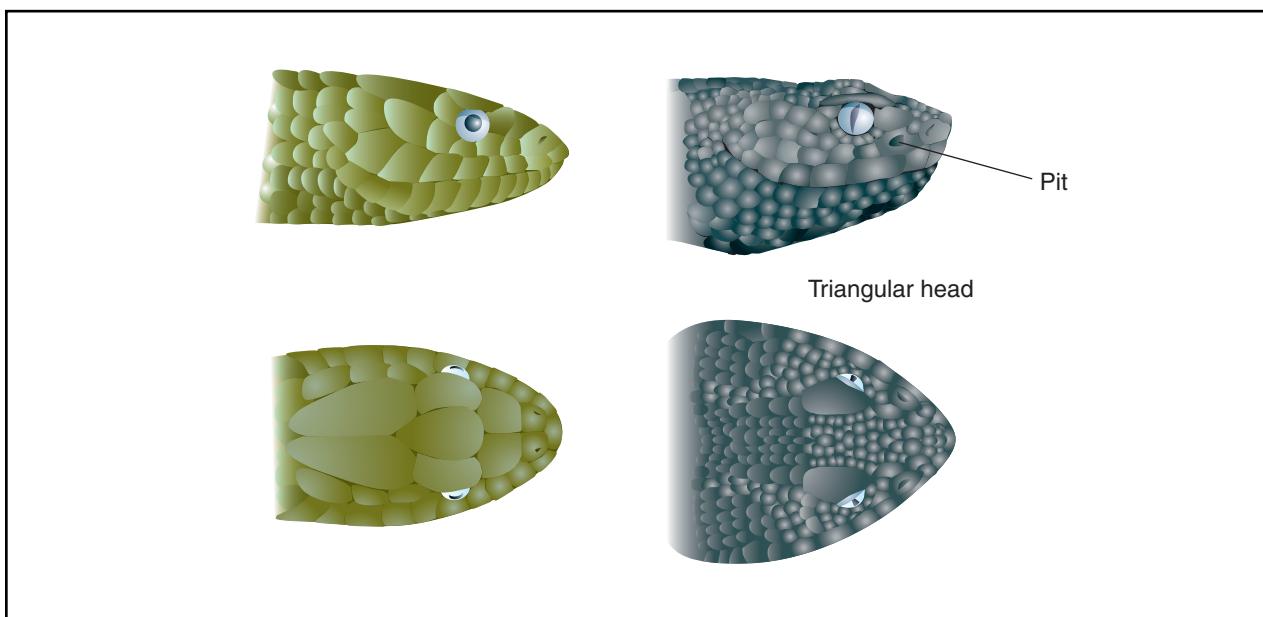
Any dog bite that does not stop bleeding after 15 minutes of pressure must be seen by a medical professional. The same is true for bites that are deep or gaping; for bites to the head, hands, or feet; and for bites that may have broken a bone, damaged nerves, or caused a major injury of another kind. Bite victims must also watch for infection. A fever is one sign of infection, as are redness, swelling, warmth, increased tenderness, and pus at the wound site. Diabetics, people with AIDS or **cancer**, individuals who have not had a tetanus shot in five years, and anyone else who has a medical problem that can increase susceptibility to infection should seek medical treatment no matter how minor the bite appears.

Medical treatment of dog bites involves washing the wound with an anti-infective solution. Removal of dead and damaged tissue (under local, regional, or general anesthetic) may be required after the wound has been washed, and any person whose tetanus shots are not up to date should receive a booster injection. Some wounds are left open and allowed to heal on their own, while others require stitches (stitching may be delayed a few days if infection is a concern). Many emergency departments prescribe **antibiotics** for all people with dog bites, but some researchers suggest that antibiotics are usually unnecessary and should be limited to those whose injuries or other health problems make them likely candidates for infection. A follow-up visit after one or two days is generally required for anyone who has received bite treatment.

CATS. Because of the high risk of infection, people who are bitten by a cat should always see a doctor. Cat scratches do not require professional medical treatment unless the wound appears infected or the scratched person has a weakened immune system.

Medical treatment for cat bites generally follows the procedures used for dog bites. Experts advise, however, that cat-bite wounds should always be left open to prevent infection. Persons who have been bitten by cats generally receive antibiotics as a preventive measure.

HUMANS. Human bites should always be examined by a doctor. Such bites are usually treated with antibiotics and left open because of the high risk of infection. A person who has been bitten may also require immunization against hepatitis B and other diseases. Persons



Profile and top views of typically nonpoisonous and poisonous snakes. Characteristic triangular head and pits on the side of the head are indicative of poisonous pit vipers found in the United States. (Illustration by Argosy Inc.)

who are being treated for a clenched-fist injury will require a daily follow-up examination for 3-5 days.

Arthropods

SPIDERS. No spider bite should be ignored. The antidote for severe widow spider bites is a substance called antivenin, which contains antibodies taken from the blood serum of horses injected with spider venom. Doctors **exercise** caution in using antivenin, however, because it can trigger anaphylactic **shock**, a potentially deadly (though treatable) allergic reaction, and **serum sickness**, an inflammatory response that can give rise to joint pain, a fever, **rashes**, and other unpleasant, though rarely serious, consequences.

An antivenin for brown spider bites exists as well, but it is not yet available in the United States. The drug dapsone, used to treat **leprosy**, can sometimes stop the tissue **death** associated with a brown spider bite. Necrotic areas may need **debridement** (removal of dead and damaged tissue) and skin grafts. Pain medications, **antihistamines**, antibiotics, and tetanus shots are a few of the other treatments that are sometimes necessary after a bite from a brown spider or widow spider.

BEES AND WASPS. Most stings can be treated at home. A stinger that is stuck in the skin can be scraped off with a blade, fingernail, credit card, or piece of paper (using tweezers may push more venom out of the venom sac and into the wound). The area should be cleaned and

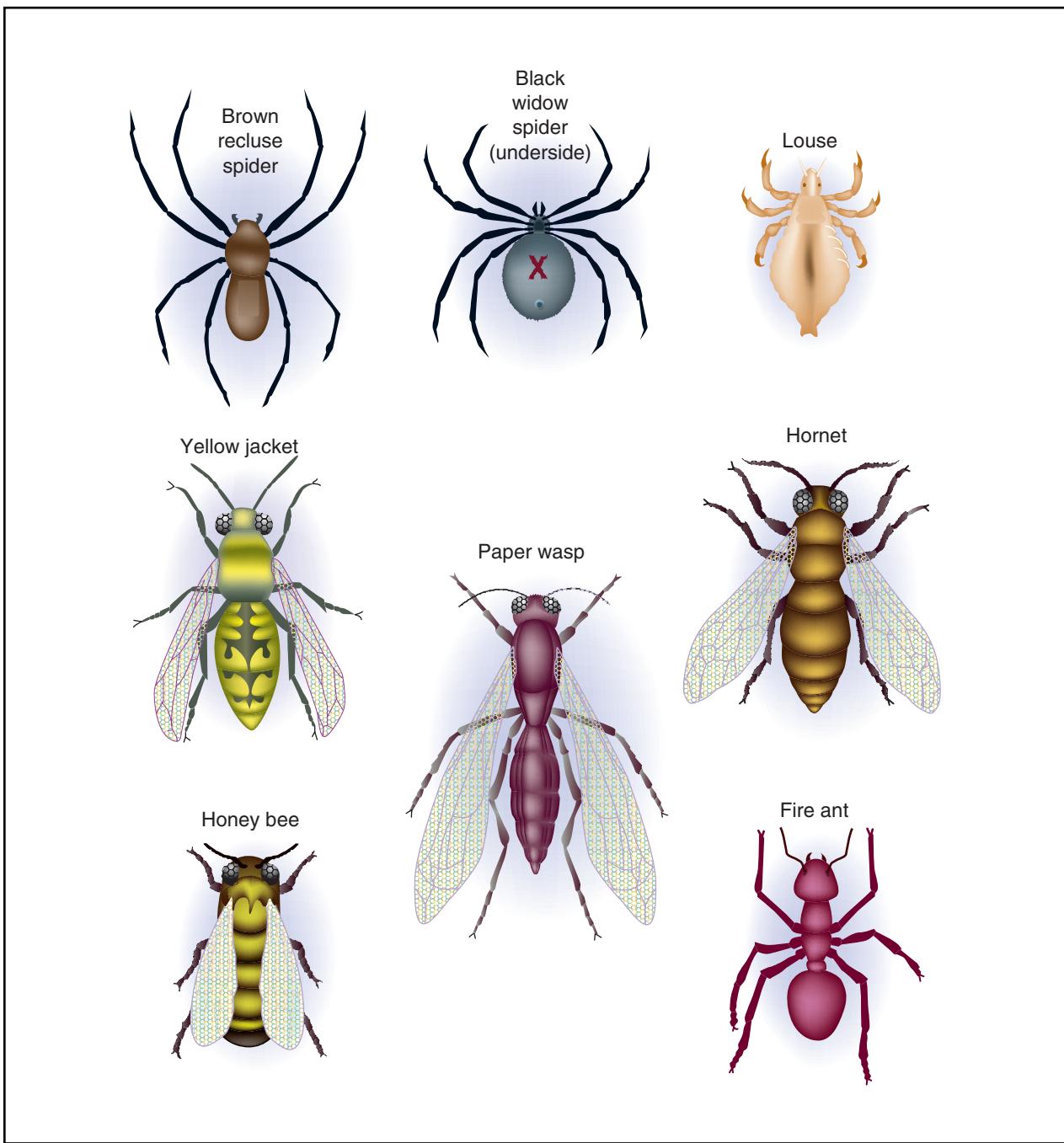
covered with an ice pack. **Aspirin** and other pain medications, oral antihistamines, and calamine lotion are good for treating minor symptoms. Putting meat tenderizer on the wound has no effect.

Persons who have been stung and experience an allergic reaction, or who are at risk due to their medical history, require immediate medical attention. The danger signs, which usually begin 10 minutes after an individual is stung (though possibly not for several hours), include nausea, faintness, chest pain, abdominal cramps, diarrhea, and difficulty swallowing or breathing.

Snakes

Although most snakes are not venomous, any snakebite should immediately be examined at a hospital. While waiting for emergency help to arrive, the victim should wash the wound site with soap and water, and then keep the injured area still and at a level lower than the heart. Ice should never be used on the wound site nor should attempts be made to suck out the venom. Making a cut at the wound site is also dangerous. It is important to stay calm and wait for emergency medical aid if it can arrive quickly. Otherwise, the victim should proceed directly to a hospital.

When the victim arrives at a hospital, the medical staff must determine whether the bite was inflicted by a venomous snake and, if so, whether envenomation occurred and how much venom the person has received.



Types of spiders and insects that bite and sting. (Illustration by Argosy Inc.)

Patients may develop low blood pressure, abnormal blood clotting, or severe pain, all of which require aggressive treatment. Fortunately, the effects of some snakebites can be counteracted with antivenin. Minor rattlesnake envenomations can be successfully treated without antivenin, as can copperhead and water-moccasin bites. However, coral snake envenomations and the more dangerous rattlesnake envenomations require antivenin,

sometimes in large amounts. Other treatment measures include antibiotics to prevent infection and a tetanus booster injection.

Marine animals

JELLYFISH. Vinegar and other acidic substances are used to neutralize jellyfish nematocysts still clinging to

the skin, which are then scraped off. Anesthetic ointments, antihistamine creams, and steroid lotions applied to the skin are sometimes beneficial. Other measures may be necessary to counter the many harmful effects of jellyfish stings, which, if severe, require emergency medical care.

STINGRAYS. Stingray wounds should be washed with saltwater and then soaked in very hot water for 30–90 minutes to neutralize the venom. Afterwards, the wound should be examined by a doctor to ensure that no pieces of spine remain.

Alternative treatment

Arthropods

Several alternative self-care approaches are used to treat minor bee, wasp, and other arthropod stings, including **aromatherapy**, **ayurvedic medicine**, **flower remedies**, herbs, **homeopathy**, and nutritional therapy.

Prognosis

Mammals

Prompt treatment and recognizing that even apparently minor bites can have serious consequences are the keys to a good outcome after a mammal bite. Infected bites can be fatal if neglected. Surgery and hospitalization may be needed for severe bites.

Arthropods

SPIDERS. Even without treatment, adults usually recover from black widow bites after 2–3 days. Those most at risk of dying are very young children, the elderly, and people with high blood pressure. In the case of brown spider bites, the risk of death is greatest for children, though rare.

BEES AND WASPS. The pain and other symptoms of a bee or wasp sting normally fade away after a few hours. People who are allergic to such stings, however, can experience severe and occasionally fatal anaphylaxis.

Snakes

A snakebite victim's chances of survival are excellent if medical aid is obtained in time. Some bites, however, result in **amputation**, permanent deformity, or loss of function in the injured area.

Marine animals

STINGRAYS. Stingray venom kills its human victims on rare occasions.

Prevention

Mammals

DOGS. The risk of a dog bite injury can be reduced by avoiding sick or stray dogs, staying away from dog-fights (people often get bitten when they try to separate the animals), and not behaving in ways that might provoke or upset dogs, such as wrestling with them or bothering them while they are sleeping, eating, or looking after their puppies. Special precautions need to be taken around infants and young children, who must never be left alone with a dog. Pit bulls, rottweilers, and German shepherds (responsible for nearly half of all fatal dog attacks in the United States in 1997–2000) are potentially dangerous pets in households where children live or visit. For all breeds of dog, obedience training as well as spaying or neutering lessen the chances of aggressive behavior.

CATS. Prevention involves warning children to stay away from strange cats and to avoid rough play and other behavior that can anger cats and cause them to bite.

Arthropods

SPIDERS. Common-sense precautions include clearing webs out of garages, outhouses, and other places favored by venomous spiders; keeping one's hands away from places where spiders may be lurking; and, when camping or vacationing, checking clothing, shoes, and sleeping areas.

BEES AND WASPS. When possible, avoid the nests of bees and wasps and do not eat sweet food or wear bright clothing, perfumes, or cosmetics that attract bees and wasps.

Emergency medical kits containing self-administrable epinephrine to counter anaphylactic shock are available for allergic people and should be carried by them at all times. People who suspect they are allergic should consult an allergist about shots that can reduce reactions to bee and wasp venom.

Snakes

Snakes should not be kept as pets. Measures such as mowing the lawn, keeping hedges trimmed, and removing brush from the yard also discourages snakes from living close to human dwellings. Tongs should be used to move brush, lumber, and firewood, to avoid exposing one's hands to snakes that might be lying underneath. Similarly, golfers should never use their hands to retrieve golf balls from a water hole, since snakes can be hiding in the rocks and weeds. Caution is also necessary when walking through weedy or grassy areas, and children should be prevented from playing in weedy, vacant lots.

KEY TERMS

Anaphylaxis—A life-threatening allergic reaction occurring in persons hypersensitive to bites and stings.

Antibiotics—Substances used against bacteria that cause infection.

Antibodies—Substances created by the body to combat infection.

Antihistamines—Drugs used to treat allergic reactions by acting against a substance called histamine.

Arachnid—Large class of arthropods that include spiders, scorpions, mites, and ticks. Arachnids have a segmented body divided into two parts, one of which has four pairs of legs but no antennae.

Arachnidism—Poisoning resulting from the bite or sting of an arachnid.

Bacteremia—Bacteria in the blood.

Blood serum—A component of blood.

Immune system—The body system that fights infection and protects the body against foreign invaders and disease.

Killer bees—Hybrids of African bees accidentally introduced into the wild in South and North America in 1956 and first reported in Texas in 1990. They were first imported by Brazilian scientists attempting to create a new hybrid bee to improve honey production.

Lymph nodes—Small, kidney-shaped organs that filter a fluid called lymph and that are part of the body's immune system.

Pus—A thick yellowish or greenish fluid composed of the remains of dead white blood cells, pathogens and decomposed cellular debris.

and other places where snakes may live. Leather boots and long pants offer hikers and campers some protection from bites. Approaching a snake, even a dead one, can be dangerous, for the venom of recently killed snakes may still be active.

Marine animals

JELLYFISH. Prevention of jellyfish stings includes obeying posted warning signs at the beach. Also, jellyfish tentacles may be transparent and up to 120 ft (36.5 m) long, therefore great caution must be exercised whenever a jellyfish is sighted nearby.

STINGRAYS. Shuffling while walking through shallow areas that may be inhabited by stingrays will disturb the water, causing the animal to move before it can be stepped on.

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American Academy of Emergency Medicine. 611 East Wells Street, Milwaukee, WI 53202. (800) 884-2236, Fax: (414) 276-3349. <<http://www.aaem.org/>>.

American Academy of Family Physicians, 11400 Tomahawk Creek Parkway, Leawood, KS 66211-2672. (913) 906-6000. <<http://www.aafp.org/>>. fp@aafp.org.

American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, IL 60007-1098. (847) 434-4000, Fax: (847) 434-8000. <<http://www.aap.org/default.htm>>. kidsdoc@aap.org.

American Association of Poison Control Centers, 3201 New Mexico Avenue NW, Washington, DC 20016. (202) 362-7217. Fax: (202) 362-8377. <<http://www.aapcc.org/>>.

American College of Occupational and Environmental Medicine, 55 West Seegers Road, Arlington Heights, IL 60005. (708) 228-6850. Fax: (708) 228-1856. <<http://www.acoem.org/>>.

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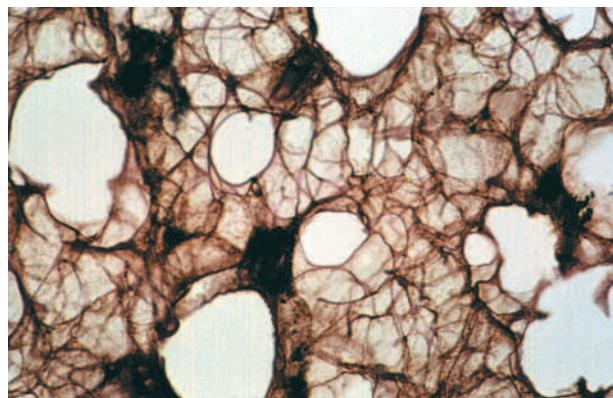
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L. Fleming Fallon, Jr., MD, PhD

Black death see **Plague**



A light micrograph of a human lung containing particles of inspired coal dust (anthracosis). The black masses shown are groups of coal dust particles. (Photograph by Astrid & Hanns-Frieder Michler, Photo Researchers, Inc. Reproduced by permission.)

In the years since the federal government has regulated dust levels in coal mines, the number of cases of black lung disease has fallen sharply. Since the Federal Coal Mine Health and Safety Act of 1969, average dust levels have fallen from 8.0 mg. per cubic meter to the current standard of 2.0 mg. per cubic meter. The 1969 law also set up a black lung disability benefits program to compensate coal miners who have been disabled by on-the-job dust exposure.

Despite the technology available to control the hazard, however, miners still run the risk of developing this lung disease. The risk is much lower today, however; fewer than 10% of coal miners have any x ray evidence of coal dust deposits. When there is such evidence, it often shows up as only small black spots less than 0.4 in (1 cm). in diameter, and may have been caused by **smoking** rather than coal dust. This condition is called "simple CWP" and does not lead to symptoms or disability.

Causes and symptoms

Since the particles of fine coal dust, which a miner breathes when he is in the mines, cannot be destroyed within the lungs or removed from them, builds up. Eventually, this build-up causes thickening and scarring, making the lungs less efficient in supplying oxygen to the blood.

The primary symptom of the disease is **shortness of breath**, which gradually gets worse as the disease progresses. In severe cases, the patient may develop **cor pulmonale**, an enlargement and strain of the right side of the heart caused by chronic lung disease. This may eventually cause right-sided **heart failure**.

Description

The risk of having black lung disease is directly related to the amount of dust inhaled over the years; the disease typically affects workers over age 50. Its common name comes from the fact that the inhalation of heavy deposits of coal dust makes miners lungs look black instead of a healthy pink.

Although people who live in cities often have some black deposits in their lungs from polluted air, coal miners have much more extensive deposits.

KEY TERMS

Emphysema—A disease in which the tiny air sacs in the lungs become damaged, leading to shortness of breath, and respiratory and heart failure.

Fibrosis—The growth of scar tissue, often as a response to injury, infection, or inflammation.

Pulmonary function test—A group of procedures used to evaluate the function of the lungs and confirm the presence of certain lung disorders.

Silica dust—A type of dust from silica (crystalline quartz) which causes breathing problems in workers in the fields of mining, stone cutting, quarrying (especially granite), blasting, road and building construction industries that manufacture abrasives, and farming. Breathing the dust causes silicosis, a severe disease that can scar the lungs.

Some patients develop **emphysema** (a disease in which the tiny air sacs in the lungs become damaged, leading to shortness of breath, and respiratory and heart failure) as a complication of black lung disease. Others develop a severe type of black lung disease called progressive massive fibrosis, in which damage continues in the upper parts of the lungs even after exposure to the dust has ended. Scientists aren't sure what causes this serious complication. Some think that it may be due to the breathing of a mixture of coal and silica dust that is found in certain mines. Silica is far more likely to lead to scarring than coal dust alone.

Diagnosis

Black lung disease can be diagnosed by checking a patient's history for exposure to coal dust, followed by a chest x-ray to discover if the characteristic spots in the lungs caused by coal dust are present. A **pulmonary function test** may aid in diagnosis.

X rays can detect black lung disease before it causes any symptoms. If exposure to the dust is stopped at that point, progression of the disease may be prevented.

Treatment

There is no treatment or cure for this condition, although it is possible to treat complications such as lung infections and cor pulmonale. Further exposure to coal dust must be stopped.

Prognosis

Those miners with simple CWP can lead a normal life. However, patients who develop black lung disease at an early age, or who have progressive massive fibrosis, have a higher risk of premature **death**.

Prevention

The only way to prevent black lung disease is to avoid long-term exposure to coal dust. Coal mines may help prevent the condition by lowering coal dust levels and providing protective clothes to coal miners.

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Mine Safety and Health Administration. 4015 Wilson Blvd. Arlington, VA 22203. (703) 235-1910. <<http://www.msha.gov>>.

Carol A. Turkington

Bladder calculi see **Bladder stones**

Bladder cancer

Definition

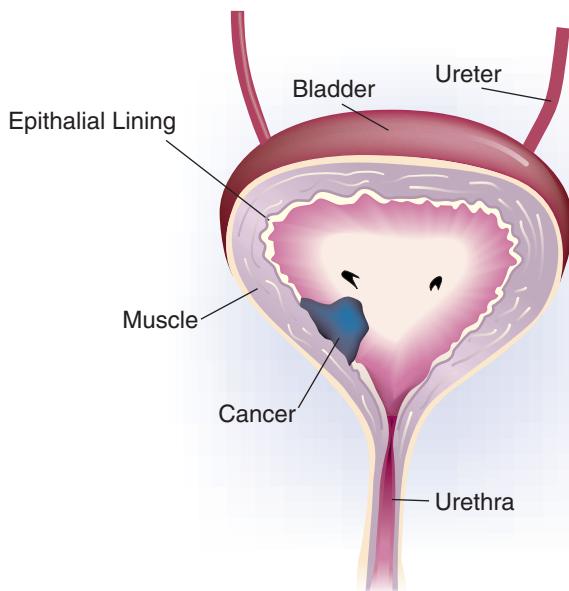
Bladder **cancer** is a disease in which the cells lining the urinary bladder lose the ability to regulate their growth and start dividing uncontrollably. This abnormal growth results in a mass of cells that form a tumor.

Description

Bladder cancer is the fifth most common cancer in the United States. The American Cancer Society (ACS) estimates that in 1998, approximately 55,000 new cases of bladder cancer will be diagnosed, and it will cause at least 12,500 deaths. The disease is three times more common among men than women, and the incidence is also higher in caucasians.

The urinary bladder is a hollow muscular organ that stores urine from the kidneys until it is excreted out of the body. Two tubes called the ureters bring the urine from the kidneys to the bladder. The urethra carries the urine from the bladder to the outside of the body.

Bladder cancer has a very high rate of recurrence. Even after superficial tumors are completely removed,



Bladder cancer on the inner lining of the bladder. (Illustration by Argosy Inc.)

there is a 75% chance that new tumors will develop in other areas of the bladder. Hence, patients need very frequent and thorough follow-up care.

Causes and symptoms

Although the exact cause of bladder cancer is not known, smokers are twice as likely as nonsmokers to get the disease. Hence, **smoking** is considered the greatest risk factor for bladder cancer. Workers who are exposed to certain chemicals that are used in the dye industry and in the rubber, leather, textile, and paint industries are believed to be at a higher risk for bladder cancer. The disease is also three times more common in men than in women; caucasians also are at an increased risk. The risk of bladder cancer increases with age. Most cases are found in people who are 50–70 years old.

Frequent urinary infections, kidney and **bladder stones**, and other conditions that cause long-term irritation to the bladder may increase the risk of getting bladder cancer. A past history of tumors in the bladder could also increase one's risk of getting other tumors.

One of the first warning signals of bladder cancer is blood in the urine. Sometimes, there is enough blood in the urine to change the color of the urine to a yellow-red or a dark red. At other times, the color of the urine appears normal but chemical testing of the urine reveals the presence of blood cells. A change in bladder habits such as painful

urination, increased frequency of urination and a feeling of needing to urinate but not being able to do so are some of the signs of possible bladder cancer. All of these symptoms may also be caused by conditions other than cancer, but it is important to see a doctor and have the symptoms evaluated. When detected early and treated appropriately, patients have a very good chance of being cured completely.

Diagnosis

If a doctor has any reason to suspect bladder cancer, he may use several tests to find out if the disease is present. As a first step, a complete medical history will be taken to check for any risk factors. A thorough **physical examination** will be conducted to assess all the signs and symptoms. Laboratory testing of a urine sample will help to rule out the presence of a bacterial infection. In a urine cytology test, the urine is examined under a microscope to look for any abnormal or cancerous cells. A catheter (tube) can be advanced into the bladder through the urethra, and a salt solution is passed through it to wash the bladder. The solution can then be collected and examined under a microscope to check for the presence of any cancerous cells.

A test known as the intravenous pyelogram (IVP) is an x-ray examination that is done after a dye is injected into the blood stream through a vein in the arm. The dye travels through the blood stream and then reaches the kidneys to be excreted. It clearly outlines the kidneys,

ureters, bladder, and urethra. Multiple x rays are taken to detect any abnormality in the lining of these organs.

The physician may use a procedure known as a **cystoscopy** to view the inside of the bladder. A thin hollow lighted tube is introduced into the bladder through the urethra. If any suspicious looking masses are seen, a small piece of the tissue can be removed from it using a pair of biopsy forceps. The tissue is then examined microscopically to verify if cancer is present, and if so, to identify the type of cancer.

If cancer is detected and there is evidence to indicate that it has metastasized (spread) to distant sites in the body, imaging tests such as chest x rays, **computed tomography scans** (CT), and **magnetic resonance imaging** (MRI) may be done to determine which organs are affected. Bladder cancer generally tends to spread to the lungs, liver, and bone.

Treatment

Treatment for bladder cancer depends on the stage of the tumor. The patient's medical history, overall health status, and personal preferences are also taken into account when deciding on an appropriate treatment plan. The three standard modes of treatment that are available for bladder cancer are surgery, **radiation therapy**, and **chemotherapy**. In addition, newer treatment methods such as photodynamic therapy and immunotherapy are also being investigated in clinical trials.

Surgery is considered an option only when the disease is in its early stages. If the tumor is localized to a small area and has not spread to the inner layers of the bladder, then the surgery is done without cutting open the abdomen. A cytoscope is introduced into the bladder through the urethra, and the tumor is removed through it. This procedure is called a transurethral resection (TUR). Passing a high-energy laser beam through the cytoscope and burning the cancer may treat any remaining cancer. This procedure is known as electrofulguration. If the cancer has invaded the walls of the bladder, surgery will be done through an incision in the abdomen. Cancer that is not very large can be removed by partial **cystectomy**, a procedure where a part of the bladder is removed. If the cancer is large or is present in more than one area of the bladder, a radical cystectomy is done. In this operation, besides the entire bladder, the adjoining organs may also be removed. In men, the prostate is removed, while in women, the uterus, ovaries, and fallopian tubes are removed.

If the entire urinary bladder is removed, then an alternate storage place must be created for the urine to be stored before it is excreted out of the body. To do this, a piece of intestine is converted into a small bag and attached to the ureters. This is then connected to an open-

ing (stoma) that is made in the abdominal wall. The procedure is called a urostomy. In some urostomy procedures, the urine from the intestinal sac is routed into a bag that is placed over the stoma in the abdominal wall. The bag is hidden by the clothing and has to be emptied occasionally by the patient. In a different procedure, the urine is collected in the intestinal sac, but there is no bag on the outside of the abdomen. The intestinal sac has to be emptied by the patient, by placing a drainage tube through the stoma.

Radiation therapy that uses high-energy rays to kill cancer cells is generally used after surgery to destroy any remaining cancer cells that may not have been removed during surgery. If the tumor is in a location that makes surgery difficult, or if it is large, radiation may be used before surgery to shrink the tumor. In cases of advanced bladder cancer, radiation therapy is used to ease the symptoms such as **pain**, bleeding, or blockage. Radiation can be delivered by external beam radiation where a source of radiation that is outside the body focuses the radiation on the area of the tumor. Occasionally, a small pellet of radioactive material may be placed directly into the cancer. This is known as interstitial radiation therapy.

Chemotherapy uses **anticancer drugs** to destroy the cancer cells that may have migrated to distant sites. The drugs are introduced into the bloodstream by injecting them into a vein in the arm or taking them orally in pill form. Generally a combination of drugs is more effective than any single drug in treating bladder cancer. Chemotherapy may be given following surgery to kill any remaining cancer cells. It may also be given even when no remaining cancer cells can be seen. This is called adjuvant chemotherapy. Anticancer drugs, including thiotepa, doxorubicin, and mitomycin, may also be instilled directly into the bladder (intravesicular chemotherapy) to treat superficial tumors.

Immunotherapy or biological therapy, uses the body's own immune cells to fight the disease. To treat superficial bladder cancer, bacille Calmette-Guerin (BCG) may be instilled directly into the bladder. BCG is a weakened (attenuated) strain of the **tuberculosis** bacillus that stimulates the body's immune system to fight the cancer. This therapy has been shown to be effective in controlling superficial bladder cancer.

Photodynamic treatment is a novel mode of treatment that uses special chemicals and light to kill the cancerous cells. First, a drug is introduced into the bladder that makes the cancer cells more susceptible to light. Following that, a special light is shone on the bladder in an attempt to destroy the cancerous cells.

Prognosis

When detected at the early stages, the prognosis for bladder cancer is excellent. At least 94% of the people

KEY TERMS

Biopsy—The surgical removal and microscopic examination of living tissue for diagnostic purposes.

Chemotherapy—Treatment with drugs that are anti cancer.

Computed tomography (CT) scan—A medical procedure where a series of X-rays are taken and put together by a computer in order to form detailed pictures of areas inside the body.

Cystoscopy—A diagnostic procedure where a hollow lighted tube, (cystoscope) is used to look inside the bladder and the urethra.

Electrofulguration—A procedure where a high-energy laser beam is used to burn the cancerous tissue.

Immunotherapy—Treatment of cancer by stimulating the body's immune defense system.

Intravenous pyelogram (IVP)—A procedure where a dye is injected into a vein in the arm. The dye travels through the body and then concentrates in the urine to be excreted. It outlines the kidneys, ureters, and the urinary bladder. An x-ray of the pelvic region is then taken and any abnormalities of the urinary tract are revealed.

Magnetic Resonance Imaging (MRI)—A medical procedure used for diagnostic purposes where pictures of areas inside the body can be created using a magnet linked to a computer.

Partial cystectomy—A surgical procedure where the cancerous tissue is removed by cutting out a small piece of the bladder.

Photodynamic therapy—A novel mode of treatment where a combination of special light rays and drugs are used to destroy the cancerous cells. First, the drugs, which make the cancerous cells more susceptible to the light rays, are introduced into the bladder. Then the light is shone on the bladder to kill the cells.

Radiation therapy—Treatment using high-energy radiation from X-ray machines, cobalt, radium, or other sources.

Radical cystectomy—A surgical procedure that is used when the cancer is in more than one area of the bladder. Along with the bladder, the adjoining organs are also removed. In men, the prostate is removed, while in women, the ovaries, fallopian tubes and uterus may be removed.

Stoma—An artificial opening between two cavities or between a cavity and the surface of the body.

Transurethral resection—A surgical procedure to remove abnormal tissue from the bladder. The technique involves the insertion of an instrument called a cytoscope into the bladder through the urethra, and the tumor is removed through it.

Urostomy—A surgical procedure consisting of cutting the ureters from the bladder and connecting them to an opening (see Stoma) on the abdomen, allowing urine to flow into a collection bag.

survive five years or more after initial diagnosis. However, if the disease has spread to the nearby tissues, the survival rates drop to 49%. If it has metastasized to distant organs such as the lung, and the liver, commonly only 6% of the patients will survive five years or more.

Prevention

Since we do not know what exactly causes bladder cancer, there is no certain way to prevent it. Avoiding risk factors whenever possible is the best alternative.

Since smoking doubles one's risk of getting bladder cancer, avoiding tobacco may prevent at least half the deaths that result from bladder cancer. Taking appropriate safety precautions when working with organic cancer-causing chemicals is another way of preventing the disease.

If a person has had a history of bladder cancer, or has been exposed to cancer-causing chemicals, then he or she is considered to be at an increased risk of getting bladder cancer. Similarly, **kidney stones**, frequent urinary infections, and other conditions that cause long-term irritation to the bladder also increases the chance of getting the disease. In such cases, it is advisable to undergo regular screening tests such as urine cytology, cystoscopy and x rays of the urinary tract, so that bladder cancer can be detected at its early stages and treated appropriately.

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- American Foundation for Urologic Disease. 300 W. Pratt St., Suite 401. Baltimore, MD 21201. Phone: (800)-828-7866.
- Cancer Research Institute. 681 Fifth Ave., New York, N.Y. 10022. (800) 992-2623. <<http://www.cancerresearch.org>>.
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Lata Cherath, PhD

Bladder removal see **Cystectomy**

Bladder resection see **Transurethral bladder resection**

Bladder stones

Definition

Bladder stones are crystalline masses that form from the **minerals** and proteins, which naturally occur in urine. These types of stones are much less common than **kidney stones**.

Description

Bladder stones can form anywhere in the urinary tract before depositing in the bladder. They begin as tiny granules about the size of a grain of sand, but they can grow to more than an inch in diameter. These stones can

block the flow of urine causing **pain** and difficulty with urination. They can also scratch the bladder wall, which may lead to bleeding or infection.

Causes and symptoms

While the exact causes of the formation of bladder stones are not completely understood, bladder stones usually occur because of urinary tract infection (UTI), obstruction of the urinary tract, enlargement of the prostate gland in men, or the presence of foreign bodies in the urinary tract. Diet and the amount of fluid intake also appear to be important factors in the development of bladder stones.

Ninety-five percent of all bladder stones occur in men, most of who have an **enlarged prostate** gland or a UTI. These stones are rarely seen in children or in African Americans. People with **gout** may develop bladder stones composed almost entirely of uric acid.

The symptoms of bladder stones may become evident when the wall of the bladder is scratched or when the urinary tract becomes obstructed by the stone. These symptoms include:

- abnormally dark colored urine
- blood in the urine
- difficulty urinating
- frequent urge to urinate
- lower abdominal pain
- pain or discomfort in the penis

Some people with bladder stones also may experience an inability to control urination (**urinary incontinence**).

Diagnosis

The diagnosis of bladder stones is usually made after a **physical examination**, which may include a **rectal examination** to check for enlargement of the prostate gland. Urine tests are then used to determine if there is blood or indications of an UTI in the urine. If bladder stones are suspected, bladder or pelvic x rays may be ordered. Stones that are large enough to cause problems with urinary function are almost always detectable by x ray.

Treatment

Many bladder stones can be passed out of the body in the urine. People with small bladder stones will be asked to increase their fluid intakes to at least six to eight eight-ounce glasses of water per day to increase urinary output. If the stones do not pass after two weeks, or if the

patient's symptoms become worse, further medical treatment may be required.

A large bladder stone, or small stone that the patient cannot pass in the urine, may be broken up into smaller stones using ultrasound (shock waves). These smaller stones may then pass in the urine. Stones that cannot be broken into pieces by these methods, or that the patient cannot pass, may have to be surgically removed.

Alternative treatment

Traditional herbal remedies for bladder stones include celery seed and horsetail. Also, because incomplete bladder emptying may cause bladder stones, many patients may benefit from methods and remedies aimed at improving overall bladder function. These include Kegel exercises, which are used to strengthen the muscles involved in urination; herbal supplements (cornsilk, hydrangea, juniper berries, parsley, and uva ursi) used to increase urine flow and flush out sediment from the bladder; and, the consumption of cranberry juice and/or fresh, unsweetened, lemon juice. Cranberry juice helps to control urinary tract infection and contains a chemical that coats the walls of the bladder, making them more resistant to infection. Lemon juice helps to flush out the urinary system.

Prognosis

Most bladder stones can be, and are, passed out of the body in the urine without any permanent damage to the bladder or the rest of the urinary tract. However, most bladder stones arise from an underlying medical condition. Therefore, if this medical condition is not corrected approximately half of all patients will experience a recurrence of bladder stones within five years.

Prevention

Bladder stones may, in some cases, be prevented by the patient receiving prompt medical treatment for an enlarged prostate gland or UTI. The consumption of at least six to eight eight-ounce glasses of water per day and/or the regular consumption of cranberry juice may help to prevent recurrences of bladder stones.

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KEY TERMS

Bladder—A small organ that serves as the reservoir for urine prior to its passing from the body during urination.

Prostate gland—A small gland in the male genitals that contributes to the production of seminal fluid.

Urinary tract—The system of organs that produces and expels urine from the body. This system begins at the kidneys, where the urine is formed; passes through the bladder; and, ends at the urethra, where urine is expelled.

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Bladder training

Definition

Bladder training is a behavioral modification treatment technique for **urinary incontinence** that involves placing a patient on a toileting schedule. The time interval between urination is gradually increased in order to train the patient to remain continent.

Purpose

Bladder training is used to treat urinary urge incontinence. Urge incontinence occurs when an individual feels a sudden need to urinate and cannot control the urge to do so and, as a consequence, involuntarily loses urine before making it to the toilet.

Precautions

Incontinence may be controlled through a number of invasive and non-invasive treatment options, including Kegel exercises, **biofeedback**, bladder training, medication, insertable incontinence devices, and surgery. Each patient should undergo a full diagnostic work-up to

KEY TERMS

Biofeedback—Biofeedback training monitors temperature and muscle contractions in the vagina to help incontinent patients control their pelvic muscles.

Pelvic muscle exercises—Exercises that tighten and tone the pelvic floor, or perineal, muscles. Also known as Kegel and PC muscle exercises.

determine the type and cause of the incontinence in order to determine the best course of treatment.

Description

Bladder training may be prescribed and implemented by a general physician, urologist, or urogynecologist. A urination schedule is created for the patient. The schedule typically starts out with fairly short intervals between bathroom breaks (e.g., an hour). As soon as the patient is able to consistently remain continent for several days at a certain toileting time interval, the time span is increased. Bladder training continues until the patient regularly achieves continence at a time interval he/she feels comfortable with.

Preparation

A complete evaluation to determine the cause of urinary incontinence is critical to proper treatment. A thorough medical history and **physical examination** should be performed on patients considering bladder training. Diagnostic testing may include x rays, ultrasound, urine tests, and a physical examination of the pelvis. It may include a series of exams called urodynamic testing that measure bladder pressure and capacity and the urinary flow. The patient may also be asked to keep a diary of their urination output and frequency and episodes of incontinence over a period of several days or a week.

Risks

Bladder training may not be successful in all patients with urge incontinence. Patients who demonstrate a strong desire to control their continence and are committed to sticking with a training program tend to have the most success with bladder training.

Normal results

Patients who undergo successful bladder training gain complete or improved control over their urination. In some

cases, additional alternate treatment such as biofeedback or pelvic muscle exercises may be recommended to supplement the progress made with bladder training.

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National Association for Continence. P.O. Box 8310, Spartanburg, SC 29305-8310. (800) 252-3337. <<http://www.nafc.org>>.

National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC). 3 Information Way, Bethesda, MD 20892-3580. (800) 891-5388. <<http://www.niddk.nih.gov/health/urolog/pubs/kuorg/kuorg.htm>>.

Paula Anne Ford-Martin

Blastomyces dermatitidis see **Blastomycosis**

Blastomycosis

Definition

Blastomycosis is an infection caused by inhaling microscopic particles (spores) produced by the fungus *Blastomyces dermatitidis*. Blastomycosis may be limited to the lungs or also involve the skin and bones. In its most severe form, the infection can spread throughout the body and involve many organ systems (systemic).

Description

Blastomycosis is a fungal infection caused by *Blastomyces dermatitidis*. Although primarily an airborne disease, farmers and gardeners may become infected from contact with spores in the soil through cuts and scrapes. The fungus that causes the disease is found in moist soil and wood in the southeastern United States, the Mississippi River valley, southern Canada, and Central America. Blastomycosis is also called Gilchrist's dis-

ease, Chicago disease, or North American blastomycosis. Another South and Central American disease, paracoccidioidomycosis, is sometimes called **South American blastomycosis**, but despite the similar name, this disease is substantially different from North American blastomycosis. Canine blastomycosis, a common dog disease, is caused by the same fungus that infects humans. However, people do not get this disease from their dogs except only very rarely through dog bites.

Blastomycosis is a rare disease infecting only about 4 in every 100,000 people. It is at least six times more common in men than in women and tends to more often infect children and individuals in the 30–50 year old age group. People who have **diabetes mellitus** or who are taking drugs that suppress the immune system (immuno-compromised) are more likely to develop blastomycosis. Although people with **AIDS** can get blastomycosis because of their weakened immune system, blastomycosis has not been one of the more common fungal infections associated with AIDS.

Causes and symptoms

Once inhaled, the spores of *B. dermatitidis* can lodge in the lungs and cause a localized inflammation. This is known as primary pulmonary blastomycosis. The disease does not spread from one person to another. In the early stages, symptoms may include a dry **cough**, **fever**, heavy sweating, **fatigue**, and a general feeling of ill health. In approximately 25% of blastomycosis cases, only the lungs are affected. As the disease progresses, small lesions form in the lungs causing the air sacs deep within the lungs (alveoli) to break down and form small cavities.

In another 35%, the disease involves both the lungs and the skin. Bumps develop on the skin, gradually becoming small, white, crusted blisters filled with pus. The blisters break open, creating abscesses that do not heal. Approximately 19% of infected people have skin sores without infection in the lungs.

The remaining approximately 20% of the infected population has blastomycosis that has spread or disseminated to other systems of the body. Symptoms may include **pain** and lesions on one or more bones, the male genitalia, and/or parts of the central nervous system. The liver, spleen, lymph nodes, heart, adrenal glands, and digestive system may also be infected.

Diagnosis

A positive diagnosis of blastomycosis is made when the fungus *B. dermatitidis* is identified by direct microscopic examination of body fluids such as sputum and prostate fluid or in tissue samples (biopsies) from the



Blastomycosis is usually attributed to contact with yeast-like fungi. (Custom Medical Stock Photo. Reproduced by permission.)

lung or skin. Another way to diagnose blastomycosis is to culture and isolate the fungus from a sample of sputum. Chest x rays are used to assess lung damage, but alone cannot lead to a definitive diagnosis of blastomycosis because any damage caused by other diseases, such as by **pneumonia** or **tuberculosis**, may appear look on the x ray. Because its symptoms vary widely, blastomycosis is often misdiagnosed.

Treatment

Blastomycosis must be treated or it will gradually lead to **death**. Treatment with the fungicidal drug ketoconazole (Nizoral) taken orally is effective in about 75% of patients. Amphotericin B (Fungizone) given intravenously is also very effective, but it has more toxic side effects than ketoconazole. Treatment with amphotericin B usually requires hospitalization, and the patient may also receive other drugs to minimize the its side effects.

Alternative treatment

Alternative treatment for fungal infections focuses on creating an internal environment where the fungus cannot survive. This is accomplished by eating a diet low in dairy products, sugars, including honey and fruit juice, and foods like beer that contain yeast. This is complemented by a diet consisting, in large part, of uncooked and unprocessed foods. Supplements of **vitamins C, E, A-plus, and B complex** may also be useful. *Lactobacillus acidophilus* and *Bifidobacterium* will replenish the good bacteria in the intestines. Some antifungal herbs, like garlic (*Allium sativum*), can be consumed in relatively large doses and for an extended period of time in order to increase effectiveness. A variety of antifungal herbs, such as myrrh (*Commiphora molmol*), tea tree oil (*Melaleuca spp.*), citrus seed extract, pau d'arco tea

KEY TERMS

Abscess—An area of inflamed and injured body tissue that fills with pus.

Acidophilus—The bacteria called *Lactobacillus acidophilus* that is usually found in yogurt.

Alveoli—Small air pockets in the lungs that increase the surface area for oxygen absorption.

Bifidobacteria—A group of bacteria normally present in the intestine. Commercial supplements containing these bacteria are available.

Biopsy—The removal of a tissue sample for diagnostic purposes.

Immunocompromised—A state in which the immune system is suppressed or not functioning properly.

Spores—The small, thick-walled reproductive structures of fungi.

Sputum—Mucus and other matter coughed up from airways.

Systemic—Not localized to a single area of the body but, instead, involving one or more body systems.

(*Tabebuia impetiginosa*), and garlic may also be applied directly to the infected skin.

Prognosis

Left untreated, blastomycosis gradually leads to death. When treated, however, patients begin to improve within one week and, with intensive treatment, may be cured within several weeks. The highest rate of recovery is among patients who only have **skin lesions**. People with the disseminated form of the disease are least likely to be cured and most likely to suffer a relapse.

Prevention

Because the fungus that causes blastomycosis is airborne and microscopic, the only form of prevention is to avoid visiting areas where it is found in the soil. For many people this is impractical. Since the disease is rare, people who maintain general good health do not need to worry much about infection.

Resources

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Tish Davidson

Bleeding disorders see **Coagulation disorders**

Bleeding time

Definition

Bleeding time is a crude test of hemostasis (the arrest or stopping of bleeding). It indicates how well platelets interact with blood vessel walls to form blood clots.

Purpose

Bleeding time is used most often to detect qualitative defects of platelets, such as Von Willebrand's disease. The test helps identify people who have defects in their platelet function. This is the ability of blood to clot following a wound or trauma. Normally, platelets interact with the walls of blood vessels to cause a blood clot. There are many factors in the clotting mechanism, and they are initiated by platelets. The bleeding time test is usually used on patients who have a history of prolonged bleeding after cuts, or who have a family history of bleeding disorders. Also, the bleeding time test is sometimes performed as a preoperative test to determine a patient's likely bleeding response during and after surgery. However, in patients with no history of bleeding problems, or who are not taking anti-inflammatory drugs, the bleeding time test is not usually necessary.

Precautions

Before administering the test, patients should be questioned about what medications they may be taking. Some medications will adversely affect the results of the bleeding time test. These medications include anticoagulants, diuretics, anticancer drugs, sulfonamides, thiazide, aspirin and aspirin-containing preparations, and nonsteroidal anti-inflammatory drugs. The test may also be affected by anemia (a deficiency in red blood cells). Since the taking of aspirin or related drugs are the most common cause of prolonged bleeding time, no aspirin should be taken two weeks prior to the test.

Description

There are four methods to perform the bleeding test. The Ivy method is the traditional format for this test. In the Ivy method, a blood pressure cuff is placed on the upper arm and inflated to 40 mM Hg. A lancet or scalpel blade is used to make a stab wound on the underside of the forearm. An automatic, spring-loaded blade device is most commonly used to make a standard-sized cut. The area stabbed is selected so that no superficial or visible veins are cut. These veins, because of their size, may have longer bleeding times, especially in people with bleeding defects. The time from when the stab wound is made until all bleeding has stopped is measured and is called the bleeding time. Every 30 seconds, filter paper or a paper towel is used to draw off the blood. The test is finished when bleeding has stopped completely.

The three other methods of performing the bleeding test are the template, modified template, and Duke methods. The template and modified template methods are variations of the Ivy method. A blood pressure cuff is used and the skin on the forearm prepared as in the Ivy method. A template is placed over the area to be stabbed and two incisions are made in the forearm using the template as a location guide. The main difference between the template and the modified method is the length of the cut made.

For the Duke method, a nick is made in an ear lobe or a fingertip is pricked to cause bleeding. As in the Ivy method, the test is timed from the start of bleeding until bleeding is completely stopped. The disadvantage to the Duke method is that the pressure on the blood veins in the stab area is not constant and the results achieved are less reliable. The advantage to the Duke method is that no scar remains after the test. The other methods may result in a tiny, hairline scar where the wound was made. However, this is largely a cosmetic concern.

Preparation

There is no special preparation required of the patient for this test. The area to be stabbed should be wiped clean with an alcohol pad. The alcohol should be left on the skin long enough for it to kill bacteria at the wound site. The alcohol must be removed before stabbing the arm because alcohol will adversely affect the test results by inhibiting clotting.

Aftercare

If a prolonged bleeding time is caused by unknown factors or diseases, further testing is required to identify the exact cause of the bleeding problem.

KEY TERMS

Hemostasis—The stopping of bleeding or blood flow through a blood vessel or organ.

Normal results

A normal bleeding time for the Ivy method is less than five minutes from the time of the stab until all bleeding from the wound stops. Some texts extend the normal range to eight minutes. Normal values for the template method range up to eight minutes, while for the modified template methods, up to 10 minutes is considered normal. Normal for the Duke method is three minutes.

Abnormal results

A bleeding time that is longer than normal is an abnormal result. The test should be stopped if the patient hasn't stopped bleeding by 20-30 minutes. Bleeding time is longer when the normal function of platelets is impaired, or there are a lower-than-normal number of platelets in the blood.

A longer-than-normal bleeding time can indicate that one of several defects in hemostasis is present, including severe **thrombocytopenia**, platelet dysfunction, vascular defects, Von Willebrand's disease, or other abnormalities.

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Bleeding varices

Definition

Bleeding varices are bleeding, dilated (swollen) veins in the esophagus (gullet), or the upper part of the stomach, caused by liver disease.

KEY TERMS

Cirrhosis of the liver—A type of liver disease, most often caused by chronic alcohol abuse. It is characterized by scarring of the liver, which leads to an increase in the blood pressure in the portal veins.

Endoscopy—Medical imaging technique for visualizing the interior of a hollow organ.

Esophagus—The tube in the body which takes food from the mouth to the stomach.

Esophagogastroduodenoscopy (EGD)—An imaging test that involves visually examining the lining of the esophagus, stomach, and upper duodenum with a flexible fiberoptic endoscope.

Portal hypertension—Portal hypertension forces the blood flow backward, causing the portal veins to enlarge and the emergence of bleeding varices across the esophagus and stomach from the pressure in the portal vein. Portal hypertension is most commonly caused by cirrhosis, but can also be seen in portal vein obstruction from unknown causes.

Portal veins—The main veins that carry blood from the stomach and intestines to the liver.

Shock—A state of depression of the vital processes of the body characterized by pallor, a rapid and weak pulse, rapid and shallow respiration, and lowered blood pressure. Shock results from severe trauma, such as crushing injuries, hemorrhage, burns, or major surgery.

Transjugular intrahepatic portosystemic shunt (TIPS)—A transjugular intrahepatic portosystemic shunt (TIPS) is a radiology procedure in which a tubular device is inserted in the middle of the liver to redirect the blood flow.

Varices—A type of varicose vein that develops in veins in the linings of the esophagus and upper stomach when these veins fill with blood and swell due to an increase in blood pressure in the portal veins.

Description

Engorged veins are called varices (plural of varix). Varices may occur in the lining of the esophagus, the tube that connects the mouth to the stomach, or in the upper part of the stomach. Such varices are called esophageal varices. These varices are fragile and can bleed easily because veins are not designed to handle high internal pressures.

Causes and symptoms

Liver disease often causes an increase in the blood pressure in the main veins that carry blood from the stomach and intestines to the liver (portal veins). As the pressure in the portal veins increases, the veins of the stomach and esophagus swell, until they eventually become varices. Bleeding varices are a life-threatening complication of this increase in blood pressure (portal hypertension). The most common cause of bleeding varices is **cirrhosis** of the liver caused by chronic alcohol abuse or hepatitis. Bleeding varices occur in approximately one in every 10,000 people.

Symptoms of bleeding varices include

- vomiting blood, sometimes in massive amounts
- black, tarry stools
- decreased urine output

- excessive thirst
- nausea
- vomiting
- and blood in the vomit

If bleeding from the varices is severe, a patient may go into **shock** from the loss of blood, characterized by pallor, a rapid and weak pulse, rapid and shallow respiration, and lowered systemic blood pressure.

Diagnosis

Bleeding varices may be suspected in a patient who has any of the above-mentioned symptoms, and who has either been diagnosed with cirrhosis of the liver or who has a history of prolonged alcohol abuse. The definitive diagnosis is established via a specialized type of endoscopy, namely, **esophagogastroduodenoscopy** (EGD), a procedure that involves the visual examination of the lining of the esophagus, stomach, and upper duodenum with a flexible fiberoptic endoscope.

Treatment

The objective during treatment of bleeding varices is to stop and/or prevent bleeding and to restore/maintain normal blood circulation throughout the body. Patients with severe bleeding should be treated in intensive care since uncontrolled bleeding can lead to **death**.

Initial treatment of bleeding varices begins with standard resuscitation, including intravenous fluids and blood transfusions as needed. Definitive treatment is usually endoscopic, with the endoscope used to locate the sites of the bleeding. An instrument, inserted along with the endoscope, is used either to inject these sites with a clotting agent or to tie off the bleeding sites with tiny rubber bands.

Repeated endoscopic treatments (usually four to six) are generally required to eliminate the varices and to prevent the recurrence of bleeding. These endoscopic techniques are successful in about 90 percent of cases.

Patients who cannot be treated endoscopically may be considered for an alternative procedure called TIPS (transjugular intrahepatic portosystemic shunt). This procedure involves placing a hollow metal tube (shunt) in the liver connecting the portal veins with the hepatic veins (veins that leave the liver and drain to the heart). This shunt lowers the pressure in the portal veins and prevents bleeding and portal hypertension. The TIPS procedure is performed by a radiologist and has become an accepted method for reducing portal vein pressure since 1992. Although the procedure continues to evolve, TIPS can routinely be created in more than 93% of patients.

Medications aimed at controlling bleeding may also be prescribed. These include propantheline, vasopressin, octreotide acetate, and isosorbide mononitrate.

Alternative treatment

Some alternative treatments are aimed at preventing the cirrhosis of the liver that often causes bleeding varices and most are effective. However, once a patient has reached the bleeding varice stage, standard intervention to stop the bleeding is required or the patient may die.

Prognosis

Bleeding varices represent one of the most feared complications of portal hypertension. They contribute to the estimated 32,000 deaths per year attributed to cirrhosis. Half or more of patients who survive episodes of bleeding varices are at risk of renewed esophageal bleeding during the first one to two years. The risk of recurrence can be lowered by endoscopic and drug treatment. Prognosis is usually more related to the underlying liver disease. Approximately 30 to 50 percent of people with bleeding varices will die from this condition within the six weeks of the first bleeding episode.

Prevention

The best way to possibly prevent the development or recurrence of bleeding varices is to eliminate the risk factors for cirrhosis of the liver. The most common cause of cirrhosis is prolonged alcohol abuse, and alcohol con-

sumption must be completely eliminated. People with **hepatitis B** or **hepatitis C** also have an increased risk of developing cirrhosis of the liver. **Vaccination** against hepatitis B and avoidance of intravenous drug usage reduce the risk of contracting hepatitis.

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Paul A. Johnson

Blepharitis see **Eyelid disorders**

Blepharoplasty

Definition

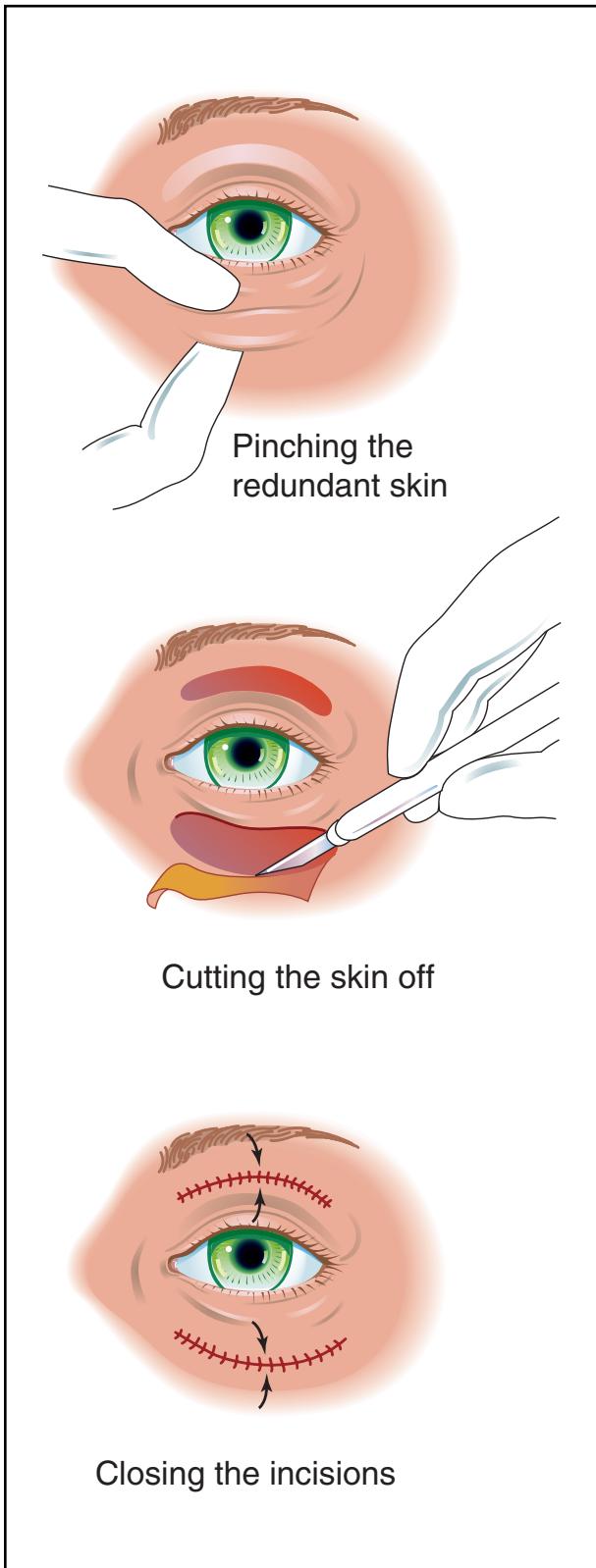
Blepharoplasty is a cosmetic surgical procedure that removes fat deposits, excess tissue, or muscle from the eyelids to improve the appearance of the eyes.

Purpose

The primary use of blepharoplasty is for improving the cosmetic appearance of the eyes. In some older patients, however, sagging and excess skin surrounding the eyes can be so extensive that it limits the range of vision. In those cases, blepharoplasty serves a more functional purpose.

Precautions

Before performing blepharoplasty, the surgeon will assess whether the patient is a good candidate for the



treatment. A good medical history is important. The surgeon will want to know about any history of thyroid disease, **hypertension**, or eye problems, which may increase the risk of complications.

Description

Blepharoplasty can be performed on the upper or lower eyelid; it can involve the removal of excess skin and fat deposits and the tightening of selected muscles surrounding the eyelids. The goal is to provide a more youthful appearance.

The surgeon will begin by deciding whether excess skin, fat deposits, or muscle looseness are at fault. While the patient is sitting upright, the surgeon will mark on the skin where incisions will be made. Care will be taken to hide the incision lines in the natural skin folds above and below the eye. The patient then receives injections of a local anesthetic to numb the **pain**. Many surgeons also give the patient a sedative intravenously during the procedure.

After a small, crescent-shaped section of eyelid skin is removed, the surgeon will work to tease out small pockets of fat that have collected in the lids. If muscle looseness is also a problem, the surgeon may trim tissue or add a stitch to pull it tighter. Then the incision is closed with stitches.

In some patients, fat deposits in the lower eyelid may be the only or primary problem. Such patients may be good candidates for transconjunctival blepharoplasty. In this procedure the surgeon makes no incision on the surface of the eyelid, but instead enters from behind to tease out the fat deposits from a small incision. The advantage of this procedure is that there is no visible scar.

Preparation

Prior to surgery, patients meet with their surgeon to discuss the procedure, clarify the results that can be achieved, and discuss the potential problems that might occur. Having realistic expectations is important in any cosmetic procedure. Patients will learn, for example, that although blepharoplasty can improve the appearance of the eyelid, other procedures, such as a chemical peel, will be necessary to reduce the appearance of wrinkles around the eye. Some surgeons prescribe vitamin C and vitamin K for 10 days prior to surgery in the belief that this helps the healing process. Patients are also told to stop **smoking** in the weeks before and after the procedure, and to refrain from alcohol and **aspirin**.

Aftercare

An antibiotic ointment is applied to the line of stitches for several days after surgery. Patients also take an

antibiotic several times a day to prevent infection. Ice-cold compresses are applied to the eyes continuously for the first day following surgery, and several times a day for the next week or so, to reduce swelling. Some swelling and discoloration around the eyes is expected with the procedure. Patients should avoid aspirin or alcoholic beverages for one week and should limit their activities, including bending, straining, and lifting. The stitches are removed a few days after surgery. Patients can generally return to their usual activities within a week to 10 days.

Risks

As with any surgical procedure, blepharoplasty can lead to infection and scarring. Good care of the wound following surgery can minimize these risks. In cases where too much skin is removed from the eyelids, the patient may have difficulty closing his eyes. Dry eye syndrome may develop, requiring the use of artificial tears to lubricate the eye. In a rare complication, called retrobulbar hematoma, a pocket of blood forms behind the eyeball.

Normal results

Most patients can expect good results from blepharoplasty, with the removal of excess eyelid skin and fat producing a more youthful appearance. Some swelling and discoloration is expected immediately following the procedure, but this clears in time. Small scars will be left where the surgeon has made incisions; but these generally lighten in appearance over several months, and, if placed correctly, will not be readily noticeable.

Abnormal results

As noted, if too much excess skin is removed from the upper eyelid, the patient may be unable to close his eyes completely; another surgery to correct the defect may be required. Similarly, too much skin can be removed from the lower eyelid, allowing too much of the white of the eye (the sclera) to show. In extreme cases, the lower lid may be pulled down too far, revealing the underlying tissue. Called an ectropion, this, too, may require a second, corrective surgery. The eye's ability to make tears may also be compromised, leading to dry eye syndrome. Dry eye syndrome is potentially dangerous; in rare cases it leads to damage to the cornea of the eye and vision loss.

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KEY TERMS

Ectropion—A complication of blepharoplasty, in which the lower lid is pulled downward, exposing the surface below.

Intravenous sedation—A method of injecting a fluid sedative into the blood through the vein

Retrobulbar hematoma—A rare complication of blepharoplasty, in which a pocket of blood forms behind the eyeball.

Transconjunctival blepharoplasty—A type of blepharoplasty in which the surgeon makes no incision on the surface of the eyelid, but, instead, enters from behind to tease out the fat deposits.

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ORGANIZATIONS

American Society for Dermatologic Surgery. 930 N. Meacham Road, P.O. Box 4014, Schaumburg, IL 60168-4014. (847) 330-9830. <<http://www.asds-net.org>>.

American Society of Plastic and Reconstructive Surgeons. 44 E. Algonquin Rd., Arlington Heights, IL 60005. (847) 228-9900. <<http://www.plasticsurgery.org>>.

Richard H. Camer

Blindness see **Visual impairment**

Blood-viscosity reducing drugs

Definition

Blood-viscosity reducing drugs are medicines that improve blood flow by making the blood less viscous (sticky).

Purpose

The main use of blood-viscosity reducing drugs is to relieve painful leg cramps caused by poor circulation, a condition called intermittent claudication. Physicians

KEY TERMS

Raynaud's disease—A blood vessel disorder in which the fingers and toes become numb and turn white when exposed to cold.

also may prescribe this medicine for other conditions, including **stroke**, **impotence**, male **infertility**, **Raynaud's disease**, and nerve and circulation problems caused by diabetes.

Description

Blood-viscosity reducing drugs are available only with a physician's prescription and come in extended-release tablet form. Examples of blood-viscosity reducing drugs are pentoxifylline (Trental) and oxypentifylline.

Recommended dosage

The usual dosage for adults is 400 mg, two to three times a day, with meals. However, the dose may be different for different patients. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage. Dosages for children must be determined by a physician.

Taking an antacid with this medicine may help prevent upset stomach.

Precautions

This medicine may relieve leg **pain** that results from poor circulation, but it should not be considered a substitute for other treatments the physician recommends, such as physical therapy or surgery.

This medicine may take several weeks to produce noticeable results. Be sure to keep taking it as directed, even if it doesn't seem to be helping.

Patients being treated with this medicine should not smoke, as **smoking** may worsen the conditions for which the medicine is prescribed.

Anyone who has had unusual reactions to pentoxifylline, aminophylline, **caffeine**, dyphylline, ethylenediamine (contained in aminophylline), oxtriphylline, theobromine, or theophylline in the past should let his or her physician know before taking a blood-viscosity reducing drug. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

Women who are pregnant or breastfeeding or who may become pregnant should check with their physicians before using a blood-viscosity reducing drug.

Older people may be especially sensitive to the effects of this medicine, which may increase the chance of side effects.

Before using blood-viscosity reducing drugs, people with any of these medical problems should make sure their physicians are aware of their conditions:

- recent stroke
- any condition in which there is an increased chance of bleeding
- kidney disease
- liver disease

Side effects

Minor discomforts, such as **dizziness**, **headache**, upset stomach, nausea, or vomiting usually go away as the body adjusts to the drug and do not require medical treatment unless they persist or they interfere with normal activities.

More serious side effects are rare. However, if these or any other unusual or troublesome symptoms occur, check with the physician who prescribed the medicine as soon as possible:

- chest pain
- irregular heartbeat

Interactions

Blood-viscosity reducing drugs may interact with other medicines, changing the effects of one or both of the drugs or increasing the risk of side effects. Anyone who takes blood-viscosity reducing drugs should let the physician know all other prescription or nonprescription (over-the-counter) medicines he or she is taking. Among the drugs that may interact with blood-viscosity reducing drugs are:

- anticoagulants such as warfarin (Coumadin)(also called blood thinners or clot inhibitors)
- calcium channel blockers such as diltiazem (Cardizem), used to treat high blood pressure
- angiotensin-converting enzyme (ACE) inhibitors such as enalapril (Vasotec), used to treat high blood pressure
- theophylline (Theo-Dur)
- medicines such as cimetidine (Tagamet), taken for ulcers or heartburn

Nancy Ross-Flanigan

Blood count

Definition

One of the most commonly ordered clinical laboratory tests, a blood count, also called a complete blood count (CBC), is a basic evaluation of the cells (red blood cells, white blood cells, and platelets) suspended in the liquid part of the blood (plasma). It involves determining the numbers, concentrations, and conditions of the different types of blood cells.

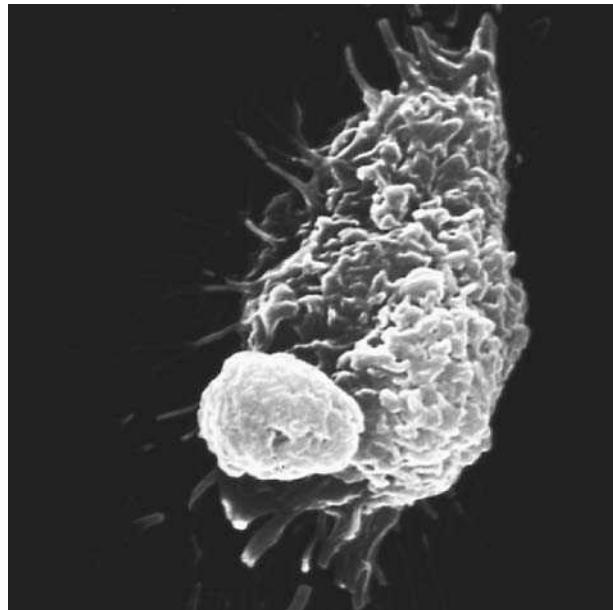
Purpose

The CBC is a useful screening and diagnostic test that is often done as part of a routine **physical examination**. It can provide valuable information about the blood and blood-forming tissues (especially the bone marrow), as well as other body systems. Abnormal results can indicate the presence of a variety of conditions—including **anemias**, leukemias, and infections—sometimes before the patient experiences symptoms of the disease.

Description

A complete blood count is actually a series of tests in which the numbers of red blood cells, white blood cells, and platelets in a given volume of blood are counted. The CBC also measures the hemoglobin content and the packed cell volume (**hematocrit**) of the red blood cells, assesses the size and shape of the red blood cells, and determines the types and percentages of white blood cells. Components of the complete blood count (hemoglobin, hematocrit, white blood cells, platelets, etc.) can also be tested separately, and are sometimes done that way when a doctor wants to monitor a specific condition, such as the white cell count of a patient diagnosed with leukemia, or the hemoglobin of a patient who has recently received a blood **transfusion**. Because of its value, though, as an indicator of a person's overall health, the CBC package is most frequently ordered.

The blood count is performed relatively inexpensively and quickly. Most laboratories routinely use some type of automated equipment to dilute the blood, sample a measured volume of the diluted suspension, and count the cells in that volume. In addition to counting actual numbers of red cells, white cells, and platelets, the automated cell counters also measure the hemoglobin and calculate the hematocrit and the **red blood cell indices** (measures of the size and hemoglobin content of the red blood cells). Technologists then examine a stained blood smear under the microscope to identify any abnormalities in the appearance of the red blood cells and to report the types and percentages of white blood cells observed.



A white blood cell. (Photograph by Institut Pasteur, Phototake NYC. Reproduced by permission.)

The red blood cell (RBC) count determines the total number of red cells (erythrocytes) in a sample of blood. The red cells, the most numerous of the cellular elements, carry oxygen from the lungs to the body's tissues. Hemoglobin (Hgb) is the protein-iron compound in the red blood cells that enables them to transport oxygen. Its concentration corresponds closely to the RBC count. Also closely tied to the RBC and hemoglobin values is the hematocrit (Hct), which measures the percentage of red blood cells in the total blood volume. The hematocrit (expressed as percentage points) is normally about three times the hemoglobin concentration (reported as grams per deciliter).

Red blood cell indices provide information about the size and hemoglobin content of the red cells. They are useful in differentiating types of anemias. The indices include four measurements that are calculated using the RBC count, hemoglobin, and hematocrit results. Mean corpuscular volume (MCV) is a measurement of the average size of the red blood cells and indicates whether that is small, large or normal. The red blood cell distribution width (RDW) is an indication of the variation in RBC size. Mean corpuscular hemoglobin (MCH) measures the average amount (weight) of hemoglobin within a red blood cell. A similar measurement, mean corpuscular hemoglobin concentration (MCHC), expresses the average concentration of hemoglobin in the red blood cells.

The white blood cell (WBC) count determines the total number of white cells (leukocytes) in the blood

sample. Fewer in number than the red cells, WBCs are the body's primary means of fighting infection. There are five main types of white cells (neutrophils, lymphocytes, monocytes, eosinophils, and basophils), each of which plays a different role in responding to the presence of foreign organisms in the body. A differential white cell count is done by staining a smear of the patient's blood with a Wright's stain, allowing the different types of white cells to be clearly seen under the microscope. A technologist then counts a minimum of 100 WBCs and reports each type of white cell as a percentage of the total white blood cells counted.

The **platelet count** is an actual count of the number of platelets (thrombocytes) in a given volume of blood. Platelets, the smallest of the cellular elements of blood, are involved in blood clotting. Because platelets can clump together, the automated counting method is subject to a certain level of error and may not be accurate enough for low platelet counts. For this reason, very low platelet levels are often counted manually.

Normal results

Blood count values can vary by age and sex. The normal red blood cell count ranges from 4.2–5.4 million RBCs per microliter of blood for men and 3.6–5.0 million for women. Hemoglobin values range from 14–18 grams per deciliter of blood for men and 12–16 grams for women. The normal hematocrit is 42–54% for men and 36–48% for women. The normal number of white blood cells for both men and women is approximately 4,000–10,000 WBCs per microliter of blood.

Abnormal results

Abnormal blood count results are seen in a variety of conditions. One of the most common is anemias, which are characterized by low RBC counts, hemoglobins, and hematocrits. Infections and leukemias are associated with increased numbers of WBCs.

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Karen A. Boyden

Blood crossmatching see **Blood typing and crossmatching**

Blood culture

Definition

A blood culture is done when a person has symptoms of a blood infection, also called **bacteremia**. Blood is drawn from the person one or more times and is tested in a laboratory to find and identify any microorganism present and growing in the blood. If a microorganism is found, more testing is done to determine the **antibiotics** that will be effective in treating the infection.

Purpose

Bacteremia is a serious clinical condition and can lead to **death**. To give the best chance for effective treatment and survival, a blood culture is done as soon as an infection is suspected.

Symptoms of bacteremia are **fever**, chills, mental confusion, **anxiety**, rapid heart beat, hyperventilation, blood clotting problems, and **shock**. These symptoms are especially significant in a person who already has another illness or infection, is hospitalized, or has trouble fighting infections because of a weak immune system. Often, the blood infection results from an infection somewhere else in the body that has now spread.

Additionally, blood cultures are done to find the causes of other infections. These include bacterial **pneumonia** (an infection of the lung), and infectious **endocarditis** (an infection of the inner layer of the heart). Both of these infections leak bacteria into the blood.

After a blood infection has been diagnosed, confirmed by culture, and treated, an additional blood culture may be done to make sure the infection is gone.

Description

Culture strategies

There are many variables involved in performing a blood culture. Before the person's blood is drawn, the physician must make several decisions based on a knowledge of infections and the person's clinical condition and medical history.

Several groups of microorganisms, including bacteria, viruses, mold, and yeast, can cause blood infections. The bacteria group can be further broken down into aerobes and anaerobes. Most aerobes do not need oxygen to live. They can grow with oxygen (aerobic microbes) or without oxygen (anaerobic microbes).

Based on the clinical condition of the patient, the physician determines what group of microorganisms is likely to be causing the infection and then orders one or

more specific types of blood culture, including aerobic, anaerobic, viral, or fungal (for yeasts and molds). Each specific type of culture is handled differently by the laboratory. Most blood cultures test for both aerobic and anaerobic microbes. Fungal, viral, and mycobacterial blood cultures can also be done, but are less common.

The physician must also decide how many blood cultures should be done. One culture is rarely enough, but two to three are usually adequate. Four cultures are occasionally required. Some factors influencing this decision are the specific microorganisms the physician expects to find based on the person's symptoms or previous culture results, and whether or not the person has had recent antibiotic therapy.

The time at which the cultures are to be drawn is another decision made by the physician. During most blood infections (called intermittent bacteremia) microorganisms enter the blood at various time intervals. Blood drawn randomly may miss the microorganisms. Since microorganisms enter the blood 30–90 minutes before the person's fever spikes, collecting the culture just after the fever spike offers the best likelihood of finding the microorganism. The second and third cultures may be collected at the same time, but from different places on the person, or spaced at 30-minute or one-hour intervals, as the physician chooses. During continuous bacteremia, such as infective endocarditis, microorganisms are always in the blood and the timing of culture collection is less important. Blood cultures should always be collected before antibiotic treatment has begun.

Laboratory analysis

Bacteria are the most common microorganisms found in blood infections. Laboratory analysis of a bacterial blood culture differs slightly from that of a fungal culture and significantly from that of a viral culture.

Blood is drawn from a person and put directly into a blood culture bottle containing a nutritional broth. After the laboratory receives the blood culture bottle, several processes must be completed:

- provide an environment for the bacteria to grow
- detect the growth when it occurs
- identify the bacteria that grow
- test the bacteria against certain antibiotics to determine which antibiotic will be effective

There are several types of systems, both manual and automated, available to laboratories to carry out these processes.

The broth in the blood culture bottle is the first step in creating an environment in which bacteria will grow. It

contains all the nutrients that bacteria need to grow. If the physician expects anaerobic bacteria to grow, oxygen will be kept out of the blood culture bottle; if aerobes are expected, oxygen will be allowed in the bottle.

The bottles are placed in an incubator and kept at body temperature. They are watched daily for signs of growth, including cloudiness or a color change in the broth, gas bubbles, or clumps of bacteria. When there is evidence of growth, the laboratory does a gram stain and a subculture. To do the gram stain, a drop of blood is removed from the bottle and placed on a microscope slide. The blood is allowed to dry and then is stained with purple and red stains and examined under the microscope. If bacteria are seen, the color of stain they picked up (purple or red), their shape (such as round or rectangular), and their size provide valuable clues as to what type of microorganism they are and what antibiotics might work best. To do the subculture, a drop of blood is placed on a culture plate, spread over the surface, and placed in an incubator.

If there is no immediate visible evidence of growth in the bottles, the laboratory looks for bacteria by doing gram stains and subcultures. These steps are repeated daily for the first several days and periodically after that.

When bacteria grows, the laboratory identifies it using biochemical tests and the gram stain. Sensitivity testing, also called antibiotic susceptibility testing, is also done. The bacteria are tested against many different antibiotics to see which antibiotics can effectively kill it.

All information is passed on to the physician as soon as it is known. An early report, known as a preliminary report, is usually available after one day. This report will tell if any bacteria have been found yet, and if so, the results of the gram stain. The next preliminary report may include a description of the bacteria growing on the subculture. The laboratory notifies the physician immediately when an organism is found and as soon as sensitivity tests are complete. Sensitivity tests may be complete before the bacteria is completely identified. The final report may not be available for five to seven days. If bacteria was found, the report will include its complete identification and a list of the antibiotics to which the bacteria is sensitive.

One automated system is considered one of the most important recent technical advances in blood cultures. It is called continuous-monitoring blood culture systems (CMCCS). The instruments automatically monitor the bottles containing the patient blood for evidence of microorganisms, usually every 10 minutes. Many data points are collected daily for each bottle, and fed into a computer for analysis. Sophisticated mathematical calculations can determine when microorganisms have grown. This, combined with more frequent blood tests, make it

KEY TERMS

Aerobe—Bacteria that require oxygen to live.

Anaerobe—Bacteria that live where there is no oxygen.

Bacteremia—Bacteria in the blood.

Continuous bacteremia—A kind of bacteremia where bacteria is always in the blood.

Intermittent bacteremia—A kind of bacteremia where the bacteria enter the blood at various time intervals.

possible to detect microbial growth earlier. In addition, all CMBCS instruments have the detection system, incubator, and agitation unit in one unit.

Preparation

Ten ml (milliliter) of blood is usually needed for each blood culture bottle. First a healthcare worker locates a vein in the inner elbow region. The area of skin where the blood will be drawn must be disinfected to prevent any microorganisms on a person's skin from entering the blood culture bottle and contaminating it. The area is disinfected by wiping the area with alcohol in a circular fashion, starting with tiny circles at the spot where the needle will puncture the skin and enlarging the size of the circles while wiping away from the puncture site. The same pattern of wiping is repeated using an iodine or iodophor solution. The top of the bottle is disinfected using alcohol. After the person's skin has been disinfected, the healthcare worker draws the blood and about 10 ml of blood is injected into each blood culture bottle. The type of bottles used will vary based on whether the physician is looking for bacteria (aerobes or anaerobes), yeast, mold, or viruses.

Aftercare

Discomfort or bruising may occur at the puncture site or the person may feel dizzy or faint. Pressure to the puncture site until the bleeding stops reduces bruising. Warm packs relieve discomfort.

Normal results

Normal results will be negative. A single negative culture does not rule out a blood infection. False negatives can occur if the person was started on antibiotics before the blood was drawn, if the environment for

growth was not right, the timing was off, or for some unknown reason the microorganism just didn't grow. Three negative cultures may be enough to rule out bacteremia in the case of endocarditis.

Abnormal results

The physician's skill in interpreting the culture results and assessing the person's clinical condition is essential in distinguishing a blood culture that is positive because of a true infection from a culture that is positive because it became contaminated. In true bacteremia, the patient's clinical condition should be consistent with a blood infection caused by the microorganism that was found. The microorganism is usually found in more than one culture, it usually grows soon after the bottles are incubated, and it is often the cause of an infection somewhere else in the person's body.

When the culture is positive because of contamination, the patient's clinical condition usually is not consistent with an infection from the identified microorganism. In addition, the microorganism is often one commonly found on skin, it rarely causes infection, it is found in only one bottle, and it may appear after several days of incubation. More than one microorganism often grow in contaminated cultures.

Resources

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ORGANIZATIONS

American Society of Microbiology. 1752 N Street N.W., Washington, D.C. 20036. (202) 737-3600. <<http://www.asmusa.org>>.

Nancy J. Nordenson

Blood donation and registry

Definition

Blood donation refers to the process of collecting, testing, preparing, and storing blood and blood components. Donors are most commonly unpaid volunteers, but they may also be paid by commercial enterprises. Blood

registry refers to the collection and sharing of data about donated blood and ineligible donors.

Purpose

The purpose of the blood collection and distribution system is to help ensure an adequate supply of blood for accident victims, people needing surgery, and people suffering from certain diseases, as well as for medical research.

Sometimes, donors give blood specifically to benefit a particular person. People preparing for elective surgery may donate their own blood to be held and then returned to them during surgery. This is known as autologous blood donation. Directed donor blood has been donated by someone known to the intended recipient, such as a family member or friend.

Each year, more than four million Americans receive blood transfusions involving more than 26 million units of blood (one unit equals 450 milliliters, or about one pint), or an average of about 32,000 units per day. All of that blood must be collected, tested, prepared, stored, and delivered to the appropriate sites. Roughly eight million people in the United States donate blood each year; about half of the total amount needed is provided by the 36 regional blood centers of the American Red Cross.

Whole blood and the various blood components have many uses. Red blood cells, which carry oxygen, are used to treat anemia. Platelets, which play a role in controlling bleeding, are commonly used in the treatment of leukemia and other cancers. Fresh frozen plasma is also used to control bleeding in people deficient in certain clotting factors. Cryoprecipitated AHF, made from fresh frozen plasma, contains a few specific clotting factors.

Precautions

To ensure the safety of the blood supply, a multi-tiered process of donor screening and deferral is employed. This involves donor education, taking a detailed health history of each prospective donor, and giving potential donors a simple **physical examination** (which includes taking a few drops of blood to test for anemia). At any point in the process, a potential donor may be “deferred,” or judged ineligible to donate blood. This deferral may be temporary or permanent, depending on the reason. Potential donors are also encouraged to “self-defer,” or voluntarily decline to donate, rather than put future blood recipients at risk.

All donated blood is extensively tested before being used. The first step is determining the blood type, which indicates who can receive the blood. Receiving the wrong type of blood can cause **death**. Blood is also screened for any antibodies that could cause complications for recipi-

ents. In addition, blood is tested to screen out donors infected with the following diseases: **Hepatitis B** surface antigen ADD, hepatitis B core antibody, **hepatitis C** virus antibody, HIV-1 and HIV-2 antibody, HIV p24 antigen, HTLV-I and HTLV-II antibodies, and **syphilis**. Nucleic Acid Amplification testing is also performed, and other tests may be done if a doctor requests them.

In order to detect the greatest possible number of infections, these screening tests are extremely sensitive. For this reason, however, donors sometimes receive false positive test results. In these cases, more specific confirmatory tests are performed, to help rule out false positive results. Blood found to be abnormal is discarded, and all items coming into direct contact with donors are used only once and then discarded. Donors of infected blood are entered into the Donor Deferral Register, a confidential national data base used to prevent deferred people from donating blood.

In general, blood donors must be at least 17 years old (some states allow younger people to donate blood with their parents' consent), must weigh at least 110 pounds (50 kg), and must be in good health.

Many factors can temporarily or permanently disqualify potential donors. Most of them have to do with having engaged in behaviors that put them at risk of infection or having spent time in certain specified areas. Among these factors are having had a tattoo, having had sex with people in high-risk groups, having had certain diseases, and having been raped.

Description

There are eight different blood types in all—four ABO groups, each of which may be either Rh positive or Rh negative. These types, and their approximate distribution in the U.S. population, are as follows: O+ (38%), O- (7%), A+ (34%), A- (6%), B+ (9%), B- (2%), AB+ (3%), AB- (1%). In an emergency, anyone can safely receive type O red blood cells, and people with this blood type are known as “universal donors.” People with type AB blood, known as “universal recipients,” can receive any type of red blood cells and can give plasma to all blood types.

Blood donations can be made in community blood centers, at hospitals or in bloodmobiles, which visit schools, churches and workplaces. The actual process of donating whole blood takes about 20 minutes. A sterile needle is inserted into a vein in the donor's arm. The blood flows through plastic tubing into a blood bag. Donors may be asked to clench their fist to encourage blood to flow. Usually, one unit of blood is collected. Afterward, donors are escorted to an observation area, given light refreshments, and allowed to rest.

KEY TERMS

Apheresis—Extraction of a specific component from donated blood, with the remainder returned to the donor.

Autologous donation—Blood donated for the donor's own use.

Granulocytes—White blood cells.

Plasma—The liquid part of blood.

Platelets—Tiny, disklike elements of plasma that promote clotting.

Plasma, the liquid portion of the blood in which red blood cells, platelets and other elements are suspended, is also collected, often by commercial enterprises that sell it to companies manufacturing clotting factors and other blood products. This is done using a process known as apheresis, in which whole blood is collected, the desired blood component is removed, and the remainder is returned to the donor. Collecting plasma generally takes one to two hours. Apheresis may also be used to collect other blood components, such as platelets and granulocytes.

Preparation

Once whole blood has been collected, it is sent to a lab for testing and processing. Most donated blood is separated into its constituent components, such as red blood cells, platelets, and cryoprecipitate. This enables more than one person to benefit from the same unit of donated blood.

Different blood components vary in how long they can be stored. Red blood cells can be refrigerated for up to 42 days or frozen for as much as 10 years. Platelets, stored at room temperature, may be kept for up to five days. Fresh frozen plasma and cryoprecipitated AHF can be kept for as much as one year.

Aftercare

It generally takes about 24 hours for the donor's body to replenish the lost fluid. Replacing the lost red blood cells, however, may take as much as two months. Whole blood donors must wait a minimum of eight weeks before donating again. Some states place further limits on the frequency and/or total number of times an individual may donate blood within a 12-month period.

Risks

Thanks to the use of a multi-tiered screening system and advances in the effectiveness of screening tests,

the transmission of infectious diseases via **transfusion** has been significantly diminished. Nonetheless, there is still a minuscule risk that blood recipients could contract HIV, Hepatitis C, or other infections via transfusion. Other diseases that could conceivably be contracted in this way, or that are of particular concern to blood-collection agencies, include **babesiosis**, Chagas disease, HTLV-I and -II, **Creutzfeldt-Jakob disease**, cytomegalovirus, **Lyme disease**, **malaria**, and new variant Creutzfeldt-Jakob disease.

Autologous blood donors run a tiny risk of having the wrong blood returned to them due to clerical error. There is also a faint possibility of bacterial contamination of the autologous blood.

Normal results

For most donors, the process is quick and painless and they leave feeling fine. They may also find satisfaction in knowing that they have contributed to the nation's blood supply and may even have helped save lives.

Abnormal results

Most blood donors suffer no significant aftereffects. Occasionally, however, donors feel faint or dizzy, nauseous, and/or have **pain**, redness, or a bruise where the blood was taken. More serious complications, which rarely occur, include **fainting**, muscle spasms, and nerve damage.

Resources

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ORGANIZATIONS

American Association of Blood Banks. 8101 Glenbrook Road, Bethesda, MD 20814-2749. (301) 907-6977. <<http://www.aabb.org>>.

American Red Cross. 430 17th Street NW, Washington, D.C. 20006. <<http://www.redcross.org>>.

National Blood Data Resource Center. (301) 215-6506. <<http://www.nbdrc.org>>.

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Blood fluke infection see **Schistosomiasis**

Blood gas analysis

Definition

Blood gas analysis, also called arterial blood gas (ABG) analysis, is a test which measures the amounts of oxygen and carbon dioxide in the blood, as well as the acidity (pH) of the blood.

Purpose

An ABG analysis evaluates how effectively the lungs are delivering oxygen to the blood and how efficiently they are eliminating carbon dioxide from it. The test also indicates how well the lungs and kidneys are interacting to maintain normal blood pH (acid-base balance). Blood gas studies are usually done to assess respiratory disease and other conditions that may affect the lungs, and to manage patients receiving oxygen therapy (respiratory therapy). In addition, the acid-base component of the test provides information on kidney function.

Description

Blood gas analysis is performed on blood from an artery. It measures the partial pressures of oxygen and carbon dioxide in the blood, as well as oxygen content, oxygen saturation, bicarbonate content, and blood pH.

Oxygen in the lungs is carried to the tissues through the bloodstream, but only a small amount of this oxygen can actually dissolve in arterial blood. How much dissolves depends on the partial pressure of the oxygen (the pressure that the gas exerts on the walls of the arteries). Therefore, testing the partial pressure of oxygen is actually measuring how much oxygen the lungs are delivering to the blood. Carbon dioxide is released into the blood as a by-product of cell metabolism. The partial carbon dioxide pressure indicates how well the lungs are eliminating this carbon dioxide.

The remainder of oxygen that is not dissolved in the blood combines with hemoglobin, a protein—iron compound found in the red blood cells. The oxygen content measurement in an ABG analysis indicates how much oxygen is combined with the hemoglobin. A related value is the oxygen saturation, which compares the amount of oxygen actually combined with hemoglobin to the total amount of oxygen that the hemoglobin is capable of combining with.

Carbon dioxide dissolves more readily in the blood than oxygen does, primarily forming bicarbonate and smaller amounts of carbonic acid. When present in normal amounts, the ratio of carbonic acid to bicarbonate creates an acid-base balance in the blood, helping to keep



A blood gas analyzer from Corning Corporation. (Photograph by Hank Morgan, Photo Researchers, Inc. Reproduced by permission.)

the pH at a level where the body's cellular functions are most efficient. The lungs and kidneys both participate in maintaining the carbonic acid-bicarbonate balance. The lungs control the carbonic acid level and the kidneys regulate the bicarbonate. If either organ is not functioning properly, an acid-base imbalance can result. Determination of bicarbonate and pH levels, then, aids in diagnosing the cause of abnormal blood gas values.

The procedure

The blood sample is obtained by arterial puncture (usually in the wrist, although it could be in the groin or arm) or from an arterial line already in place. If a puncture is needed, the skin over the artery is cleaned with an antiseptic. A technician then collects the blood with a small sterile needle attached to a disposable syringe. The patient may feel a brief throbbing or cramping at the site of the puncture. After the blood is drawn, the sample must be transported to the laboratory as soon as possible for analysis.

KEY TERMS

Acid-base balance—The condition that exists when the body's carbonic acid-bicarbonate buffer system is in equilibrium, helping to maintain the blood pH at a normal level of 7.35–7.45.

Hemoglobin—A protein-iron compound in red blood cells that functions primarily in carrying oxygen from the lungs to the tissues of the body.

pH—A measure of the acidity of a solution. Normal blood pH ranges from 7.35–7.45.

Preparation

There are no special preparations. Patients have no restrictions on drinking or eating before the test. If the patient is receiving oxygen, the oxygen concentration must remain the same for 20 minutes before the test; if the test is to be taken without oxygen, the gas must be turned off for 20 minutes before the test is taken. The patient should breathe normally during the test.

Aftercare

After the blood has been taken, the technician or the patient applies pressure to the puncture site for 10–15 minutes to stop the bleeding, and then places a dressing over the puncture. The patient should rest quietly while applying the pressure to the puncture site. Health care workers will observe the patient for signs of bleeding or circulation problems.

Risks

Risks are very low when the test is done correctly. Risks include bleeding or bruising at the site, or delayed bleeding from the site. Very rarely, there may be a problem with circulation in the puncture area.

Normal results

Normal blood gas values are as follows:

- partial pressure of oxygen (PaO_2): 75–100 mm Hg
- partial pressure of carbon dioxide (PaCO_2): 35–45 mm Hg
- oxygen content (O_2CT): 15–23%
- oxygen saturation (SaO_2): 94–100%
- bicarbonate (HCO_3^-): 22–26 mEq/liter
- pH: 7.35–7.45

Abnormal results

Values that differ from those listed above may indicate respiratory, metabolic, or kidney disease. These results also may be abnormal if the patient has experienced trauma that may affect breathing (especially head and neck injuries). Disorders, such as anemia, that affect the oxygen-carrying capacity of blood, can produce an abnormally low oxygen content value.

Resources

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Carol A. Turkington

Blood poisoning see **Acute lymphangitis**

Blood registry see **Blood donation and registry**

Blood removal see **Phlebotomy**

Blood sugar tests

Definition

Blood sugar tests include several different tests that measure the amount of sugar (glucose) in a person's blood. These tests are done either on an empty stomach, or after consuming a meal or premeasured glucose drink. Blood sugar tests are done primarily to diagnose and evaluate a person with **diabetes mellitus**.

Purpose

The body uses sugar, also called glucose, to supply the energy it needs to function. People get sugar from their diet and from their body tissues. Insulin is made by the pancreas and affects the outer membrane of cells, making it easy for glucose to move from the blood into the cells. When insulin is active, blood glucose levels fall. Sugar from body tissues is stored in the form of glycogen. When glycogen is active, blood glucose levels rise.

After a meal, blood glucose levels rise sharply. The pancreas responds by releasing enough insulin to take care of all the newly added sugar found in the body. The insulin moves the sugar out of the blood and into the cells. Only then does the blood sugar start to level off and

begin to fall. A person with diabetes mellitus either does not make enough insulin, or makes insulin that does not work properly. The result is blood sugar that remains high, a condition called hyperglycemia.

Diabetes must be diagnosed as early as possible. If left untreated, it can damage or cause failure of the eyes, kidneys, nerves, heart, blood vessels, and other body organs. **Hypoglycemia**, or low blood sugar, may also be discovered through blood sugar testing. Hypoglycemia is caused by various hormone disorders and liver disease, as well as by too much insulin.

Description

There are a variety of ways to measure a person's blood sugar.

Whole blood glucose test

Whole blood glucose testing can be performed by a person in his or her home, and kits are available for this purpose. The person pricks his or her finger (a finger stick) with a sterile sharp blade from the kit. A single drop of blood is placed on a strip in a portable instrument called a glucometer. The glucometer quickly determines the blood sugar and shows the results on a small screen in usually a few seconds.

Fasting plasma glucose test

The fasting plasma glucose test is done on an empty stomach. For the eight hours before the test, the person must fast (nothing to eat or drink, except water). The person's blood is drawn from a vein by a healthcare worker. The blood sample is collected into a tube containing an anticoagulant. Anticoagulants stop the blood from clotting. In the laboratory, the tube of blood spins at high speed within a machine called a centrifuge. The blood cells sink to the bottom and the liquid stays on the top. This straw-colored liquid on the top is the plasma. To measure the glucose, a person's plasma is combined with other substances. From the resulting reaction, the amount of glucose in the plasma is determined.

Oral glucose tolerance test

The oral glucose tolerance test is done to see how well the body handles a standard amount of glucose. This test measures the amount of glucose in a person's plasma before and two hours after drinking a large premeasured beverage containing glucose. The person must eat a consistent diet, containing at least 5.25oz (150 g) of carbohydrates each day, for three days before this test. For eight hours before the test, the person must fast. A healthcare provider draws the first sample of blood at the end of the

fast to determine the glucose level at the start of the test. The healthcare provider then gives the person a beverage containing 2.6 oz (75 g) of glucose. Two hours later, the person's blood is drawn again. These blood samples are centrifuged and processed in the laboratory. A doctor can then compare the before and after glucose levels to see how well the body processed the sugar.

Two-hour postprandial blood glucose test

The two-hour postprandial blood glucose test measures the amount of glucose in plasma after a person eats a specific meal containing a certain amount of sugar. Although the meal follows a predetermined menu, it is difficult to control many factors associated with this testing method.

Blood sugar tests can be used in a variety of situations including:

- Testing people suspected for diabetes. The American Diabetic Association (ADA) recommends that either a fasting plasma glucose test or an oral glucose tolerance test be used to diagnose diabetes. If the person already has symptoms of diabetes, a blood glucose test without fasting (called a casual plasma glucose test) may be done. If the test result is abnormal, it must be confirmed with another test performed on another day. The two tests can be different or they can be the same, but they must be done on different days. If the second test is also abnormal, the person has diabetes. A two-hour post-prandial test is not recommended by the ADA as a test to use for the diagnosis of diabetes. A doctor may order this test, and follow it with the oral glucose tolerance test or the fasting plasma glucose test if the results are abnormal.
- Testing pregnant women. Diabetes that occurs during **pregnancy (gestational diabetes)** is dangerous for both the mother and the baby. Women who may be at risk are screened when they are 24-28 weeks pregnant. A woman is considered at risk if she is older than 25 years, is not at her normal body weight, has a parent or sibling with diabetes, or if she is in an ethnic group that has a high rate of diabetes (Hispanics, Native Americans, Asians, African Americans). The blood sugar test to screen for gestational diabetes is a variation of the oral glucose tolerance test. Fasting is not required. If the result is abnormal, a more complete test is done on another day.
- Testing healthy people. Healthy people without symptoms of diabetes should be screened for diabetes when they are 45 years old and again every three years. Either the fasting plasma glucose or oral glucose tolerance test is used for screening. People in high risk groups should be tested before the age of 45 and tested more frequently.

- Testing of people already diagnosed with diabetes. The ADA recommends that a person with diabetes keep the amount of glucose in the blood at a normal level as much as possible. This can be done by the diabetic person testing his or her own blood at home one or more times a day.

Preparation

Each blood sugar test that uses plasma requires a 5 mL blood sample. A healthcare worker ties a tight band (tourniquet) on the person's upper arm, locates a vein in the inner elbow region, and inserts a needle into that vein. Vacuum action draws the blood through the needle into an attached tube. Collection of the sample takes only a few minutes.

When fasting is required, the person should have nothing to eat or drink (except water) for eight hours before the test and until the test or series of tests is completed. The person should not smoke before or during the testing period because this can temporarily increase the amount of glucose in the blood. Other factors that can cause inaccurate results are a change in diet before the test, illness or surgery two weeks before the test, certain drugs, and extended bed rest. The doctor may tell a person on insulin or taking pills for diabetes to stop the medication until after the test.

Aftercare

After the test or series of tests is completed (and with the approval of his or her doctor), the person should eat, drink, and take any medications that were stopped for the test.

The patient may feel discomfort when blood is drawn from a vein. Bruising may occur at the puncture site or the person may feel dizzy or faint. Pressure to the puncture site until the bleeding stops will reduce bruising. Warm packs to the puncture site will relieve discomfort.

Risks

If the person experiences any weakness, **fainting**, sweating, or any other unusual reaction while fasting or during the test, he or she should immediately tell the person giving the test.

Normal results

Normal results are:

- fasting plasma glucose test less than 120 mg/dL
- oral glucose tolerance test, 2 hours less than 140 mg/dL

For the diabetic person, the ADA recommends an ongoing blood sugar goal of less than or equal to 120 mg/dL.

Abnormal results

These abnormal results indicate diabetes and must be confirmed with repeat testing:

- fasting plasma glucose test less than or equal to 126 mg/dL
- oral glucose tolerance test, 2 hours less than or equal to 200 mg/dL
- casual plasma glucose test (nonfasting, with symptoms) less than or equal to 200 mg/dL
- gestational oral glucose tolerance test, 1 hour less than or equal to 140 mg/dL

Brain damage can occur from glucose levels below 40 mg/dL and **coma** from levels above 470 mg/dL.

Other hormone disorders can cause both hyperglycemia and hypoglycemia. Abnormal results must be interpreted by a doctor who is aware of the person's medical condition and medical history.

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ORGANIZATIONS

American Diabetes Association. 1701 North Beauregard Street, Alexandria, VA 22311. (800) 342-2383. <<http://www.diabetes.org>>.

Centers for Disease Control and Prevention. 1600 Clifton Rd., NE, Atlanta, GA 30333. (800) 311-3435, (404) 639-3311. <<http://www.cdc.gov>>.

National Diabetes Information Clearinghouse. 1 Information Way, Bethesda, MD 20892-3560. (800) 860-8747. <<http://www.niddk.nih.gov/health/diabetes/ndic.htm>>.

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Building 31, Room 9A04, 31 Center Drive, MSC 2560, Bethesda, MD 20879-2560. (301) 496-3583. <<http://www.niddk.nih.gov>>.

Nancy J. Nordenson

Blood thinners see **Anticoagulant and antiplatelet drugs**

Blood transfusion see **Transfusion**

Blood typing and crossmatching

Definition

Blood typing is a laboratory test done to determine a person's blood type. If the person needs a blood **transfusion**, another test called crossmatching is done after the blood is typed to find blood from a donor that the person's body will accept.

Purpose

Blood typing and crossmatching are most commonly done to make certain that a person who needs a transfusion will receive blood that matches (is compatible with) his own. People must receive blood of the same blood type, otherwise, a serious, even fatal, transfusion reaction can occur.

Parents who are expecting a baby have their blood typed to diagnose and prevent hemolytic disease of the newborn (HDN), a type of anemia also known as **erythroblastosis fetalis**. Babies who have a blood type different from their mothers are at risk for developing this disease. The disease is serious with certain blood type differences, but is milder with others.

A child inherits factors or genes from each parent that determine his blood type. This fact makes blood typing useful in paternity testing. To determine whether or not the alleged father could be the true father, the blood types of the child, mother, and alleged father are compared.

Legal investigations may require typing of blood or other body fluids, such as semen or saliva, to identify persons involved in crimes or other legal matters.

Description

Blood typing and crossmatching tests are performed in a blood bank laboratory by technologists trained in blood bank and transfusion services. The tests are done on blood, after it has separated into cells and serum (serum is the yellow liquid left after the blood clots.) Costs for both tests are covered by insurance when the tests are determined to be medically necessary.

Blood bank laboratories are usually located in facilities, such as those operated by the American Red Cross, that collect, process, and supply blood that is donated, as well as in facilities, such as most hospitals, that prepare blood for transfusion. These laboratories are regulated by the United States Food and Drug Administration (FDA) and are often inspected and accredited by a professional

association such as the American Association of Blood Banks (AABB).

Blood typing and crossmatching tests are based on the reaction between antigens and antibodies. An antigen can be anything that causes the body to launch an attack, known as an immune response, against it. The attack begins when the body builds a special protein, called an antibody, that is uniquely designed to attack and make ineffective (neutralize) the specific antigen that caused the attack. A person's body normally doesn't make antibodies against its own antigens, only against antigens that are foreign to it.

A person's body contains many antigens. The antigens found on the surface of red blood cells are important because they determine a person's blood type. When red blood cells having a certain blood type antigen are mixed with serum containing antibodies against that antigen, the antibodies attack and stick to the antigen. In a test tube, this reaction is observed as the formation of clumps of cells (clumping).

When blood is typed, a person's cells and serum are mixed in a test tube with commercially-prepared serum and cells. Clumping tells which antigens or antibodies are present and reveals the person's blood type. When blood is crossmatched, patient serum is mixed with cells from donated blood that might be used for transfusion. Clumping or lack of clumping in the test tube tells whether or not the blood is compatible.

Although there are over 600 known red blood cell antigens, organized into 22 blood group systems, routine blood typing and crossmatching is usually concerned with only two systems: the ABO and Rh blood group systems.

Blood typing

ABO BLOOD GROUP SYSTEM. In 1901, Karl Landsteiner, an Austrian pathologist, randomly combined the serum and red blood cells of his colleagues. From the reactions he observed in test tubes, he discovered the ABO blood group system. This discovery earned him the 1930 Nobel Prize in Medicine.

A person's ABO blood type—A, B, AB, or O—is based on the presence or absence of the A and B antigens on his red blood cells. The A blood type has only the A antigen and the B blood type has only the B antigen. The AB blood type has both A and B antigens, and the O blood type has neither A nor B antigen.

By the time a person is six months old, he naturally will have developed antibodies against the antigens his red blood cells lack. That is, a person with A blood type will have anti-B antibodies, and a person with B blood

Recipient's blood			Reactions with donor's red blood cells			
ABO antigens	ABO antibodies	ABO blood type	Donor type O cells	Donor type A cells	Donor type B cells	Donor type AB cells
None	Anti-A Anti-B	O				
A	Anti-B	A				
B	Anti-A	B				
A & B	None	AB				

Blood typing is a laboratory test done to discover a person's blood type. If the person needs a blood transfusion, cross-matching is done following blood typing to locate donor blood that the person's body will accept. (Illustration by Electronic Illustrators Group.)

type will have anti-A antibodies. A person with AB blood type will have neither antibody, but a person with O blood type will have both anti-A and anti-B antibodies. Although the distribution of each of the four ABO blood types varies between racial groups, O is the most common and AB is the least common.

ABO typing is the first test done on blood when it is tested for transfusion. A person must receive ABO-matched blood. ABO incompatibilities are the major cause of fatal transfusion reactions. ABO antigens are also found on most body organs, so ABO compatibility is also important for organ transplants.

An ABO incompatibility between a pregnant woman and her baby is a minor cause of HDN and usually causes no problem for the baby. The structure of ABO antibodies makes it unlikely they will cross the placenta to attack the baby's red blood cells.

Paternity testing compares the ABO blood types of the child, mother, and alleged father. The alleged father can't be the true father if the child's blood type requires a gene that neither he nor the mother have. For example, a child with blood type B whose mother has blood type O,

requires a father with either AB or B blood type; a man with blood type O cannot be the true father.

In some people, ABO antigens can be found in body fluids other than blood, such as saliva and semen. ABO typing of these fluids provides clues in legal investigations.

RH BLOOD GROUP SYSTEM. The Rh, or Rhesus, system was first detected in 1940 by Landsteiner and Wiener when they injected blood from rhesus monkeys into guinea pigs and rabbits. More than 50 antigens have since been discovered belonging to this system, making it the most complex red blood cell antigen system.

In routine blood typing and crossmatching tests, only one of these 50 antigens, the D antigen, also known as the Rh factor or $Rh_o[D]$, is tested for. If the D antigen is present, that person is Rh-positive; if the D antigen is absent, that person is Rh-negative.

Other important antigens in the Rh system are C, c, E, and e. These antigens are not usually tested for in routine blood typing tests. However, testing for the presence of these antigens is useful in paternity testing, and when a technologist tries to identify unexpected Rh antibodies

KEY TERMS

ABO blood type—Blood type based on the presence or absence of the A and B antigens on the red blood cells.

Antibody—A special protein made by the body as a defense against foreign material that enters the body. It is uniquely designed to attack and neutralize the specific antigen that triggered the immune response.

Antigen—Anything that causes the body to launch an immune response against that antigen through the production of antibodies.

Blood bank—A laboratory that specializes in blood typing, antibody identification, and transfusion services.

Blood type—Blood categories based on the presence or absence of certain antigens on the red blood cells.

Crossmatch—A laboratory test done to confirm that blood from a donor and blood from the recipient are compatible.

Gene—A piece of DNA, located on a chromosome, that determines how traits such as blood type are inherited and expressed.

Immune response—The body's attack against an antigen that it considers foreign to itself. The attack begins with the production of antibodies against the antigen.

Rh blood type—Blood type based on the presence or absence of the D antigen on the red blood cells.

Transfusion—The therapeutic introduction of blood or a blood component into a patient's bloodstream.

or find matching blood for a person with antibodies to one or more of these antigens.

Unlike the ABO system, antibodies to Rh antigens don't develop naturally. They develop only as an immune response after a transfusion or during **pregnancy**.

The incidence of the Rh blood types varies between racial groups, but not as widely as the ABO blood types: 85% of whites and 90% of blacks are Rh-positive; 15% of whites and 10% of blacks are Rh-negative.

In transfusions, the Rh system is next in importance after the ABO system. Most Rh-negative people who receive Rh-positive blood will develop anti-D antibodies. A later transfusion of Rh-positive blood could result in a severe or fatal transfusion reaction.

Rh incompatibility is the most common and severe cause of HDN. This incompatibility can happen when an Rh-negative woman and an Rh-positive man produce an Rh-positive baby. Cells from the baby can cross the placenta and enter the mother's bloodstream, causing the mother to make anti-D antibodies. Unlike ABO antibodies, the structure of anti-D antibodies makes it likely that they will cross the placenta and enter the baby's bloodstream. There, they can destroy the baby's red blood cells, causing severe or fatal anemia.

The first step in preventing HDN is to find out the Rh types of the expectant parents. If the mother is Rh-negative and the father is Rh-positive, the baby is at risk for developing HDN. The next step is to test the mother's serum to make sure she doesn't already have anti-D antibodies from

a previous pregnancy or transfusion. This procedure is similar to blood typing. Finally, the Rh-negative mother is given an injection of Rh Immunoglobulin (RhIg) at 28 weeks of gestation and again after delivery, if the baby is Rh positive. The RhIg attaches to any Rh-positive cells from the baby in the mother's bloodstream, preventing them from triggering anti-D antibody production in the mother. An Rh-negative woman should also receive RhIg following a **miscarriage**, abortion, or **ectopic pregnancy**.

OTHER BLOOD GROUP SYSTEMS. Several other blood group systems may be involved in HDN and transfusion reactions, although they are much less frequent than ABO and Rh. They are the Duffy, Kell, Kidd, MNS, and P systems. Tests for antigens from these systems are not included in routine blood typing, but they are commonly used in paternity testing.

Like Rh antibodies, antibodies in these systems do not develop naturally, but as an immune response after transfusion or during pregnancy. An antibody screening test is done before a crossmatch to check for unexpected antibodies to antigens in these systems. A person's serum is mixed in a test tube with commercially-prepared cells containing antigens from these systems. If clumping occurs, the antibody is identified.

Crossmatching

Crossmatching is the final step in pretransfusion testing. It is commonly referred to as compatibility testing, or "Type and Cross."

Before blood from a donor and the recipient are crossmatched, both are ABO and Rh typed. In addition, antibody screening is done to look for antibodies to certain Rh, Duffy, MNS, Kell, Kidd, and P system antigens. If an antibody to one of these antigens is found, only blood without that antigen will be compatible in a crossmatch. This sequence must be repeated before each transfusion a person receives.

To begin the crossmatch, blood from a donor with the same ABO and Rh type as the recipient is selected. In a test tube, serum from the patient is mixed with red blood cells from the donor. If clumping occurs, the blood is not compatible; if clumping does not occur, the blood is compatible. If an unexpected antibody is found in either the patient or the donor, the blood bank does further testing to make sure the blood is compatible.

In an emergency, when there is not enough time for blood typing and crossmatching, O red blood cells may be given, preferably Rh-negative. O blood type is called the universal donor because it has no ABO antigens for a patient's antibodies to attack. In contrast, AB blood type is called the universal recipient because it has no ABO antibodies to attack the antigens on transfused red blood cells. If there is time for blood typing, red blood cells of the recipient type (type specific cells) are given. In either case, the crossmatch is continued, even though the transfusion has begun.

Preparation

To collect the 10 mL blood needed for these tests, a healthcare worker ties a tourniquet above the patient's elbow, locates a vein in the inner elbow region, and inserts a needle into that vein. Vacuum action draws the blood through the needle into an attached tube. Collection of the sample takes only a few minutes.

Blood typing and crossmatching must be done three days or less before a transfusion. A person doesn't need to change diet, medications, or activities before these tests. He should tell his healthcare provider if, during the last three months, he has received a blood transfusion or a plasma substitute, or has had a radiology procedure using intravenous contrast media. These can give false clumping reactions in both typing and crossmatching tests.

Aftercare

The possible side effects of any blood collection are discomfort or bruising at the site where the needle punctured the skin, as well as **dizziness** or **fainting**. Bruising is reduced if pressure is applied with a finger to the puncture site until the bleeding stops. Discomfort is treated with warm packs to the puncture site.

Risks

There are no risks from the blood collection or test procedures. Blood transfusions always have the risk of an unexpected transfusion reaction. A nurse watches a patient for signs of a reaction during the entire transfusion.

Normal results

There is no normal blood type. The desired result of a crossmatch is that compatible donor blood is found. Compatibility testing procedures are designed to provide the safest blood product possible for the recipient, but a compatible crossmatch is no guarantee that an unexpected adverse reaction will not appear during the transfusion.

Abnormal results

Except in an emergency, a person cannot receive a transfusion without a compatible crossmatch result.

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- American Association of Blood Banks. 8101 Glenbrook Road, Bethesda, MD 20814. (301) 907-6977. <<http://www.aabb.org>>.
- American College of Obstetricians and Gynecologists. 409 12th Street, S.W., P.O. Box 96920
- American Red Cross Blood Services. 430 17th Street NW, Washington, DC 20006. (202) 737-8300. <<http://www.redcross.org>>.

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Blood urea nitrogen test

Definition

The blood urea nitrogen (BUN) test measures the level of urea nitrogen in a sample of the patient's blood. Urea is a substance that is formed in the liver when the body breaks down protein. Urea then circulates in the blood in the form of urea nitrogen. In healthy people, most urea nitrogen is filtered out by the kidneys and leaves the body in the urine. If the patient's kidneys are not functioning properly or if the body is using large amounts of protein, the BUN level will rise. If the patient has severe liver disease, the BUN will drop.

Purpose

The BUN level may be checked in order to assess or monitor:

- the presence or progression of kidney or liver disease.
- blockage of urine flow.
- mental confusion. Patients with kidney failure are sometimes disoriented and confused.
- abnormal loss of water from the body (**dehydration**).
- recovery from severe **burns**. The body uses larger than normal amounts of protein following serious burns.

Description

The BUN test is performed on a sample of the patient's blood, withdrawn from a vein into a vacuum tube. The procedure, which is called a venipuncture, takes about five minutes.

Preparation

The doctor should check to make sure that the patient is not taking any medications that can affect BUN results. These drugs include the **antibiotics** chloramphenicol, streptomycin, amphotericin B, methicillin, gentamicin, tobramycin, and kanamycin, as well as **diuretics** and **corticosteroids**.

The patient should be advised not to eat large amounts of meat the day before the test.

Aftercare

Aftercare consists of routine care of the area around the venipuncture.

Risks

The primary risk is the possibility of a bruise or swelling in the area of the venipuncture. The patient can apply moist warm compresses.

KEY TERMS

Urea—A compound containing nitrogen that occurs in the urine and other body fluids as a result of protein metabolism.

Normal results

Normal BUN levels are 5–18 mg/dL for children; 7–18 mg/dL for adults; and 8–20 mg/dL in the elderly.

Abnormal results

BUN levels can be too low as well as too high.

Abnormally low BUN

Low levels of BUN may indicate **overhydration**, **malnutrition**, **celiac disease** [a disease characterized by the inability to tolerate foods containing wheat protein (gluten)], liver damage or disease, or use of corticosteroids. Low BUN may also occur in early **pregnancy**.

Abnormally high BUN

High levels of BUN may indicate kidney disease or failure; blockage of the urinary tract by a kidney stone or tumor; a **heart attack** or congestive **heart failure**; dehydration; **fever**; **shock**; or bleeding in the digestive tract. High BUN levels can sometimes occur during late pregnancy or result from eating large amounts of protein-rich foods. A BUN level higher than 100 mg/dL points to severe kidney damage.

Resources

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Blood vessel scan see **Doppler ultrasonography**

Body lice see **Lice infestation**

Boils

Definition

Boils and carbuncles are bacterial infections of hair follicles and surrounding skin that form pustules (small blister-like swellings containing pus) around the follicle. Boils are sometimes called furuncles. A carbuncle is formed when several furuncles merge to form a single deep abscess with several heads or drainage points.

Description

Boils and carbuncles are firm reddish swellings about 0.2–0.4 in (5–10 mm) across that are slightly raised above the skin surface. They are sore to the touch. A boil usually has a visible central core of pus; a carbuncle is larger and has several visible heads. Boils occur most commonly on the face, back of the neck, buttocks, upper legs and groin area, armpits, and upper torso. Carbuncles are less common than single boils; they are most likely to form at the back of the neck. Males are more likely to develop carbuncles.

Boils and carbuncles are common problems in the general population, particularly among adolescents and adults. People who are more likely to develop these skin infections include those with:

- diabetes, especially when treated by injected insulin
- alcoholism or drug abuse
- poor personal hygiene
- crowded living arrangements
- jobs or hobbies that expose them to greasy or oily substances, especially petroleum products
- allergies or immune system disorders, including HIV infection.
- family members with recurrent skin infections

Causes and symptoms

Boils and carbuncles are caused by *Staphylococcus aureus*, a bacterium that causes an infection in an oil gland or hair follicle. Although the surface of human skin is usually resistant to bacterial infection, *S. aureus* can enter through a break in the skin surface—including breaks caused by needle punctures for insulin or drug injections. Hair follicles that are blocked by greasy creams, petroleum jelly, or similar products are more vulnerable to infection. Bacterial skin infections can be spread by shared cosmetics or washcloths, close human contact, or by contact with pus from a boil or carbuncle.

As the infection develops, an area of inflamed tissue gradually forms a pus-filled swelling or pimple that is



Boils often occur from a bacterial infection in a hair follicle or skin gland. (Custom Medical Stock Photo. Reproduced by permission.)

painful to touch. As the boil matures, it forms a yellowish head or point. It may either continue to swell until the point bursts open and allows the pus to drain, or it may be gradually reabsorbed into the skin. It takes between one and two weeks for a boil to heal completely after it comes to a head and discharges pus. The bacteria that cause the boil can spread into other areas of the skin or even into the bloodstream if the skin around the boil is injured by squeezing. If the infection spreads, the patient will usually develop chills and **fever**, swollen lymph nodes (**lymphadenitis**), and red lines in the skin running outward from the boil.

Furunculosis is a word that is sometimes used to refer to recurrent boils. Many patients have repeated episodes of furunculosis that are difficult to treat because their nasal passages carry colonies of *S. aureus*. These bacterial colonies make it easy for the patient's skin to be reinfected. They are most likely to develop in patients with diabetes, HIV infection, or other immune system disorders.

Carbuncles are formed when the bacteria infect several hair follicles that are close together. Carbunculosis is a word that is sometimes used to refer to the development of carbuncles. The abscesses spread until they merge with each other to form a single large area of infected skin with several pus-filled heads. Patients with carbuncles may also have a low-grade fever or feel generally unwell.

Diagnosis

The diagnosis of boils and carbuncles is usually made by the patient's primary care doctor on the basis of visual examination of the skin. In some cases involving recurrent boils on the face, the doctor may need to consider **acne** as a possible diagnosis, but for the most part

boils and carbuncles are not difficult to distinguish from other skin disorders.

S. aureus can easily be cultured in the laboratory if the doctor needs to rule out inclusion cysts or deep fungal infections that gardeners sometimes get. The doctor can make a culture from pus taken from the boil or carbuncle to confirm the diagnosis of a staphylococcal infection. He or she can also culture the patient's nasal discharge to test for the presence of a *S. aureus* colony.

Treatment

Patient and family education

Patient education is an important part of the treatment of boils and carbuncles. Patients need to be warned against picking at or squeezing boils because of the danger of spreading the infection into other parts of the skin or bloodstream. It is especially important to avoid squeezing boils around the mouth or nose because infections in these areas can be carried to the brain. Patients should also be advised about keeping the skin clean, washing their hands carefully before and after touching the boil or carbuncle, avoiding the use of greasy cosmetics or creams, and keeping their towels and washcloths separate from those of other family members. Some doctors may recommend an antiseptic soap or gel for washing the infected areas.

If the patient has had several episodes of furunculosis, the doctor may examine family members or close contacts to see if they are carriers of *S. aureus*. In many cases they also need treatment for boils or carbuncles. Skin infections and reinfections involving small groups or clusters of people are being reported more frequently in the United States.

Medications

Boils are usually treated with application of antibiotic creams—usually clindamycin or polymyxin—following the application of hot compresses. The compresses help the infection to come to a head and drain.

Carbuncles and furunculosis are usually treated with oral **antibiotics** as well as antibiotic creams or ointments. The specific medications that are given are usually dicloxacillin (Dynapen) or cephalexin (Keflex). Erythromycin may be given to patients who are allergic to penicillin. The usual course of oral antibiotics is 5–10 days; however, patients with recurrent furunculosis may be given oral antibiotics for longer periods. Furunculosis is treated with a combination of dicloxacillin and rifampin (Rifadin).

Patients with bacterial colonies in their nasal passages are often given mupirocin (Bactroban) to apply directly to the lining of the nose.



A close-up view of a carbuncle on person's back. (Photograph by John Watney, Photo Researchers, Inc. Reproduced by permission.)

Surgical treatment

Boils and carbuncles that are very large, or that are not draining, may be opened with a sterile needle or surgical knife to allow the pus to drain. The doctor will usually give the patient a local anesthetic if a knife is used; surgical treatment of boils is painful and usually leaves noticeable scars.

Alternative treatment

Naturopathic therapy

Naturopathic practitioners usually recommend changes in the patient's diet as well as applying herbal poultices to the infected area. The addition of zinc supplements and vitamin A to the diet is reported to be effective in treating boils. The application of a paste or poultice containing goldenseal (*Hydrastis canadensis*) root is recommended by naturopaths on the grounds that goldenseal helps to kill bacteria and reduce inflammation.

Homeopathy

Homeopaths maintain that taking the proper homeopathic medication in the first stages of a boil or carbuncle will bring about early resolution of the infection and prevent pus formation. The most likely choices are *Belladonna* or *Hepar sulphuris*. If the boil has already formed, *Mercurius vivus* or *Silica* may be recommended to bring the pus to a head.

Western herbal therapies

A variety of herbal remedies can be applied topically to boils to fight infection. These include essential oils of bergamot (*Citrus bergamia*), chamomile (*Matricaria*

KEY TERMS

Abscess—A localized collection of pus in the skin or other body tissue.

Carbuncle—A large, deep skin abscess formed by a group or cluster of boils.

Follicle—The small sac at the base of a hair shaft. The follicle lies below the skin surface.

Furunculosis—A condition in which the patient suffers from recurrent episodes of boils.

Pustule—A small raised pimple or blister-like swelling of the skin that contains pus.

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caria recutita), lavender (*Lavandula officinalis*), and sage (*Salvia officinalis*), as well as tea tree oil (*Melaleuca* spp.). Herbalists also recommend washing the skin with a mixture of goldenseal and witch hazel. To fight the inflammation associated with boils, herbalists suggest marsh mallow (*Althaea officinalis*) ointment, tinctures (herbal solutions made with alcohol) of blue flag (*Iris versicolor*) or myrrh (*Commiphora molmol*), and slippery elm (*Ulmus fulva*) made into a poultice.

Prognosis

The prognosis for most boils is excellent. Some patients, however, suffer from recurrent carbuncles or furunculosis. In addition, although the spread of infection from boils is relatively unusual, there have been deaths reported from brain infections caused by squeezing boils on the upper lip or in the tissue folds at the base of the nose.

Prevention

There are some precautions that people can take to minimize the risk of developing bacterial skin infections:

- cleanse skin properly with soap and water, and take showers rather than tub baths
- do not share washcloths, towels, or facial cosmetics with others
- cut down on greasy or fatty foods and snacks
- always wash hands before touching the face
- consider using antiseptic soaps and shower gels
- consult a doctor if furunculosis is a persistent problem—it may indicate an underlying disease such as diabetes

Bone biopsy

Definition

Bone biopsy is the removal of a piece of bone for laboratory examination and analysis.

Purpose

Bone biopsy is used to distinguish between malignant tumors and benign bone disease such as **osteoporosis** and **osteomyelitis**. This test may be ordered to determine why a patient's bones ache or feel sore, or when a mass or deformity is found on an x ray, CT scan, bone scan, or other diagnostic imaging procedure.

Precautions

The patient's doctor and the surgeon who performs the bone biopsy must be told about any prescription and over-the-counter medications the patient is taking, and about **allergies** or reactions the patient has had to anesthetics or **pain** relievers. Special care must be taken with patients who have experienced bleeding problems.

Description

A bone biopsy involves using a special drill or other surgical instruments to remove bone from the patient's body. The procedure usually lasts about 30 minutes and may be performed in the hospital, a doctor's office, or a surgical center.

A drill biopsy is generally used to obtain a small specimen. After the skin covering the bone has been cleansed with an antiseptic and shaved, the patient is given a local anesthetic. The doctor will not begin the procedure until the anesthetic has numbed the area from which the bone is to be removed, but the patient may feel pressure or mild pain when the needle pierces the bone. The surgeon turns the needle in a half-circle to extract a sample from the core, or innermost part, of the bone. The sample is drawn into the hollow stem of the biopsy needle. The sample is then sent to a laboratory, where it is examined under a microscope.

An open biopsy is used when a larger specimen is needed. After the area covering the bone has been cleansed with an antiseptic and shaved, the patient is given a general anesthetic. After the anesthetic takes effect and the patient is unconscious, the surgeon makes an incision and removes a bone specimen. The specimen is sent to the laboratory for immediate analysis. Results of that analysis may indicate that additional surgery should be performed right away.

Preparation

No special preparation is needed for a drill biopsy, but a patient must fast for at least 12 hours before an open biopsy.

Aftercare

Pain medication will be prescribed after a biopsy, and vital signs will be monitored until they return to normal. Most patients can go home in about an hour. If bone was removed from the spine, the patient may stay in the hospital overnight. The surgical site must be kept clean and dry for 48 hours, and the patient's doctor should be notified if any of these symptoms appear:

- fever
- headache
- pain on movement
- inflammation or pus near the biopsy site
- bleeding through the bandage at the biopsy site

Risks

Risks include bone fracture, injury to nearby tissue, and infection. Bleeding is a rare complication. Factors that increase risk include:

- stress
- obesity
- poor nutrition

KEY TERMS

Biopsy—Removal and examination of tissue to determine if cancer is present.

Osteomyelitis—An infection of the bone that is usually treated with antibiotics but sometimes requires surgery.

Osteoporosis—Thinning and loss of bone tissue.

- chronic illness
- some medications
- mind-altering drugs

Normal results

Normal bone is made up of collagen fibers and bone tissue.

Abnormal results

Bone biopsy can reveal the presence of benign disease, infection, or malignant tumors that have spread to the bone from other parts of the body.

Results of this test are considered reliable, but may be affected by:

- failure to fast before open biopsy
- failure to obtain an adequate specimen
- delayed microscopic examination or laboratory analysis

Resources

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ORGANIZATIONS

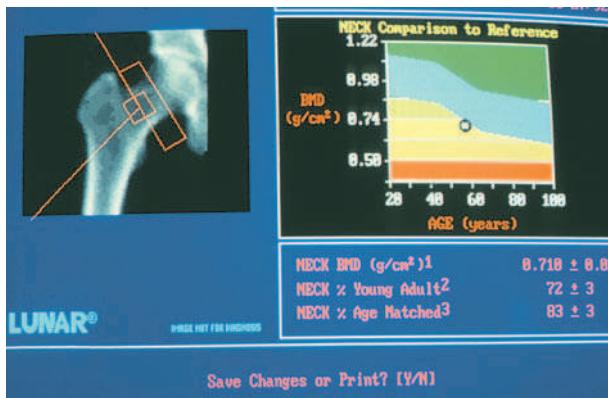
Cancer Group Institute. 1814 N.E. Miami Gardens Drive, North Miami Beach, FL 33179. (305) 651-5070. <<http://www.cancergroup.com/em19.html>>.

National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse. National Institutes of Health. 1 AMS Circle, Bethesda, MD 20892-3695. (301) 495-3675.

OTHER

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Computer read-out of a bone density scan. (Photo Researchers. Reproduced by permission.)

Bone break fever see **Dengue fever**

Bone cancer see **Sarcomas**

Bone densitometry see **Bone density test**



Patient undergoing a bone density scan. (Photo Researchers. Reproduced by permission.)

Bone density test

Definition

A bone density test, or scan, is designed to check for **osteoporosis**, a disease that occurs when the bones become thin and weak. Osteoporosis happens when the bones lose calcium and other **minerals** that keep them strong. Osteoporosis begins after **menopause** in many women, and worsens after age 65, often resulting in serious **fractures**. These fractures may not only bring disability, but may affect longevity. As many as one-fourth of women who fracture their hip after age 50 die within one year.

Most people today will get a bone density scan from a machine using a technology called Dual Energy X-ray Absorptiometry or DEXA for short. This machine takes a picture of the bones in the spine, hip, total body and wrist, and calculates their density. If a DEXA machine is not available, bone density scans can also be done with dual photon absorptiometry (measuring the spine, hip and total body) and quantitative **computed tomography scans** (measuring the spine). Bone density scanners that use DEXA technology to just measure bone density in the wrist (called pDEXA scans) provide scans at some drugstores. Yet these tests are not as accurate as those that measure density in the total body, spine or hip—where most fractures occur.

Purpose

A bone density scan measures the strength of an individual's bones and determines the risk of fracture. An observation of any osteoporosis present can be made.

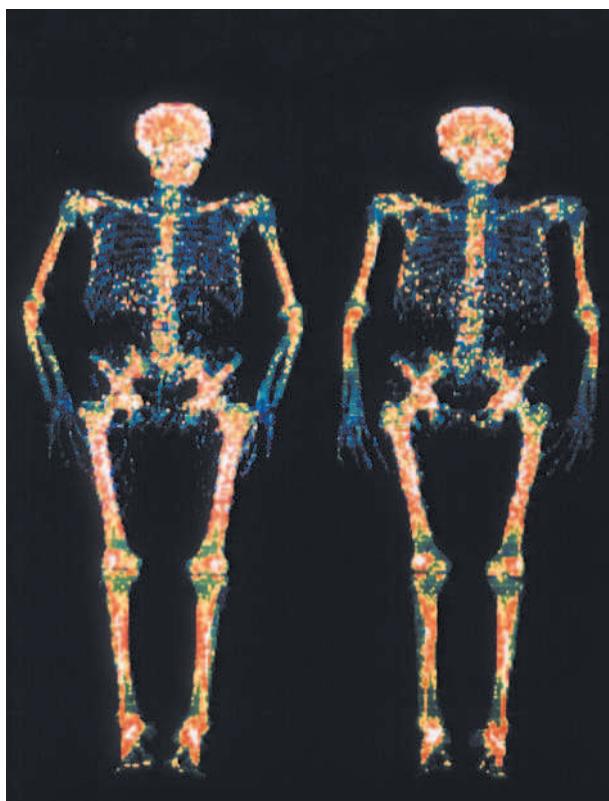
Description

To take a DEXA bone density scan, the patient lies on a bed underneath the scanner, a curving plastic arm that emits x rays. These low-dose x rays form a fan beam that rotates around the patient. During the test, the scanner moves to capture images of the patient's spine, hip or entire body. A computer then compares the patient's bone strength and risk of fracture to that of other people in the United States at the same age and to young people at peak bone density. Bones reach peak density at age 30 and then start to lose mass. The test takes about 20 minutes to do and is painless. The DEXA bone scan costs about \$250. Some insurance companies and Medicare cover the cost. pDEXA wrist bone scans in drugstores are available for about \$30.

Preparation

The patient puts on a hospital gown and lies on the bed underneath the scanner. Not all doctors routinely schedule this test. If the following factors apply to a patient, they may need a bone density scan and can discuss this with their doctor. The patient:

- is at risk for osteoporosis
- is near menopause
- has broken a bone after a modest trauma
- has a family history of osteoporosis
- uses steroid or antiseizure medications



A bone densitometry scan of identical twins. Their bone density is normal and identical to one another. (Photo Researchers. Reproduced by permission.)

- has had a period of restricted mobility for more than six months

Risks

The DEXA bone scan exposes the patient to only a small amount of radiation—about one-fiftieth that of a **chest x ray**, or about the amount you get from taking a cross-country airplane flight.

Normal results

The patient, when compared with people at “young normal bone density” (called the T-score) has the same or denser bones than a healthy 30-year-old. T scores above 1 mean that a patient has a healthy bone mass. Scores from 0 to –1 mean that the patient has borderline bone mass and should repeat the test in two to five years.

Abnormal results

The patient has two to four times the risk of a broken bone as other people in the United States at the same age and those at peak bone density. If a patient’s T score

KEY TERMS

Calcium—A mineral that helps build bone. After menopause, when women start making less of the bone-protecting hormone estrogen, they may need to increase their intake of calcium.

DEXA bone density scan—A bone density scan that uses a rotating x-ray beam to measure the strength of an individual’s bones and his or her fracture risk.

Osteoporosis—A disease that occurs when the bones lose the calcium and structure that keep them strong. It often occurs after menopause (around age 50) in women and in old age in men.

ranges from –1 to –2.5 they have low bone mass and are at risk for osteoporosis. A T score below –2.5 means osteoporosis is already evident. These patients should have a repeat bone density scan every year or two.

Resources

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ORGANIZATIONS

- National Osteoporosis Foundation. 1150 17th St., NW, Suite 500, Washington, DC 20036-4603. (800) 223-9994. <<http://www.nof.org>>.

Barbara Boughton

Bone disorder drugs

Definition

Bone disorder drugs are medicines used to treat diseases that weaken the bones.

Purpose

The drugs described here are used to treat or prevent **osteoporosis** (brittle bone disease) in women past **menopause** as well as older men. They also are used prescribed for Paget's disease, a painful condition that weakens and deforms bones, and they are used to control calcium levels in the blood.

Bone is living tissue. Like other tissue, bone is constantly being broken down and replaced with new material. Normally, there is a balance between the breakdown of old bone and its replacement with new bone. But when something goes wrong with the process, bone disorders may result.

Osteoporosis is a particular concern for women after menopause, as well as for older men. In osteoporosis, the inside of the bones become porous and thin. Over time, this condition weakens the bones and makes them more likely to break. Osteoporosis is four times more common in women than in men. This is because women have less bone mass than men, tend to live longer and take in less calcium, and need the female hormone estrogen to keep their bones strong. If men live long enough, they are also at risk of getting osteoporosis later in life. Once total bone mass has peaked—around age 35—all adults start to lose it. In women, the rate of bone loss speeds up during menopause, when estrogen levels fall. Bone loss may also occur if both ovaries are removed by surgery. Ovaries make estrogen. **Hormone replacement therapy** is one approach to preventing osteoporosis. However, not all people can use hormone replacement therapy. Bone disorder drugs are a good alternative for people who already have osteoporosis or who are at risk of developing it. Risk factors include lack of regular **exercise**, early menopause, being underweight, and a strong family history of osteoporosis.

Description

Bone disorder drugs are available only with a physician's prescription and come in tablet, nasal spray, and injectable forms. Commonly used bone disorder drugs are alendronate (Fosamax), calcitonin (Miacalcin, Calcimar), and raloxifene (Evista). Raloxifene belongs to a group of drugs known as selective estrogen receptor modulators (SERMs), which act like estrogen in some parts of the body but not in others. This makes the drugs less likely to cause some of the harmful effects that estrogen may cause. Unlike estrogen, raloxifene does not increase the risk of **breast cancer**. In fact, research suggests that raloxifene may even reduce that risk.

Recommended dosage

Alendronate

FOR OSTEOPOROSIS. The usual dose is 10 mg once a day. Treatment usually continues over many years.

FOR PAGET'S DISEASE. The usual dose is 40 mg once a day for six months.

This medicine works only when it is taken with a full glass of water first thing in the morning, at least 30 minutes before eating or drinking anything or taking any other medicine. Do not lie down for at least 30 minutes after taking it because the drug can irritate the esophagus, the tube that delivers food from the mouth to the stomach.

Calcitonin

NASAL SPRAY. The usual dose is one spray into the nose once a day. Alternate nostrils, spraying the right nostril one day, the left nostril the next day, and so on.

INJECTABLE. The recommended dosage depends on the condition for which the medicine is prescribed and may be different for different people. Check with the physician who prescribed the medicine or the pharmacist who filled the prescription for the proper dosage.

Raloxifene

The usual dose is one 60-mg tablet daily.

Precautions

Aldendronate

People with low levels of calcium in their blood should not take this medicine. It also is not recommended for women on hormone replacement therapy or for anyone with kidney problems. Before using alendronate, anyone who has digestive or swallowing problems should make sure that his or her physician knows about the condition.

Calcitonin

Calcitonin nasal spray may cause irritation or small sores in the nose. Check with a physician if this becomes very uncomfortable or if there is bleeding from the nose.

The injectable form of calcitonin has caused serious allergic reactions in a few people. The nasal spray is not known to cause such reactions, but the possibility exists. Before starting treatment with calcitonin, the physician who prescribes the drug may order an allergy test to make sure there will not be a problem.

Raloxifene

A rare, but serious side effect of raloxifene is an increased risk of blood clots that form in the veins and

may break away and travel to the lungs. This is about as likely in women who take raloxifene as it is in women who take estrogen. Because of this possible problem, women with a history of blood clots in their veins should not take raloxifene.

Women who have had breast **cancer** or cancer of the uterus should check with their physicians about whether they can safely use raloxifene.

General precautions for bone disorder drugs

To keep bones strong, the body needs calcium and vitamin D. Dairy products and fish such as salmon, sardines and tuna are good sources of both calcium and vitamin D. People who are taking bone disorder drugs for osteoporosis and who do not get enough of these nutrients in their **diets** should check with their physicians about taking supplements. Other important bone-saving steps are avoiding **smoking** and alcohol and getting enough of the kind of exercise that puts weight on the bones (such as walking or lifting weights).

People who are taking these drugs because they have too much calcium in their blood may need to *limit* the amount of calcium in their diets. Too much calcium may prevent the medicine from working properly. Discuss the proper diet with the physician who prescribed the drug, and do not make any diet changes without the physician's approval.

Anyone who has had unusual reactions to bone disorder drugs in the past should let his or her physician know before taking the drugs again. The physician also should be told about any **allergies** to foods, dyes, preservatives, or other substances.

Women who are pregnant or who may become pregnant and women who are breastfeeding should check with their physicians before using this alendronate or calcitonin. Raloxifene should not be used by women who are pregnant or who may become pregnant. In laboratory studies of rats, raloxifene caused **birth defects**.

Side effects

Aldendronate

Common side effects include **constipation**, **diarrhea**, **indigestion**, nausea, **pain** in the abdomen, and pain in the muscles and bones. These problems usually go away as the body adjusts to the medicine and do not need medical attention unless they continue or they interfere with normal activities.

Calcitonin

The most common side effects of calcitonin nasal spray are nose problems, such as dryness, redness, **itch-**

KEY TERMS

Estrogen—The main sex hormone that controls normal sexual development in females. During the menstrual cycle, estrogen helps prepare the body for possible pregnancy.

Fracture—A break or crack in a bone.

Hormone—A substance that is produced in one part of the body, then travels through the bloodstream to another part of the body where it has its effect.

Menopause—The stage in a woman's life when the ovaries stop producing egg cells at regular times and menstruation stops.

Osteoporosis—A disease in which bones become very porous and weak. The bones are then more likely to fracture and take longer to heal. The condition is most common in women after menopause but can also occur in older men.

ing, sores, bleeding and general discomfort. These problems should go away as the body adjusts to the medicine, but if they do not or if they are very uncomfortable, check with a physician. Other side effects that should be brought to a physician's attention include **headache**, back pain and joint pain.

Injectable calcitonin may cause minor side effects such as nausea or vomiting; diarrhea; stomach pain; loss of appetite; flushing of the face, ears, hands or feet; and discomfort or redness at the place on the body where it is injected. Medical attention is not necessary unless these problems persist or cause unusual discomfort.

Anyone who has a skin rash or **hives** after taking injectable calcitonin should check with a physician as soon as possible.

Raloxifene

Common side effects include hot flashes, leg cramps, **nausea and vomiting**. Women who have these problems while taking raloxifene should check with their physicians.

Interactions

Aldendronate

Taking **aspirin** with alendronate may increase the chance of upset stomach, especially if the dose of alendronate is more than 10 mg per day. If an analgesic is

necessary, switch to another drug, such as **acetaminophen** (Tylenol) or use buffered aspirin. Ask a physician or pharmacist for the correct medication to use.

Some calcium supplements, **antacids** and other medicines keep the body from absorbing alendronate. To prevent this problem, do not take any other medicine within 30 minutes of taking alendronate.

Calcitonin

Calcitonin may keep certain other drugs for Paget's disease, such as etidronate (Didronel), from working as they should.

Raloxifene

Raloxifene may affect blood clotting. Patients who are taking other drugs that affect blood clotting, such as warfarin (Coumadin), should check with their physicians before using raloxifene.

Resources

ORGANIZATIONS

Foundation For Osteoporosis Research & Education. (888) 266-3015. <<http://www.fore.org>>.

National Association for the Relief of Paget's Disease. <<http://www.demon.co.uk/narpd>>.

National Osteoporosis Foundation 1150 17th Street NW Suite 500 Washington, D.C. 20036-4603. <<http://www.nof.org>>.

Nancy Ross-Flanigan

Bone grafting

Definition

Bone grafting is a surgical procedure by which new bone or a replacement material is placed into spaces between or around broken bone (**fractures**) or holes in bone (defects) to aid in healing.

Purpose

Bone grafting is used to repair bone fractures that are extremely complex, pose a significant risk to the patient, or fail to heal properly. Bone graft is also used to help fusion between vertebrae, correct deformities, or provide structural support for fractures of the spine. In addition to **fracture repair**, bone graft is used to repair defects in bone caused by **birth defects**, traumatic injury, or surgery for bone **cancer**.

Description

Bone is composed of a matrix, mainly made up of a protein called collagen. It is strengthened by deposits of calcium and phosphate salts, called hydroxyapatite. Within and around this matrix are located the cells of the bones, which are of four types. Osteoblasts produce the bone matrix. Osteocytes are mature osteoblasts and serve to maintain the bone. Osteoclasts break down and remove bone tissue. Bone lining cells cover bone surfaces. Together, these four types of cells are responsible for building the bone matrix, maintaining it, and remodeling the bone as needed.

There are three ways in which a bone graft can help repair a defect. The first is called osteogenesis, the formation of new bone by the cells contained within the graft. The second is osteoinduction, a chemical process in which molecules contained within the graft (bone morphogenetic proteins) convert the patient's cells into cells that are capable of forming bone. The third is osteoconduction, a physical effect by which the matrix of the graft forms a scaffold on which cells in the recipient are able to form new bone.

New bone for grafting can be obtained from other bones in the patient's own body (e.g., hip bones or ribs), called autograft, or from bone taken from other people that is frozen and stored in tissue banks, called allograft. A variety of natural and synthetic replacement materials are also used instead of bone, including collagen (the protein substance of the white fibers of the skin, bone, and connective tissues); polymers, such as silicone and some acrylics; hydroxyapatite; calcium sulfate; and ceramics. A new material, called resorbable polymeric grafts, is also being studied. These resorbable grafts provide a structure for new bone to grow on; the grafts then slowly dissolve, leaving only the new bone behind.

To place the graft, the surgeon makes an incision in the skin over the bone defect and shapes the bone graft or replacement material to fit into the defect. After the graft is placed into the defect, it is held in place with pins, plates, or screws. The incision is closed with stitches and a splint or cast is used to prevent movement of the bones while healing.

The costs associated with a bone graft vary. These costs include: the surgeon's fee (variable); anesthesiologist's fees (averaging \$350 to \$400 per hour); hospital charges (averaging \$1,500 to \$1,800 per day, more for intensive care or private rooms); medication charges (\$200 to \$400); and additional charges, including an assisting surgeon, treatment of complications, diagnostic procedures (e.g., blood work or x rays), medical supplies, and equipment use. The cost for the graft itself can range from \$250 to \$900.

This procedure is covered by many third-party insurers; insurance coverage should be explored for each individual case.

Aftercare

The time required for convalescence for fractures or spinal fusion may vary from one to 10 days, and vigorous **exercise** may be limited for up to three months.

Most bone grafts are successful in helping the bone defect to heal. The extent of recovery will depend on the size of the defect and the condition of the bone surrounding the graft at the time of surgery. Severe defects may take some time to heal and may require further attention after the initial graft. In one study of over 1,000 patients who received very large allografts after surgery for bone cancer, researchers found that approximately 85% of the patients were able to return to work or normal physical activities without using crutches. However, about 25% of these patients required a second operation, because the first did not heal properly. Less severe bone defects, though, should heal completely without serious complications.

Risks

The risks for any surgical procedure requiring anesthesia include reactions to the medications and breathing problems. The risks for any surgical procedure include bleeding and infection.

The drawbacks of autografts include: the additional surgical and anesthesia time (typically 30 minutes per procedure) to obtain, or harvest, the bone for grafting; added costs of the additional surgery; **pain** and infection that might occur at the site from which the graft is taken; and the relatively small amount of bone that is available for grafting.

The drawbacks of allografts include: variability between lots, since the bone is harvested from a variety of donors; the bone may take longer to incorporate with the host bone than an autograft would; the graft may be less effective than an autograft; and the possibility of transferring diseases to the patient. Other complications may result from the immune response mounted by the patient's immune system against the grafted bone tissue. With the use anti-rejection agents (drugs to combat rejection of grafted bone tissue) immune rejection is less of a problem.

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KEY TERMS

Allograft—Tissue for transplantation that is taken from another person.

Autograft—Tissue for transplantation that is taken from the patient.

Hydroxyapatite—A calcium phosphate complex that is the primary mineral component of bone.

Osteoblasts—Bone cells that build new bone tissue.

Osteoclasts—Bone cells that break down and remove bone tissue.

Osteoconduction—Provision of a scaffold for the growth of new bone.

Osteocytes—Bone cells that maintain bone tissue.

Osteogenesis—Growth of new bone.

Osteoinduction—Acceleration of new bone formation by chemical means.

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ORGANIZATIONS

American Association of Tissue Banks. 1350 Beverly Road, Suite 220-A, McLean, VA 22101. (703) 827-9582.

Lisa Christenson, PhD

Bone growth stimulation

Definition

Bone growth stimulation is the technique of promoting bone growth in difficult to heal **fractures** by applying a low electrical current or ultrasound to the fracture.

Purpose

Bone growth stimulation is done when satisfactory healing is not occurring naturally or when the pace of healing is too slow. This condition is called fracture nonunion, and it occurs more frequently among adults than children, in people with severe or complex fractures, and in people who smoke.

The theory behind applying an electric current to fractures to stimulate healing is based on the fact that the concave side of the bone becomes negatively charged and the convex side is positively charged. It is believed that artificially encouraging this charging with an electric current will speed healing. In 1996, the Food and Drug Administration (FDA) also approved the application of low intensity ultrasound pulses as a treatment for fracture nonunion.

Ultrasound and electromagnetic stimulation are expensive and are used only when healing problems exist for a substantial length of time. Each method must be used for at least three to six months to be effective.

Precautions

Bone growth stimulation cannot be used if the gap between the ends of the fracture is too large.

Description

Electric stimulation can be applied either from the inside of the body (invasively) or from the outside the body (noninvasively). Ultrasound is a noninvasive procedure. The type of stimulation selected depends on the doctor's preference, the type and location of the fracture, and the patient's motivation to comply with the treatment schedule. Treatment can take anywhere from three to six months.

Invasive stimulators

Invasive electric stimulators are either fully or partially implantable. The advantage of these devices is that they apply a direct electric current to the fracture 24 hours a day. The fully implantable stimulator requires little daily attention from the patient. Patients using a semi-implanted stimulator must regulate their own treatment schedule and have to care for the external power pack. The disadvantage of implantable and semi-implantable stimulators is that their implantation is a surgical procedure.

Fully implantable direct current stimulators are installed in a hospital under general or regional anesthesia. Both the stimulator and the power source are implanted. The surgeon makes an incision and places a spiral shaped cathode inside the bone. A wire leads to the power source and a small anode. The power source is a battery pack that is implanted in the nearby muscle. The body transmits electrical current to close the circuit. The incision is then closed. Once in place, the device provides continuous direct electric current for bone growth stimulation.

Partially implanted stimulators use cathode pins that are implanted at the edge of each bone that is fractured. Wires lead to the surface of the skin where a power source and the anode are located. Wires complete the circuit. The external portion of the device is held in place by a cast. This source of stimulation also runs continuously.

Noninvasive stimulators

In the noninvasive stimulator, external electromagnetic coils are placed on either side of the fracture and are held in place by a strap or cuff. Locating the coils correctly is important, and their location relative to the fracture is usually confirmed by x rays.

The coils produce a pulsating electromagnetic field. It is up to the patient to maintain the prescribed treatment schedule. Effective treatment requires stimulation anywhere from three to ten hours each day in periods of no less than one hour.

Ultrasound stimulation is the most recent treatment for stimulating bone growth. A device that generates low intensity pulses of sound is applied to the skin over the fracture. The advantage of this technique is that it is non-invasive and the period of application of the sound pulses can be as short as 20-30 minutes each day. The results of this treatment have been studied less than the effect of electromagnetic stimulation.

Preparation

Bone growth stimulation is done only when healing has failed to occur for many months. Before it is started,

x rays are done of the fracture area. If the device is to be implanted, standard preoperative blood and urine tests are done. The patient may meet with an anesthesiologist to discuss any conditions that might affect the administration of anesthesia.

Aftercare

If a noninvasive, pulsating, electromagnetic field device is used, the patient must not put any **stress** or weight on the fracture until it is healed, which is a matter of months in most cases. In all lower limb fractures, regardless of the stimulation method used, the patient can not bear weight on the limb with the fracture until healing is complete. This limits the patient's mobility for many months. Patients have the responsibility for regularly making sure that the unit works and caring for external devices and the casts that hold them in place.

Risks

Noninvasive devices have few risks associated with them. The main risk associated with implantable devices is the development of infection at the site of implantation.

Normal results

Success in healing a fracture nonunion using bone growth stimulation depends on the type, location, and severity of the fracture and the age and general health of the patient.

Resources

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Tish Davidson

Bone infection see **Osteomyelitis**

Bone marrow aspiration and biopsy

Definition

Bone marrow aspiration, also called bone marrow sampling, is the removal by suction of fluid from the soft, spongy material that lines the inside of most bones. Bone marrow biopsy, or needle biopsy, is the removal of a small piece of bone marrow.

KEY TERMS

Anode—The positive electrode to which an electromagnetic current flows.

Cathode—The negative electrode from which an electromagnetic current flows.

Purpose

Bone marrow aspiration is used to:

- pinpoint the cause of abnormal blood test results
- confirm a diagnosis or check the status of severe anemia (abnormally low numbers of red blood cells in the bloodstream) of unknown cause, or other irregularities in the way blood cells are produced or become mature
- evaluate abnormalities in the blood's ability to store iron
- diagnose infection

Bone marrow biopsy is used to:

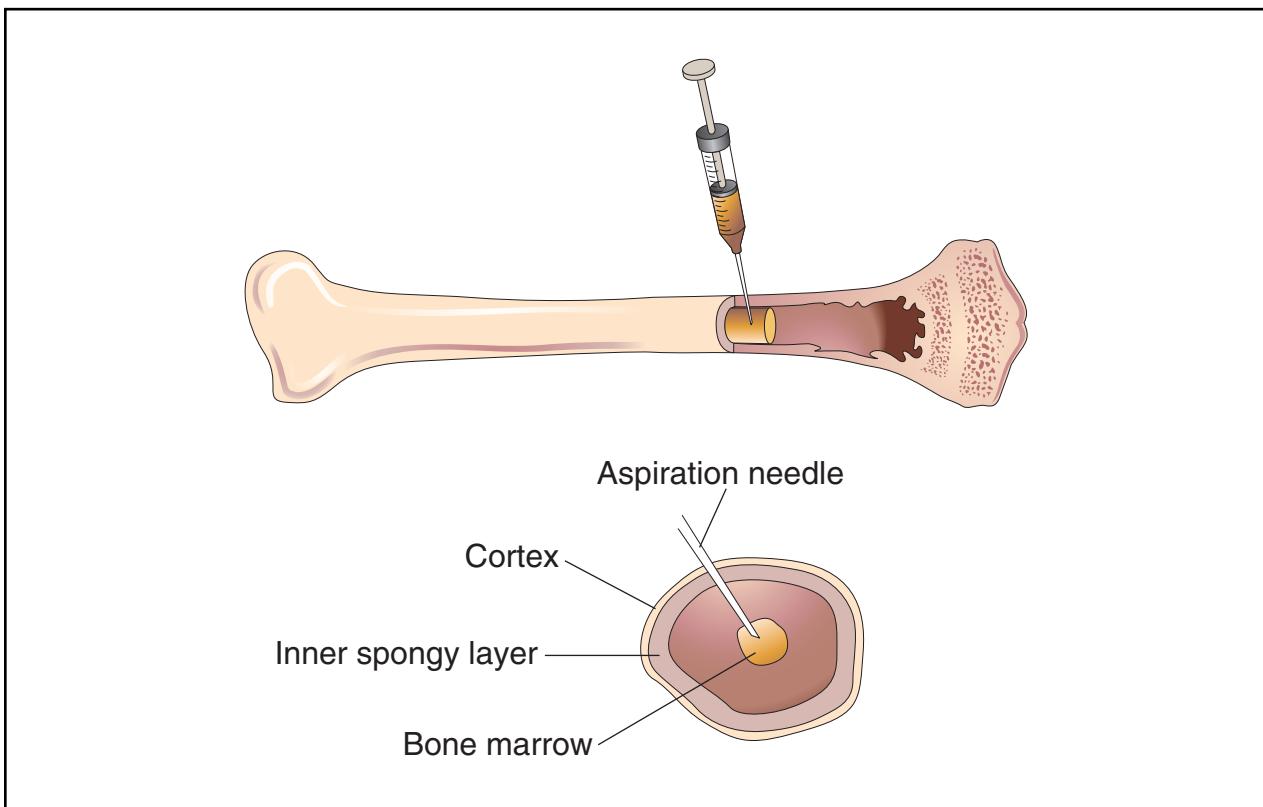
- obtain intact bone marrow for laboratory analysis
- diagnose and stage some types of **cancer** or anemia and other blood disorders
- identify the source of an unexplained fever
- diagnose fibrosis of bone marrow or myeloma (a tumor composed of cells normally found in the bone marrow) when bone marrow aspiration has failed to provide an appropriate specimen

Bone marrow aspiration and bone marrow biopsy are also used to gauge the effectiveness of **chemotherapy** and other medical treatments. These procedures are often used together to ensure the availability of the best possible bone marrow specimen.

Precautions

Allergies or previous adverse reactions to medications should be discussed with the doctor. Any current medications, including herbal or nutritional supplements, should be evaluated for the potential to interfere with proper coagulation (clot formation). These would include coumadin, **aspirin**, and other agents used as blood thinners. Caution should be used when the herbs gingko, ginger, garlic, or ginseng have been utilized as supplements, due to a risk of bleeding.

Pregnancy, lactation (production and secretion of milk), and preexisting platelet or bleeding disorders should be evaluated before either procedure is undertaken.



In a bone marrow aspiration, a needle is inserted beneath the skin and rotated until it penetrates the cortex, or outer covering of the bone. A small amount of marrow is suctioned out of the bone by a syringe attached to the needle. (Illustration by Electronic Illustrators Group.)

Description

Bone marrow aspiration and biopsy should be performed by a physician or nurse clinician. Each procedure takes about 20 to 30 minutes and is usually performed on an outpatient basis, but can be done in a hospital if necessary.

The skin covering the biopsy site is cleansed with an antiseptic, and the patient may be given a mild sedative. A local anesthetic is administered. The hematologist or nurse clinician performing the procedure will not begin until the anesthetic has numbed the area from which the specimen is to be extracted. In both adults and children, aspiration and biopsy are most commonly performed on the rear bone of the hip (posterior iliac crest). In adults, sampling from the sternum (breastbone) is sometimes done. The latter location is technically easier, but is somewhat more painful for the patient and presents the risk of heart injury. On rare occasions, a long bone of the leg (tibia) may be used as a sample site for an infant.

In a bone marrow aspiration, a special needle is inserted beneath the skin and rotated until it penetrates the cortex, or outer covering of the bone. At least half a

teaspoon of marrow is withdrawn from the bone by a syringe attached to the needle. The patient may experience discomfort when the needle is inserted or when the marrow is aspirated. If more marrow is needed, the needle is repositioned slightly, a new syringe is attached, and a second sample is taken. The samples are transferred from the syringes to slides and vials, then sent to a laboratory for analysis.

Bone marrow biopsy may be performed immediately before or after bone marrow aspiration. The procedure utilizes a special large-bore needle that is used to drill out a core of marrow. In bone marrow biopsy, the needle is inserted, rotated from side to side, withdrawn, and reinserted at a different angle. This procedure is repeated if needed until a small core, about 0.4 inches (1 cm) long, is separated from the bone marrow. The needle is again removed, and a piece of fine wire threaded through its tip transfers the specimen onto sterile gauze. The patient may feel discomfort or pressure when the needle is inserted and experience a brief, pulling sensation when the marrow is withdrawn. Unlike aspiration specimens, which are smeared, these samples contain structurally intact bone marrow. Microscopic examination can show what material its cells

contain and how they are alike or different from one another. The bone may either be embedded intact in paraffin (a type of wax), or be decalcified (a process which takes place overnight) for a different type of staining and examination. Each type of preparation has certain advantages.

Preparation

A current history and physical are obtained from the patient, along with proper consent. The patient is generally placed in a prone position (lying face down) for preparation, and local anesthetic, with or without **sedation**, is administered.

Aftercare

After the needle is removed, the biopsy site will be covered with a clean, dry bandage. Pressure is applied to control bleeding. The patient's pulse, breathing, blood pressure, and temperature are monitored until they return to normal, and the patient may be instructed to remain in a supine position (lying face up) for half an hour before getting dressed.

The patient should be able to leave the clinic and resume normal activities immediately. Patients who have received a sedative often feel sleepy for the rest of the day; driving, cooking, and other activities that require clear thinking and quick reactions should therefore be avoided.

The biopsy site should be kept covered and dry for several hours. Walking or taking prescribed **pain** medications usually ease any discomfort felt at the biopsy site, and ice can be used to reduce swelling.

A doctor should be notified if the patient:

- feels severe pain more than 24 hours after the procedure.
- experiences persistent bleeding or notices more than a few drops of blood on the wound dressing.
- has a temperature above 101°F (38.3°C). Inflammation and pus at the biopsy site and other signs of infection should also be reported to a doctor without delay

Risks

Bleeding and discomfort often occur at the biopsy site. Infection and hematoma may also develop. In rare instances, the heart or a major blood vessel is pierced when marrow is extracted from the sternum during bone marrow biopsy. This can lead to severe hemorrhage.

Normal results

Healthy adult bone marrow contains yellow fat cells, connective tissue, and red marrow that produces blood.

KEY TERMS

Aspiration—A procedure to withdraw fluid from the body.

Connective tissue—Material that links one part of the body with another.

Fibrosis—A condition characterized by the presence of scar tissue or fiber-containing tissues that replace normal tissues.

Hematologist—A medical specialist who treats diseases and disorders of the blood and blood-forming organs.

Hematoma—Blood that collects under the skin and causes swelling.

Hemorrhage—Heavy bleeding.

Myeloma—A tumor that originates in bone marrow and usually spreads to more than one bone.

Nurse practitioner—A registered nurse who is qualified to perform some specialized duties.

The bone marrow of a healthy infant is primarily red due to active production of red cells necessary for growth.

Abnormal results

Culture of bone marrow aspirate may yield information about an infectious agent. Microscopic examination of bone marrow can reveal granulomas, **myelofibrosis**, lymphomas, leukemias, or other cancers. Analyzing specimens can help doctors diagnose iron deficiency, vitamin B₁₂deficiency, and folate deficiency, as well as anemia.

Obesity can affect the ease with which a bone marrow biopsy can be done, and the results of either procedure can be affected if the patient has had **radiation therapy** at the biopsy site.

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ORGANIZATION

Leukemia Society of America. 600 Third Ave., New York, NY 10016. (800) 955-4572. <<http://www.leukemia.org>>.

National Cancer Institute Cancer Information Service. 9000 Rockville Pike, Bethesda, MD 20892. (800) 422-6237. <<http://cis.nci.nih.gov>>.

National Marrow Donor Program. 3433 Broadway St. NE, #400, Minneapolis, MN 55413. (800) 627-7692. <<http://www.marlow.org>>.

The Wellness Community. 35 E. Seventh St., Suite 412, Cincinnati, OH 45202. (888) 793-WELL. <<http://www.wellness-community.org>>.

OTHER

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Maureen Haggerty

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, defense against infection and disease, and clotting. 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 containing 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 may be 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 is 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. Illnesses 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**, **sickle 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. Most bone marrow transplants are autologous. 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

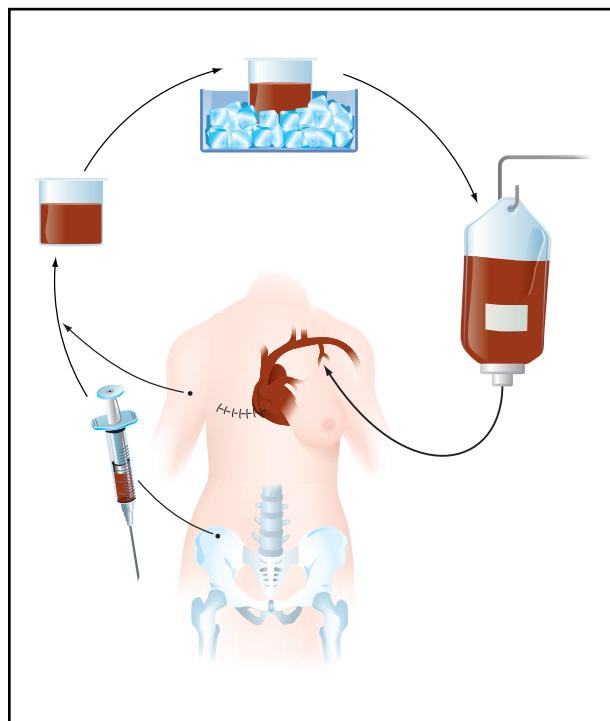
There are only five major HLA classes or types—designated HLA-A, -B, -C, -D, and class III—but much variation within the groupings. For example, HLA-A from one individual may be similar to, but not the same as, HLA-A in another individual; such a situation can render a transplant from one to the other 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.

Peripheral blood stem cell transplants

A relatively recent development in stem cell transplantation is the use of peripheral blood cells instead of stem cells from bone marrow. Peripheral blood stem cells (PBSCs) are obtained from circulating blood rather than from bone marrow, but the amount of stem cells found in the peripheral blood is much smaller than the amount of stem cells found in the bone marrow. Peripheral blood stem cells can be used in either autologous or allogeneic transplants. The majority of PBSC transplants are autologous. However, recent clinical studies indicate that PBSCs are being used more frequently than bone marrow for allogeneic bone marrow transplantation.

The advantages of PBSC transplants when compared to bone marrow transplants are: in allogeneic transplantation, haematopoietic and immune recovery are faster with PBSCs which reduces the potential for disease recurrence, primarily graft-versus-host-disease. In autologous transplantation, the use of PBSCs can result in faster **blood count** recoveries. Also, some medical conditions exist in which the recipient cannot accept bone marrow stem cell transplants, but can accept PBSC transplants. Some possible disadvantages to PBSC transplant versus bone marrow transplantation are: so much more fluid volume is necessary to collect enough PBSCs that, at the time of infusing the new stem cells into the recipient, the fluid can collect in the lungs or cause temporary kidney problems. Also, the time commitment for the donor for a PBSC transplant is considerable. When the PBSCs are



In autologous bone marrow transplantation, stem cells are collected from the patient. Once the patient has undergone chemotherapy, the cells are replaced in the blood via an intravenous catheter. The cells return to the bone marrow and begin producing healthy new cells. (Illustration by Argosy Inc.)

being collected, several outpatient sessions are needed and each session lasts approximately two–four hours.

The transplant procedure

BONE MARROW TRANSPLANTATION. The bone marrow extraction, or harvest, is the same whether for an autologous or allogeneic transplant. Harvesting 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 (0.9–1.9 l). (This amount is only a small percentage of the total bone marrow and is typically replaced within four 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.

KEY TERMS

ABO antigen—Protein molecules located on the surfaces of red blood cells that determine a person's blood type: A, B, or O.

AML—Acute myelogenous leukemia, also called acute myelocytic leukemia. Malignant disorder where myeloid blast cells accumulate in the marrow and bloodstream.

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

Anemia—Decreased red cell production which results in deficiency in oxygen-carrying capacity of the blood.

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.

Blank—If an individual has inherited same HLA antigen from both parents, the HLA typing is designated by the shared HLA antigen followed by a "blank" (–).

Blast cells—Blood cells in early stage of cellular development.

Blast crisis—Stage of chronic myelogenous leukemia where large quantities of immature cells are produced by the marrow and is not responsive to treatment.

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.

Bone marrow transplant—Healthy marrow is infused into people who have had high-dose chemotherapy for one of the many forms of leukemias, immunodeficiencies, lymphomas, anemias, metabolic disorders, and sometimes solid tumors.

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

Chronic myelogenous leukemia (CML)—Also called chronic myelocytic leukemia, malignant disorder that involves abnormal accumulation of white cells in the marrow and bloodstream.

Cytomegalovirus (CMV)—Virus that can cause pneumonia in post bone marrow transplant patients.

Conditioning—Process of preparing patient to receive marrow donation, often through the use of chemotherapy and radiation therapy.

Confirmatory typing—Repeat tissue typing to confirm the compatibility of the donor and patient before transplant.

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.

Histocompatibility—The major histocompatibility determinants are the human leukocyte antigens

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.

PERIPHERAL BLOOD STEM CELL TRANSPLANTATION. Before collection for a PBSC transplant, donors receive daily four injections of the drug G-CSF, or filgrastim. (Patients can give it to themselves at home if need be.) These pretreatments stimulate the body to release stem cells into the blood. After these pretreatments, the

donors' experience is similar to that of a whole blood donor's experience—PBSC donors' blood is collected at a clinic or hospital as an outpatient procedure. The differences are that several sessions will be needed over days or weeks and the blood is collected in a process called apheresis. The blood travels from one arm into a blood cell separator that removes only the stem cells, and the rest of the blood is returned back to the donor, in the other arm. The cells are then frozen for later use.

The PBSCs are administered to the recipient using the same methods as those used in bone marrow transplantation. As stated, the amount of fluid with PBSCs infused into the recipient's body can be an issue.

KEY TERMS

(HLA) and characterize how well the patient and donor are matched.

HLA (human leukocyte 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 (lymphocyte/leukocyte) multiply uncontrollably.

Match—How similar the HLA typing, out of a possible six antigens, is between the donor and the recipient.

Mixed lymphocyte culture (MLC)—Test that measures level of reactivity between donor and recipient lymphocytes.

Neuroblastoma—Solid tumor in children, may be treated by BMT.

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.

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.

mal 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.

Preparation

A bone marrow transplant recipient can expect to spend four to eight weeks in the hospital. In preparation for receiving the transplant, the recipient undergoes "conditioning"—a preparative regimen in which the bone marrow and abnor-

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, improve quality of life, and may aid in curing the underlying ailment.

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ORGANIZATIONS

- American Society for Blood and Marrow Transplantation (ASBMT)* 85 W. Algonquin Road, Suite 550 Arlington Heights, IL 60005. (847) 427-0224. mail@asbmt.org. Founded in 1990, a national professional association that promotes advancement of the field of blood and bone marrow transplantation in clinical practice and research.
- Blood & Marrow Transplant Newsletter* (Formerly BMT Newsletter). 2900 Skokie Valley Road, Suite B, Highland Park, IL 60035 (847) 433-3313. 1-888-597-7674. help@bmtinfonet.org. <<http://www2.bmtnews.org>>. Blood & Marrow Transplant Newsletter is a not-for-profit organization that provides publications and support services to bone marrow, peripheral blood stem cell, and cord blood transplant patients and survivors.
- International Bone Marrow Transplant Registry/Autologous Blood and Marrow Transplant Registry N. America*, Health Policy Institute, Medical College of Wisconsin, 8701 Watertown Plank Road, P.O. Box 26509, Milwaukee, WI 53226 USA, 414-456-8325, ibmtr@mcw.edu. Voluntary organizations of more than 400 institutions in 47 countries that submit data on their allogeneic and autologous blood and marrow transplant recipients to the IBMTR/ABMTR Statistical Center at the Medical College of Wisconsin in Milwaukee.
- Health Resources and Services Administration*. 5600 Fishers Lane, Rm. 14-45, Rockville, MD 20857, 301-443-3376, comments@hrsa.gov. <<http://www.hrsa.gov>>. HRSA manages contracts for the Organ Procurement and Transplantation Network, Scientific Registry of Transplant Recipients and National Marrow Donor Program and provides public education and technical assistance to increase

donation. HRSA also monitors the performance of the nation's transplant centers and provides potential transplant recipients with survival rates and other vital information.

Leukemia & Lymphoma Society, Inc. 1311 Mamaroneck Avenue White Plains, NY 10605, 914-949-5213 <<http://www.leukemia-lymphoma.org>>. National voluntary health agency dedicated to curing leukemia, lymphoma, Hodgkin's disease and myeloma, and to improving the quality of life of patients and their families.

National Marrow Donor Program. Suite 500, 3001 Broadway Street Northeast, Minneapolis, MN 55413-1753. (800) MARROW-2. <<http://www.marlow.org>>. Founded in 1986, The National Marrow Donor Program (NMDP) is a non-profit international leader in the facilitation of unrelated marrow and blood stem cell transplantation.

BMT Information <<http://www.bmtinfo.org>>. Web site, sponsored by a variety of other bone marrow transplant organizations, lists basic information and resources about bone marrow transplants.

National Organ and Tissue Donation Initiative <<http://www.organdonor.gov>>. Created by Health Resources and Services Administration (HRSA) Department of Health and Human Services (DHHS) <<http://www.os.dhhs.gov>>. Provides information and resources on organ donation and transplantation issues.

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Laura Ruth, Ph.D.

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** that 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 breastfeeding 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

KEY TERMS

Radioisotope—A radioactive, or radiation-emitting form, of an element.

Radionuclide—A substance which emits radiation as it disintegrates.

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.

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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 shielded with lead aprons as much as possible. Women of childbearing age who could be pregnant should not have x rays of their trunk or pelvic regions. The fetus is espe-

cially at risk during the first trimester of **pregnancy**. Women who are pregnant should not have x rays of their pelvic region, lumbar spine, and abdomen unless absolutely necessary. If other types of x rays are necessary, a lead apron should be used to shield the abdominal and pelvic regions.

Description

X rays are a common diagnostic test in which a form of energy called x-ray radiation penetrates the patient's body. In bone x rays, electrical current passes through an x-ray tube and produces a beam of ionizing radiation that passes through the bone(s) being examined. This produces a picture of the inside of the body on film. The physician reads the developed x ray on a wall-mounted light box.

Digital x rays are a new type of x ray in which conventional equipment is used to take the x ray but the image is produced via computer. In a digital x ray, the image is created on a reusable plate. After being read by a laser reader, the information is sent in digital form to a storage unit connected to a computer network from which the radiologist reads the x ray. An electronic report can then be sent to the patient's physician.

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 that 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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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.

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Lori De Milton

Borderline personality disorder see

Personality disorders

Bordetella pertussis infection see **Whooping cough**

Borrelia burgdorferi infection see **Lyme disease**

Botanical medicine see **Herbalism, western**

Botox injections see **Botulinum toxin injections**

Botulinum toxin injections

Definition

Botulinum is a bacterium (*Clostridium botulinum*) that produces seven different toxins that can cause **botulism** and is also medically used to block muscle contractions.

Purpose

Botulinum toxin (Botox) injection is used in conditions of excessive and inappropriate muscle contraction, hyperhidrosis (excess sweating) in armpits and palms, spasticity (persistent states of muscle contraction), sphincter contraction, eye-movement disorders, tics and **tremors**, and cosmetically to treat facial lines and wrinkles.

Botox has also been explored in the treatment of chronic muscle tension and migraine headaches. The relief is likely due to the decrease in localized muscle spasms, as no direct effect of Botox on the sensory nerves has been established.

Precautions

Botulinum toxin is produced from the bacterium that causes **food poisoning** in humans. High doses of the toxin can be fatal; however, doses administered therapeutically are so small that harmful effects are uncommon.

Description

The number of potential applications for botulinum toxin extends to every muscle group. The first therapeutic use of Botox was in the treatment of **strabismus** (eyes are unable to direct towards the same object) and since then it has been used to treat a variety of involuntary muscle contractions or disorders. Its cosmetic use is the result of treatment for facial spasms where smoothing of facial lines was reported by patients. In general, 90% of injections for facial spasms are resolved satisfactorily.

Toxin type A has a duration of effect that lasts approximately three months and is the therapeutic agent of choice for most conditions.

Preparation

The dosage of Botox must be monitored and adjusted, with multiple injections showing a lower incidence of complications versus administration by one larger dose.

Risks

In over 30 years of therapeutic use in humans, botulinum toxin has proven to be remarkably safe. Difficult-

KEY TERMS

- Antibodies**—A protein developed in response to the presence of a foreign substance.
- Immunoresistance**—The presence of circulating antibodies.
- Neuromuscular junction**—Interface between motor nerve ending and muscle tissue.
- Serotype**—Microorganisms differing in the type of surface antigens.
- Antigen**—A foreign substance inducing an antibody response within the body.

ties associated with administration of toxin are: different patients may experience different effects at the same dose, patients new to the treatment may experience exaggerated effects at subsequent visits and/or neighboring muscles may become activated at subsequent treatments.

Additional side effects may include excessive muscle weakness at the injection site or adjacent muscles. These effects typically resolve quickly. Occasionally, patients report flu-like symptoms but they are usually self-limited.

A certain percentage of patients may also experience resistance to the toxin. The presence of circulating antibodies to the toxin is presumed to be the primary reason for resistance to Botox injections. Patients who have little reaction to Botox 'A' may benefit from injections using one of the other six serotypes. Using the smallest effective dose limits the likelihood of immunoresistance in unresponsive patients.

Normal results

The anticipated outcome of Botox injections is relaxation of the target muscle tissue. The pharmacological effects of botulinum toxin are typically isolated to local areas and do not result in tissue destruction or prolonged **paralysis**. Varying the dose can deliver a precise amount of toxin to achieve graded degrees of paralysis for the desired level of response.

Resources

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Botulism

Definition

Botulism is caused by botulinum toxin, a natural 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, Justinus Kerner, 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.

Three types of botulism have been identified: food-borne, wound, and infant botulism. The main difference between types hinges on the route of exposure to the toxin. In the United States, there are approximately 110 cases of botulism reported annually. Food-borne botulism accounts for 25% of all botulism cases and can be traced to eating contaminated home-preserved food. Infant botulism accounts for 72% of all cases, but the recovery rate is good (about 98%) with proper treatment.

Though domestic **food poisoning** is a problem world-wide, there has been a growing concern regarding the use of botulism toxin in biological warfare and terror-

ist acts. The Iraqi government admitted in 1995 that it had loaded 11,200 liters of botulinum toxin into SCUD missiles during the Gulf War. Luckily, these special missiles were never used. As of 1999, there were 17 countries known to be developing biological weapons, including the culture of botulism toxins.

Causes and symptoms

Causes

Toxin produced by the bacterium *Clostridium botulinum* is the main culprit in botulism. Other members of the *clostridium* genus can produce botulinum toxin, namely *C. argentinense*, *C. butyricum*, and *C. baratii*, but they are minor sources. To grow, these bacteria require a low-acid, oxygen-free environment that is warm (40–120°F or 4.4–48.8°C) and moist. Lacking these conditions, the bacteria transform themselves into spores that, like plant seeds, can remain dormant for years. Clostridia and their spores exist all over the world, especially in soil and aquatic sediments. They do not threaten human or animal health until the spores encounter an environment that favors growth. The spores then germinate, and the growing bacteria produce the deadly botulism toxin.

Scientists have discovered that clostridia can produce at least seven types of botulism toxin, identified as A, B, C, D, E, F, and G. Humans are usually affected by A, B, E, and very rarely F. Domesticated animals such as dogs, cattle, and mink are affected by botulism C toxin, which also affects birds and has caused massive die-offs in domestic bird flocks and wild waterfowl. Botulism D toxin can cause illness in cattle, and horses succumb to botulism A, B, and C toxin. There have been no confirmed human or animal botulism cases linked to the G toxin.

In humans, botulinum toxin latches onto specific proteins in nerve endings and irreversibly destroys them. These proteins control the release of acetylcholine, a neurotransmitter that stimulates muscle cells. With acetylcholine release blocked, nerves are not able to stimulate muscles. Ironically, botulinum toxin has found a beneficial niche in the world of medicine due to this action. Certain medical disorders are characterized by involuntary and uncontrollable muscle contractions. Medical researchers have discovered that injecting a strictly controlled dose of botulinum toxin into affected muscles inhibits excessive muscle contractions. The muscle is partially paralyzed and normal movement is retained.

Symptoms

The three types of human botulism include the following symptoms:

- Food-borne. Food that has been improperly preserved or stored can harbor botulinum toxin-producing clostridia. Botulism symptoms typically appear within 18–36 hours of eating contaminated food, with extremes of four hours to eight days. Initial symptoms include blurred or double vision and difficulty swallowing and speaking. Possible gastrointestinal problems include **constipation**, nausea, and vomiting. As botulism progresses, the victim experiences weakness or paralysis, starting with the head muscles and progressing down the body. Breathing becomes increasingly difficult. Without medical care, **respiratory failure** and **death** are very likely.
- Infant. Infant botulism was first described in 1976. Unlike adults, infants younger than 12 months are vulnerable to *C. botulinum* colonizing the intestine. Infants ingest spores in honey or simply by swallowing spore-containing dust. The spores germinate in the large intestine and, as the bacteria grow, they produce botulinum toxin that is absorbed into the infant's body. The first symptoms include constipation, lethargy, and poor feeding. As infant botulism progresses, sucking and swallowing (thus eating) become difficult. A nursing mother will often notice breast engorgement as the first sign of her infant's illness. The baby suffers overall weakness and cannot control head movements. Because of the flaccid paralysis of the muscles, the baby appears "floppy." Breathing is impaired, and death from respiratory failure is a very real danger.
- Wound. Confirmed cases of wound botulism have been linked to trauma such as severe crush injuries to the extremities, surgery, and illegal drug use. Wound botulism occurs when clostridia colonize an infected wound and produce botulinum toxin. The symptoms usually appear four to 18 days after an injury occurs and are similar to food-borne botulism, although gastrointestinal symptoms may be absent.

Diagnosis

Diagnosis of botulism can be tricky because symptoms mimic those presented by other diseases. Botulism may be confused with Guillain-Barre syndrome, **myasthenia gravis**, drug reactions, **stroke**, or nervous system infection, intoxications (e.g. carbon monoxide or atropine), or shellfish **poisoning**. **Sepsis** is the most common initial diagnosis for infant botulism. **Failure to thrive** may also be suspected. Some reports have linked infant botulism to 5–15% of **sudden infant death syndrome** (SIDS, crib death) cases. Laboratory tests are used for definitive diagnosis, but if botulism seems likely, treatment starts immediately.

While waiting for laboratory results, doctors ask about recently consumed food and work to dismiss other

KEY TERMS

Acetylcholine—A chemical released by nerve cells to signal other cells.

Antitoxin—A substance that inactivates a poison (e.g., toxin) and protects the body from being injured by it.

CT scan—The abbreviated term for computed or computerized axial tomography. The test involves injecting a radioactive substance into the body. Computers are used to scan for radiation and create three-dimensional images of internal organs.

Electromyographic test—A medical test which determines if a muscle's response to electrical stimuli. The test results allow medical personnel to assess how nerves to the muscle are functioning.

Flaccid paralysis—Paralysis characterized by limp, unresponsive muscles.

Lumbar puncture—A procedure in which a small amount of cerebrospinal fluid is removed from the lower spine. Examination of this fluid helps diagnose certain illnesses.

MRI—The abbreviated term for magnetic resonance imaging. MRI uses a large circular magnet and radio waves to generate signals from atoms in the body. These signals are used to construct images of internal structures.

Neurotransmitter—A chemical found in nerves which relays nerve signals to other cells. Acetylcholine is a neurotransmitter.

Sepsis—The presence of infection-causing organisms or associated toxins in the blood or within body tissues.

Spores—A state of “suspended animation” that some bacteria can adopt when conditions are not ideal for growth. Spores are analogous to plant seeds and can germinate into growing bacteria when conditions are right.

Toxin—A poisonous substance produced by a microorganism, plant, or animal.

Tracheostomy—The procedure used to open a hole in the neck to the trachea, or windpipe. It is sometimes used in conjunction with a respirator.

disease possibilities. A **physical examination** is done with an emphasis on the nervous system. As part of this examination, CT scans, MRIs, electromyographic tests, or lumbar punctures may be ordered. Laboratory tests involve testing a suspected food and/or the patient's serum, feces, or other specimens for traces of botulinum toxin or clostridia.

Treatment

Drugs

Adults with botulism are treated with an antitoxin derived from horse serum that is distributed by the Centers for Disease Control and Prevention. The antitoxin (effective against toxin types A, B, and E) inactivates only the botulinum toxin that is unattached to nerve endings. Early injection of antitoxin (usually within 24 hours of onset of symptoms) can preserve nerve endings, prevent progression of the disease, and reduce mortality.

Infants, however, cannot receive the antitoxin used for adults. For them, human botulism immune globulin (BIG) is available in the United States through the Infant Botulism Treatment and Prevention Program in Berkeley, California. BIG neutralizes toxin types A, B, C, D, and E

before they can bind to nerves. This antitoxin can provide protection against A and B toxins for approximately four months. Though many infants recover with supportive care, BIG cuts hospital stay in half, and therefore reduces hospital costs by 50% as well.

Aside from antitoxin, no drugs are used to treat botulism. **Antibiotics** are not effective for preventing or treating botulism. In fact, antibiotic use is discouraged for infants because dying bacteria could potentially release more toxin into a baby's system. Antibiotics can be used, however, to treat secondary respiratory tract and other infections.

Respiratory support

Treatment for infants usually involves intensive respiratory support and tube feeding for weeks or even months. Once an infant can breathe unaided, physical therapy is initiated to help the child relearn how to suck and swallow. A respirator is often required to help adult patients breathe, and a tracheostomy may also be necessary.

Surgery

Surgery may be necessary to clean an infected wound and remove the source of the bacteria that is producing the toxin. Antimicrobial therapy may be necessary.

Gastric lavage

When botulism is caused by food, it often is necessary to flush the gastrointestinal tract (gastric lavage). Often cathartic agents or **enemas** are used. It is important to avoid products that contain magnesium, since magnesium enhances the effect of the toxin.

Prognosis

With medical intervention, botulism victims can recover completely, albeit slowly. It takes weeks to months to recover from botulism, and severe cases can take years before a total recovery is attained. Recovery depends on the nerve endings building new proteins to replace those destroyed by botulinum toxin.

Prevention

Vaccines against botulism do not exist to prevent infant botulism or other forms of the disease. Food safety is the surest prevention for botulism. Botulinum toxin cannot be seen, smelled, or tasted, so the wisest course is to discard any food that seems spoiled *without tasting it*. Home canners must be diligent about using sterile equipment and following U.S. Department of Agriculture canning guidelines. If any part of a canned food container is rusty or bulging, the food should not be eaten. Infant botulism is difficult to prevent, because controlling what goes into an infant's mouth is often beyond control, especially in regard to spores in the air. One concrete preventative is to never feed honey to infants younger than 12 months since it is one known source of botulism spores. As infants begin eating solid foods, the same food precautions should be followed as for adults.

Resources

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Janie Franz

Bovine spongiform encephalopathy see
Creutzfeldt-Jakob disease

Bowel incontinence see **Fecal incontinence**

Bowel preparation

Definition

Bowel preparation is a procedure usually undertaken before a diagnosis and /or treatment can be initiated for certain colon and rectum diseases. Bowel preparation is a cleansing of the intestines from fecal matter and secretions.

Purpose

The ultimate goal of bowel preparation is priming the bowel for a diagnosis procedure (using x rays to detect a disease process in the intestines) or for surgical intervention (such as removal of polyps, **cancer**, or narrowing of the intestinal diameter). **Colonoscopy** is an effective treatment procedure for polyps (a growing mass of tissue). This procedure enables visualization of the entire large bowel. During a colonoscopy, polyps can be cauterized (applying an electric current which incinerates the polyp). The procedure can be both diagnostic and therapeutic. A **sigmoidoscopy** scope is a flexible tube that allows clinicians to view the sigmoid colon (the part of the large intestine before the rectum). This procedure is important for detection of colon/rectal cancer. It is safe, quick to perform (usually 30–45 minutes in about 90% of cases), and an effective diagnostic tool for evaluation of:

- rectal bleeding
- other studies that showed an abnormality
- removal of polyps
- biopsy
- evaluation of chronic **diarrhea** or inflammatory bowel disease
- to detect recurrences for colon/rectal cancer or polyps
- relieving a twisted bowel
- foreign body removal
- treating bleeding lesions
- preventive surveillance of cancer in patients with a positive family history of colon cancer

Precautions

Antibiotic **prophylaxis** is not routinely recommended. In some cases of prosthetic heart valves, **antibiotics** can be prescribed. Evidence exists that evacuation of intestinal waste products in conjunction with antibiotics

before (prophylactic) the procedure reduces the possibility of **sepsis** (infection which spreads from the primary site to blood).

Description

The bowel is emptied of any contents for procedures such as **barium enema** (introducing a barium containing chemical to promote better visualization of intestines during x rays) or colonoscopy. Preparation of the bowel distally—from the rectum—is necessary for diagnostic procedures such as sigmoidoscopy. Prior to surgical procedures bowel preparation is recommended to decrease the possibility of developing more medical problems. Patients may also be given a course of antibiotics to prevent the possibility of infection.

Preparation

Bowel preparation for visualization of the colon is performed to ensure the procedure will be accurate and complete. There are several effective cleansing preparations that include: Polyethylene glycol solution, Magnesium citrate with bisacodyl tablets, and Castor oil with bisacodyl tablets. One of these preparations should be administered starting at 4:00 P.M. the day before the procedure.

Aftercare

After the preparation has been ingested the patient is advised to only ingest clear liquids until midnight.

Risks

The current standard of care dictates that patients receive antibiotic prophylaxis if they are high risk for developing an infection. High-risk patients include those with cardiac diseases or patients who have a prostheses.

Normal results

Absence of anatomical changes or abnormalities in the intestines would result in normal diagnosis.

Abnormal results

Polyps can be treated with electrocautery. A biopsy is taken of any suspicious polyps and further analyzed. Sigmoidoscopy can detect masses, bleeding, and ulcerative disease.

Resources

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KEY TERMS

Lesion—An abnormal change in tissues.

Polyp—A growing mass of tissue.

PERIODICALS

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ORGANIZATIONS

American College of Gastroenterology. 4900 B South 31st Street, Arlington, VA 22206. (703) 820-7400. <http://www.acg.gi.org/ct_html>.

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Bowel resection

Definition

A bowel resection is a surgical procedure in which a part of the large or small intestine is removed.

Purpose

Bowel resection may be performed to treat various disorders of the intestine, including **cancer**, obstruction, inflammatory bowel disease, ruptured diverticulum, **ischemia** (compromised blood supply), or traumatic injury.

Description

The preferred type of bowel resection involves removal of the diseased portion of intestine, and surgically re-joining the remaining ends. In this procedure, the continuity of the bowel is maintained and normal passage of stool is preserved. When deemed necessary by the surgeon, the diseased portion of the bowel may be removed, and the functioning end of the intestine may be brought out onto the surface of the abdomen, forming a temporary or permanent **ostomy**. Use of the large intestine to form the ostomy results in a **colostomy**; use of small intestine to form the ostomy results in an **ileostomy**.

Preparation

As with any surgical procedure, the patient will be required to sign a consent form after the procedure is

KEY TERMS

Diverticulum—Small tubes or pouches that project off the wall of the intestine, visible as opaque on an x ray after the patient has swallowed a contrast (dye) substance.

Embolism—Blockage of a blood vessel by any small piece of material traveling in the blood. The emboli may be caused by germs, air, blood clots, or fat.

Ischemia—A compromise in blood supply to body tissues that causes tissue damage or death.

Ostomy—A surgically-created opening in the abdomen for elimination of waste products (urine or stool).

explained thoroughly. Blood and urine studies, along with various x rays and an electrocardiogram (EKG) may be ordered as the doctor deems necessary. In order to empty and cleanse the bowel, the patient may be placed on a low residue diet for several days prior to surgery. A liquid diet may be ordered for at least the day before surgery, with nothing taken by mouth after midnight. A series of **enemas** and/or oral preparations (GoLyteLy or Colyte), may be ordered to empty the bowel of stool. Oral anti-infectives (neomycin, erythromycin, or kanamycin sulfate) may be ordered to decrease bacteria in the intestine and help prevent post-operative infection. A nasogastric tube is inserted through the nose into the stomach on the day of surgery or during surgery. This removes the gastric secretions and prevents **nausea and vomiting**. A urinary catheter (thin tube inserted into the bladder) may also be inserted to keep the bladder empty during surgery, giving more space in the surgical field and decreasing chances of accidental injury.

Aftercare

Post-operative care for the patient who has had a bowel resection, as with those who have had any major surgery, involves monitoring of blood pressure, pulse, respirations, and temperature. Breathing tends to be shallow because of the effect of anesthesia and the patient's reluctance to breathe deeply and experience **pain** that is caused by the abdominal incision. The patient is instructed how to support the operative site during deep breathing and coughing, and is given pain medication as necessary. Fluid intake and output is measured, and the operative site is observed for color and amount of wound drainage. The nasogastric tube will remain in place,

attached to low intermittent suction until bowel activity resumes. Fluids and electrolytes are infused intravenously until the patient's diet can gradually be resumed, beginning with liquids and advancing to a regular diet as tolerated. The patient is generally out of bed approximately eight to 24 hours after surgery. Postoperative weight loss follows almost all bowel resections. Weight and strength are slowly regained over a period of months.

Risks

Potential complications of this abdominal surgery include:

- excessive bleeding
- surgical wound infection
- incisional **hernia** (An organ projects through the muscle wall that surrounds it. The hernia occurs through the surgical scar.)
- thrombophlebitis (inflammation and blood clot to veins in the legs)
- pneumonia
- pulmonary **embolism** (blood clot or air bubble in the lungs' blood supply)

Normal results

Complete healing is expected without complications after bowel resection. The period of time required for recovery from the surgery may vary depending of the patient's overall health status prior to surgery.

Abnormal results

The doctor should be made aware of any of the following problems after surgery:

- increased pain, swelling, redness, drainage, or bleeding in the surgical area
- headache, muscle aches, **dizziness**, fever
- increased abdominal pain or swelling, **constipation**, nausea or vomiting, rectal bleeding, or black, tarry stools

Resources

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ORGANIZATIONS

United Ostomy Association, Inc. (UOA). 19772 MacArthur Blvd., Suite 200, Irvine, CA 92612-2405. (800) 826-0826.
[<http://www.uo.org>](http://www.uo.org).

Wound Ostomy and Continence Nurses Society. 1550 South Coast Highway, Suite #201, Laguna Beach, CA 92651. (888) 224-WOCN. Fax: (949) 376-3456.
[<http://www.wocn.org>](http://www.wocn.org).

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Bowel surgery with ostomy see **Colostomy**

Bowel training

Definition

Bowel training helps to reestablish normal bowel movements in persons who suffer from **constipation**, **diarrhea**, incontinence, or irregularity. Healthy bowel activity is considered one or two movements of moderate size every day.

Purpose

Many people for many reasons have irregular bowel function. In some cases, the irregularity lasts beyond the condition that caused it. The bowels by themselves develop bad habits that can be retrained with suitable exercises and education. Normal bowel habits not only improve the quality of life, they help prevent several common diseases—for example, diverticulitis and fecal impaction. Gall stones, **appendicitis**, **colon cancer**, **hiatal hernia**, diabetes, and heart disease have also been related to the quality of bowel movements and the foods that affect them.

- One of the most common causes of constipation is the laxative habit. Repeated artificial stimulation of the bowels destroys their natural emptying reflex, so that they will no longer move without artificial stimulants. The laxative habit begins innocently enough with the correct belief that bowels should move every day, however, **laxatives** will cause the evacuation of several days worth of stool in a single movement. Impatient for stool to reaccumulate for the necessary few days, the patient takes another laxative, and the cycle begins.
- The other major cause of constipation is a diet with insufficient bulk or roughage. The bowel works more smoothly the more contents it has. Western **diets** of highly refined foods have eliminated most of the residue from food. The result is that most food is absorbed, leaving little to pass through and be excreted as feces.
- Constipation occurs acutely with impaction—the presence in the rectum of a mass of feces too large to pass.

Fecal impaction is usually the result of poor bowel habits, a diet with too little liquid and roughage, and inadequate physical activity.

- Diarrhea, whether acute or chronic, can disrupt the bowel's normal rhythm and lead to irregularity.
- Several diseases of the nervous system affect bowel reflexes.

Description

Bowel training reestablishes the bowel's normal reflexes by repeating a routine until it becomes a habit. Naturally the patient must be able and willing to cooperate. Some patients are so convinced they need daily laxatives that they are afraid to do without them. It takes time for a changed diet to effect the bowels and for the bowel to regain its normal rhythm. Trust and patience are necessary.

After gaining the patient's cooperation, the next step is to optimize the diet. Healthy bowel movements require ingestion of a large amount of liquids and bulk foods. The patient should drink two to three quarts of liquids every day, with liberal inclusion of prune juice and perhaps coffee for their natural laxative effect. Bulk comes from unrefined foods. Oat bran, wheat bran, brown rice, green vegetables, apples, and pears are a few examples of high residue foods. Many patients will benefit from adding bulk preparations of psyllium. Constipating foods like bananas and cheese should be avoided until a natural rhythm is well established.

To assure that stools are soft enough to pass easily, it is a good idea to add a pure stool softener like DOSS (dioctyl sodium sulfosuccinate), two to four per day as needed. DOSS also helps prevent impaction.

There is usually a time of day when bowel movements are more likely to occur. In anticipation of this time, the patient should participate in activities that stimulate a normal bowel movement. Walking, eating unrefined foods, and drinking prune juice or coffee, encourage natural evacuation. It is acceptable to use lubricants such as glycerine suppositories or oil **enemas** at this time. For severe constipation, water enemas may be needed to initiate a movement.

It is also important for the patient to recognize the urge to defecate and to respond right away to that urge. The longer stool sits in the rectum, the more water the rectum will absorb from it, making it harder and more difficult to pass.

Normal results

With patience and diligence, normal bowel habits and the health that comes with them will return in most patients.

KEY TERMS

Defecate—To pass feces (stool) out of the rectum through the anus.

Diverticulitis—Infection of outpouchings in the large bowel.

Fecal impaction—Obstruction of the rectum by a large mass of feces (stool).

Hiatal hernia—Part of the stomach displaced through the diaphragm into the chest.

Resources

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Braces see **Immobilization**

Brachytherapy see **Radioactive implants**

Causes and symptoms

One-half of all brain abscesses are caused by the spread of bacteria from a nearby infection. Sources of bacteria include:

- middle ear infections (**otitis media**) or infections in the bony spaces in front of the middle ear (**mastoiditis**)

- sinus infections

- an abscessed tooth.

Other sources of bacteria include:

- lung infections

- abdominal infection

- infection of the heart’s lining (**endocarditis**)

- penetrating head **wounds**

- neurosurgery

Acquired Immune Deficiency Syndrome (**AIDS**) or the presence of another immune deficiency greatly increases the risk of brain abscess. Approximately 25% of cases have no detectable cause of infection.

Brain abscess can be caused by a variety of organisms, many of them related to ear and sinus infections. Many times brain abscess cases are caused by two or more bacteria. In 30–60% of cases, the bacteria combination includes streptococci, microorganisms that can live without oxygen (anaerobes), and enterobacteria. A small number of cases are caused by yeast, fungi, and single-cell organisms (protozoa).

The symptoms of brain abscess often develop slowly, usually within a period of about two weeks. The most common symptoms are:

- headache
- neurologic symptoms related to the specific part of the brain that is infected
- altered mental status
- seizures

Fever and stiff neck occur in less than one-third of cases. Additional symptoms may include vomiting, eye tremor (**nystagmus**), poor balance, and uncoordinated movements.

Diagnosis

Diagnosis of brain abscess is performed by using a computed tomography scan (CT) or a **magnetic resonance imaging** (MRI) scan to determine the site of infection. Tissue removal (biopsy) is usually performed as well. A biopsy is performed to determine the type of bacterium involved. Biopsies can also be used to rule out

Brain abscess

Definition

Brain **abscess** is a bacterial infection within the brain.

Description

The brain is usually well insulated from infection by bacteria, protected by the skull, the meninges (tissue layers surrounding the brain), the immune system, and the highly regulated barrier between the bloodstream and the brain. Under certain circumstances, however, bacteria can invade the brain and cause a localized infection called an abscess. Brain abscess is relatively rare, accounting for 1 in 10,000 hospital admissions. Single abscess occurs in 75% of cases, and the remainder of cases involve multiple abscesses. If not treated, brain abscess is almost always fatal.

tumor or other noninfectious localized lesions, which may look the same on the scans.

Other tests are performed to determine the source of the infection. These tests include blood cultures, x rays of the chest, and a physical exam of the ears, sinuses, and teeth. A test for human **immunodeficiency** virus (HIV) is usually also performed.

Treatment

Treatment for brain abscess begins with intravenous **antibiotics**, chosen to match the infecting bacterium if known, or to cover a wide spectrum of possibilities if not. Treatment usually continues for six to eight weeks.

Aspiration surgery is almost always done to drain the abscess. In this procedure, a needle is guided to the infected site by CT scan, and fluid is removed (aspirated) from the abscess. Aspiration may be repeated several times until the bacteria are completely killed or removed. Surgical removal of infected or dead tissue may be needed in some cases. For patients with many sites of infection, aspiration or surgical removal is not done because of the increased difficulty and risk of the procedure. For these patients, antibiotic therapy alone is used. Steroid treatment is controversial, but may be indicated in some cases.

Prognosis

Even with prompt treatment, brain abscess is fatal in about 20% of cases. About half of those who survive have some residual neurological problems, including seizures in many patients.

There are several reasons why patients with brain abscess can have a poor prognosis. The illness may not be diagnosed correctly or an accurate diagnosis may take additional time. The patient may receive an antibiotic that does not match the infecting organism. Sometimes the infection may not be limited to a definite area in the brain, making diagnosis and treatment difficult. The small number of cases caused by fungal infection may take additional time to diagnose. A patient may also have a poor prognosis because there is more than one abscess, the location of the abscess may be deep within the brain, or the infection may have moved into many locations within the brain. Severe complications can result from brain abscess, including coma and brain rupture. In 80–100% of cases involving brain rupture, the patient dies.

Prevention

Brain abscess may be preventable by prompt and aggressive treatment of the infections which give rise to it, especially sinus and ear infections.

KEY TERMS

Biopsy—The removal of a tissue sample for examination.

Aspiration—Removal of fluid from a closed space through a needle.

Resources

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Richard Robinson

Brain aneurysm see **Cerebral aneurysm**

Brain biopsy

Definition

A brain biopsy is the removal of a small piece of brain tissue for the diagnosis of abnormalities of the brain, such as **Alzheimer's disease**, tumors, infection, or inflammation.

Purpose

By examining the tissue sample under a microscope, the biopsy sample provides doctors with the information necessary to guide diagnosis and treatment.

Precautions

Imaging of the brain is performed to determine the precise positioning of the needle to enter the brain.

Description

When an abnormality of the brain is suspected, Stereotactic (probing in three dimensions) brain needle biopsy is performed and guided precisely by a computer system to avoid serious complications. A small hole is

KEY TERMS

Alzheimer's disease—A progressive, neurodegenerative disease characterized by loss of function and death of nerve cells in several areas of the brain, leading to loss of mental functions such as memory and learning.

Computed axial tomography (CT)—Computed axial tomography (CT) is a x-ray technique that has the ability to image soft tissue, bone, and blood vessels.

Cortex—The thin convoluted surface of the brain comprised primarily of cell bodies of neurons.

MRI—Magnetic resonance imaging is an imaging technique that uses radiowaves, magnetic fields, and computer analysis to visualize body tissue and structures.

Stereotactic brain needle biopsy—In this procedure a computer uses information from a CT or MRI to create a three-dimensional map of the operation site to better guide the needle to perform the biopsy.

drilled into the skull, and a needle is inserted into the brain tissue guided by computer-assisted imaging techniques (CT or MRI scans). Historically, the patient's head was held in a rigid frame to direct the probe into the brain; however since the early nineties, it has been possible to perform these biopsies without the frame. Since the frame was attached to the skull with screws, this advancement is less invasive and better tolerated by the patient. The doctor (pathologist) prepares the sample for analysis and studies it further under a microscope.

Preparation

A CT or MRI brain scan is done to find the position where the biopsy will be performed. Prior to the biopsy, the patient is placed under general anesthesia.

Aftercare

The patient is monitored in the recovery room for several hours and is usually required to spend a few days in the hospital since general anesthesia is required.

Risks

The procedure is invasive and includes risks associated with anesthesia and surgery. Brain injury may occur

due to removal of brain tissue. The resulting scar, left on the brain has the potential to trigger seizures.

Normal results

After examining the brain tissue directly, no abnormalities are detected.

Abnormal results

Various brain abnormalities can be diagnosed by microscopic analysis of the tissue sample. The pathologist (a physician trained in how disease affects the body's tissues) looks for abnormal growth, changes in cell membranes, and/or abnormal collections of cells. In Alzheimer's disease, the cortex of the brain contains abnormal collections of plaques. If infection is suspected, the infectious organism can be cultured from the tissue and identified. Classification of tumors is also possible after biopsy.

Resources

BOOKS

Zaret, B. L. *The Yale University School of Medicine Patient's Guide to Medical Tests*. Yale University School of Medicine and G.S. Sharpe Communications Inc., 1997.

ORGANIZATIONS

Alzheimer's Association. 919 North Michigan Avenue, Suite 1100 Chicago, IL 60611-1676. (800) 272-3900 <<http://www.alz.org/chapter/>>.

American Brain Tumor Association. 2720 River Road, Suite 146, Des Plaines, IL 60018-4110. (800) 886-2282. <<http://www.abta.org>>.

National Institute of Neurological Disorders and Stroke, NIH
Neurological Institute. P.O. Box 5801 Bethesda, MD 20824. (800) 352-9424. <<http://www.ninds.nih.gov/index.htm>>.

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Brain circulation scan see **Transcranial Doppler ultrasonography**

Brain infection see **Encephalitis**

Brain injury see **Head injury**

Brain surgery see **Craniotomy**

Brain tumor

Definition

A brain tumor is an abnormal growth of tissue in the brain. Unlike other tumors, brain tumors spread by local

extension and rarely metastasize (spread) outside the brain. A benign brain tumor is composed of non-cancerous cells and does not metastasize beyond the part of the brain where it originates. A brain tumor is considered malignant if it contains **cancer** cells, or if it is composed of harmless cells located in an area where it suppresses one or more vital functions.

Description

Each year, more than 17,000 brain tumors are diagnosed in the United States. About half of all primary brain tumors are benign, but in life-threatening locations. The rest are malignant and invasive.

Benign brain tumors

Benign brain tumors, composed of harmless cells, have clearly defined borders, can usually be completely removed, and are unlikely to recur. Benign brain tumors do not infiltrate nearby tissues but can cause severe **pain**, permanent brain damage, and **death**. Benign brain tumors sometimes become malignant.

Malignant brain tumors

Malignant brain tumors do not have distinct borders. They tend to grow rapidly, increasing pressure within the brain (IICP) and can spread in the brain or spinal cord beyond the point where they originate. It is highly unusual for malignant brain tumors to spread beyond the central nervous system (CNS).

Primary brain tumors

Primary brain tumors originate in the brain. They represent about 1% of all cancers and 2.5% of all cancer deaths.

Metastatic or secondary brain tumors

Approximately 25% of all cancer patients develop secondary or metastatic brain tumors when cancer cells spread from another part of the body to the brain. Secondary brain tumors are most apt to occur in patients who have:

- breast cancer.
- colon cancer.
- kidney cancer.
- lung cancer.
- melanoma (cancer) of the skin. These metastatic brain tumors can develop on any part of the brain or spinal cord.

- cancer within the nasal passages and/or throat that follow the nerve pathways into the skull, and metastasize to the brain.

Who gets brain tumors

Brain tumors can develop at any age, but are most common in children between the ages of 3-12, and in adults aged 55-65. Primary brain cancer is the second most common cause of cancer death between birth and the age of 34, and the fourth most common cause of cancer death in men aged 35-54. Primary tumors of the brain and central nervous system are often associated with HIV infection. Men and caucasians have a higher risk of developing brain tumors. Other risk factors being studied include children with a history of previous radiation treatment to the head for cancer; parents with certain cancers (nervous system, salivary gland, colon); having an older father; having well-educated parents; occupational exposure to vinyl chloride, lead, and pesticides; history of epilepsy; history of certain genetic conditions (tuberous sclerosis, **neurofibromatosis**, von Hippel Lindau, **familial polyposis**, Osler-Weber-Rendu, Li-Fraumeni).

Naming and grading brain tumors

The name of a brain tumor describes where it originates, how it grows, and what kind of cells it contains. A tumor in an adult is also graded or staged according to:

- how malignant it is
- how rapidly it is growing and how likely it is to invade other tissues
- how closely its cells resemble normal cells. (The more abnormal a tumor cell looks, the faster it is likely to grow)

Low-grade brain tumors usually have well-defined borders. Some low-grade brain tumors form or are enclosed (encapsulated) in cysts. Low-grade brain tumors grow slowly, if at all. They may spread throughout the brain, but rarely metastasize to other parts of the body.

Mid-grade and high-grade tumors grow more rapidly than low-grade tumors. Described as “truly malignant,” these tumors usually infiltrate healthy tissue. The growth pattern makes it difficult to remove the entire tumor, and these tumors recur more often than low-grade tumors.

A single brain tumor can contain several different types of cells. The tumor’s grade is determined by the highest-grade (most malignant) cell detected under a microscope, even if most of the cells in the tumor are less malignant. An infiltrating tumor is a tumor of any grade that grows into surrounding tissue.

Types of brain tumors

Glioma is the term used to refer to the most prevalent primary brain tumors. Gliomas arise from glial tissue, which supports and nourishes cells that send messages from the brain to other parts of the body. These tumors may be either malignant or benign. Astrocytomas, ependymomas, and mixed gliomas are three of the most common gliomas.

ASTROCYTOMAS. Named for the star-like shape of their cells, astrocytomas can develop on any part of the brain or spinal cord. Non-infiltrating astrocytomas grow slowly, and rarely spread to nearby tissue. Mild-to-moderately anaplastic astrocytomas with well-differentiated borders do not grow as slowly as non-infiltrating astrocytomas, and they do spread to surrounding tissues.

Anaplastic astrocytomas, which are also called Grade III astrocytomas, look more abnormal and grow more rapidly than non-infiltrating or mild-to-moderately anaplastic tumors.

Grade IV astrocytomas are also called glioblastoma multiforme (GBM) tumors. Accounting for 30% of all primary brain tumors, GBMs are the most common brain tumors in middle-aged adults. GBMs are the most malignant of all brain tumors. Because they contain a greater mixture of cells than any other brain tumor, they are the most difficult to treat.

EPENDYMOGRAMS. Also called ependymal tumors, ependymomas account for 9% of all gliomas, and 5% of all intracranial tumors. These tumors, which are most common in children and adolescents, begin in the very thin membranes that help form cerebrospinal fluid (CSF) and line the brain cavities (ventricles) that contain it.

Ependymomas are usually benign, have well-differentiated borders, resemble normal cells, and grow very slowly. The cells of anaplastic (malignant) ependymomas look abnormal and grow more rapidly than the cells of benign tumors.

MIXED GLIOMAS. These heterogeneous tumors contain elements of astrocytomas and ependymomas and/or oligodendrogiomas. These are rare tumors that usually occur in middle-aged adults, grow slowly, and do not usually spread beyond the part of the brain where they originate. Mixed gliomas behave like tumors composed of the highest-grade cells they contain.

Non-glial brain tumors

The most common brain tumors that do not develop from glial cells are medulloblastomas, meningiomas, and Schwannomas.

MEDULLOBLASTOMAS. Scientists once thought medulloblastomas (MDLs) developed from glial cells. These fast-growing, malignant tumors are now believed to originate in developing cells not normally present in the body after birth. They are sometimes called primitive neuroectodermal tumors (PNET).

MDL tumors are most common in children and are more common in boys than in girls. Only 30% of MDL tumors occur in adults. MDL tumors usually originate in the cerebellum (the part of the brain that controls coordination and some muscle activity), and are often carried to other parts of the brain by cerebrospinal fluid. MDL tumors rarely metastasize beyond the brain and spinal cord.

MENINGIOMAS. Meningiomas, which represent more than 20% of all primary brain tumors, originate in the membranes that enclose the brain and spinal cord (meninges). These tumors are usually benign and most often occur in women aged 30–50 years old. Meningiomas grow so slowly that the brain can sometimes become accustomed to their presence. Meningiomas compress, rather than invade, brain tissue and may grow to be quite large before any symptoms appear.

SCHWANNOMAS. Schwannomas originate in the Schwann cells. These cells produce myelin, material that protects the acoustic nerve, which controls hearing. These benign tumors are twice as common in women as in men, and are most often diagnosed in patients between the ages 30–60.

Schwannomas grow very slowly, and many people adapt to the slight **hearing loss** and balance problems that are the tumors' earliest symptoms. A pear-shaped Schwannoma can cause sudden or gradual loss of hearing in an ear. As the tumor progresses, it can press on the nerves that control movement and feeling in the face, and cause headaches and facial numbness or tingling. The patient may have trouble walking, swallowing, or controlling eye movements, and the sense of taste can be affected. A Schwannoma that grows large enough to press on the brainstem can be deadly.

CHILDHOOD BRAIN TUMORS. Brain tumors that occur in children are described as supratentorial (in the upper part of the brain) or infratentorial (in the lowest part of the brain). Astrocytomas and ependymomas are common supratentorial tumors. Infratentorial tumors include medulloblastomas, astrocytomas, and ependymomas.

Causes and symptoms

The cause of primary brain tumors is unknown, but people who work with rubber and certain chemicals have a greater-than-average risk of developing them. There is

no evidence that **head injury** causes brain tumors, but researchers are trying to determine the relationship, if any, between brain tumors and viruses, family history, and long-term exposure to electromagnetic fields.

Symptoms do not usually appear until the tumor grows large enough to displace, damage, or destroy delicate brain tissue. When that happens, the patient may experience:

- headaches that become increasingly painful and are most painful when lying down
- nausea and vomiting or sudden attacks of vomiting not accompanied by nausea
- seizures
- dizziness, loss of coordination or balance
- personality changes
- sudden loss of vision
- memory loss
- speech problems
- sensory changes
- mental impairment
- weakness or **paralysis** on one side of the body

A doctor should be notified whenever a patient experiences one or more of the symptoms.

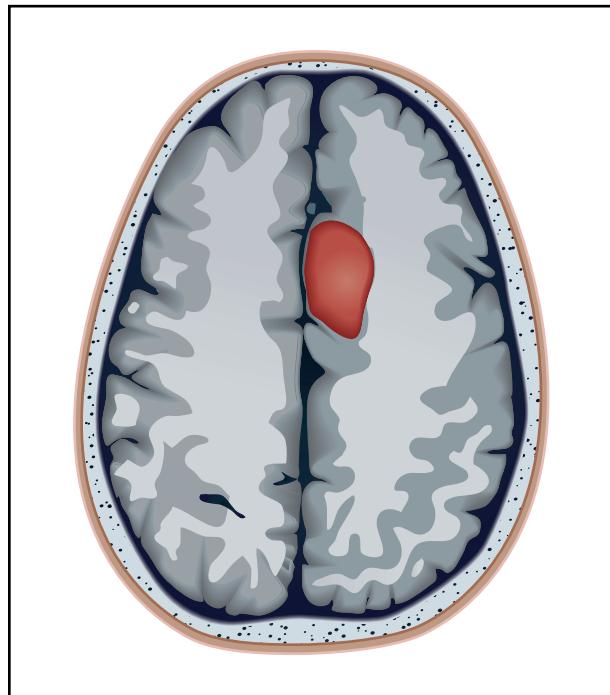
Diagnosis

Although brain tumor symptoms resemble those of many other illnesses, the presence of a brain tumor may be indicated by:

- persistent headaches with vomiting or convulsions
- progressive deterioration of sight, speech, hearing, touch; or deterioration in the ability to use an arm, hand, foot, or leg

When a patient experiences one or more of the above symptoms, a primary care physician will perform a complete **physical examination**, take a detailed medical history, and conduct a basic neurologic examination to evaluate:

- balance and coordination
- abstract thinking and memory
- eye movements
- hearing, touch, and sense of smell
- reflexes
- control of facial muscles and movements of the head and tongue
- awareness



A scan of a brain with a tumor located in the central right portion of the brain. (Illustration by Argosy Inc.)

If the results of these examinations suggest a patient may have a brain tumor, a neurologist recommends some or all of these additional diagnostic tests:

- computed tomography scan (CT scan) to reveal brain abnormalities
- magnetic resonance imaging (MRI) to detect tumors beneath the bones of the skull
- complex imaging techniques such as **Positron emission tomography (PET scan)**, Single photon emission tomography (SPECT scan)
- electroencephalography (EEG) to measure electrical activity in the brain
- magnetoencephalography (MEG scan) to measure the magnetic fields produced by nerve cells and their electric currents
- x rays to reveal any distortion in the bones of the skull
- angiography to outline a tumor and the blood vessels that lead to it
- a brain scan to identify and record the location of abnormal cells in the brain
- radionuclide brain scintigraphy to view the capillaries feeding the tumor after highlighting them with a radioactive substance

- myelography (x ray of the spine) to detect a spinal cord tumor
- a lumbar puncture (spinal tap) to obtain spinal fluid, which may contain tumor cells.
- digital holography to view a complete three-dimensional map of the tumor and surrounding brain structures

Interpreting these images and results of laboratory analysis allows neurologists to determine whether a tumor is present, but microscopic examination of tumor tissue (biopsy) is the only way to identify the kind of cells it contains.

Treatment

Brain tumors are treated by multidisciplinary teams of highly skilled specialists whose decisions are based on:

- results of diagnostic tests
- tumor size, position, and growth pattern
- the patient's health history and current medical status
- the wishes of the patient and his family

Surgery

Surgery is the treatment of choice for accessible brain tumors, which can be removed without causing serious neurologic damage. The procedure most often performed is a **craniotomy**, but the goals of any type of brain tumor surgery include:

- removing as much of the tumor as possible (called debulking the tumor)
- removing tumor tissue for microscopic analysis
- allowing neurosurgeons to see exactly how the tumor is situated and how it is growing
- creating an entry channel for **chemotherapy** drugs and forms of radiation that are implanted in the brain

Depending on the type of brain tumor, its location, and its size, a number of different techniques may be used to surgically remove it. Surgical techniques include:

- classic operation
- laser microsurgery (uses high temperatures to vaporize tumor cells)
- ultrasonic aspiration (uses ultrasound waves to break up the tumor into smaller bits which can be "vacuumed" out)

Before undergoing brain surgery, patients are often given:

- steroids to reduce swelling of brain tissue
- anticonvulsant medications to prevent or control seizures

- radiation treatments to reduce tumor size

Patients whose benign brain tumors can be completely removed may not require any additional treatment, but periodic physical and neurologic examinations and CT or MRI scans are sometimes recommended to determine whether the tumor has returned. Because surgeons cannot be sure that every bit of an infiltrating or metastasizing tumor has been removed, radiation and chemotherapy are used to eradicate cells that may have escaped the scalpel.

If a tumor cannot be completely removed, removing a portion of it (debulking) can alleviate the patient's symptoms, enhance the sense of well-being, and increase the effectiveness of other treatments.

Radiation therapy

External radiotherapy, generally delivered on an outpatient basis, directs radiation to the tumor and the area around it. Implant **radiation therapy** involves placing tiny pieces of radioactive material in the brain. Left in place permanently, or for a short time, these radioactive pellets release measured doses of radiation each day. This technique is called brachytherapy. Patients are usually hospitalized during the several days the pellets are most active.

Stereotactic radiosurgery involves fitting the patient with a frame to stabilize the head, using imaging techniques to determine the exact location of tumor cells, and using a sophisticated instrument to administer radiation precisely to that point. Instruments used for delivery of radiation include the gamma knife, adapted linear accelerator (LINAC), and cyclotron.

A variety of drugs may also be given during radiation therapy, to protect brain cells from the effects of radiation (radioprotective drugs), to increase the sensitivity of tumor cells to radiation (radiosensitizers), or to boost radiation's effects (radioenhancers).

Chemotherapy

One or more cancer-killing drugs may be taken by mouth or injected into a blood vessel, muscle, or the cerebrospinal fluid. Chemotherapy may be used with radiation and surgery as part of a patient's initial treatment, or used alone to treat tumors that recur in the same place or in another part of the body. The usual chemotherapy regimen for a brain tumor is a combination approach, most commonly using procarbazine, CCNU, and vincristine.

New methods of delivering chemotherapy are being used as well. These include:

- interstitial chemotherapy is performed at the time of surgery. A chemotherapy-soaked wafer is placed in the cavity left after tumor removal.

- Intrathecal chemotherapy instills the medications right into the spinal fluid.
- Intraarterial chemotherapy uses tiny catheter tubes to deliver high-dose chemotherapy directly into the arteries of the brain.
- Potentially toxic chemotherapy drugs can be wrapped in special biologic envelopes called liposomes, to allow the drugs to be delivered to the tumor without adversely affecting other healthy tissues along the way.
- Electrochemotherapy uses electric voltage to transport chemotherapy agents into the brain.

When a young child has a brain tumor, chemotherapy is often used to eliminate or delay the need for radiation.

Other treatments

If a brain tumor cannot be cured, treatment is designed to make the patient as comfortable as possible and preserve as much of his neurologic functioning as possible. The patient's doctor may prescribe:

- analgesics to relieve pain
- anticancer drugs to limit tumor growth
- anticonvulsants to control seizures
- steroids to reduce swelling of brain tissue

Potential therapies

Scientists are studying ways to empower chemotherapy drugs to penetrate the blood-brain barrier (which protects the CNS by separating the brain from blood circulating throughout the body), and attack cancer cells that have infiltrated tissue inside it. Agents under investigation include both mannitol and substances called receptor-mediated permeabilizers

Brain tumor researchers are also investigating:

- Less invasive surgical procedures.
- Monoclonal antibodies, which pair antibodies with radioactive substances. The antibodies are directed to find and attach to tumor cells, at which time the radioactive substance kills the tumor cell.
- Interleukin and interferon, which are substances produced naturally by the human immune system which seem to kill tumor cells. Scientists seek to produce these substances in the laboratory and incorporate their use in brain tumor treatment.
- T-lymphocytes, which are also produced normally by the human immune system, and are being used to inject directly into the tumor location during surgery and to infuse into the bloodstream after surgery, in the hopes that they will boost the immune system's ability to fight tumor cells.

- Tumor vaccines, which use elements of tumor cells to stimulate the patient's immune system.
- Methods of incorporating chemotherapy drugs into tumor cells to reduce the need for radiation.
- Laboratory techniques that enable physicians to select the chemotherapy drugs most likely to kill particular types of tumors.
- Gene therapy in which genetically engineered material is transported to tumor cells by viruses that infect tumor cells and convert them to normal cells, stop their growth, or kill them.

Alternative treatment

Alternative treatments have not been shown to cure brain tumors and should never be substituted for conventional therapy. However, complementary therapies (used with, not instead of, standard treatments) can help some patients cope with the **stress** of their illness and side effects of their treatment.

Biofeedback can teach patients to influence and control heart rate, muscle tension, and other stress-related body functions. Some patients claim that **guided imagery** (visualization) helps them feel healthier and more in control of their disease.

Massage, **meditation**, and **reflexology** help some patients relax; while **yoga** is said to soothe the body, spirit, and mind. **Hydrotherapy** uses ice, liquid, and steam to improve circulation and relieve pain. **Therapeutic touch** practitioners say they can relieve pain and other symptoms by moving their hands in slow, rhythmic motions several inches above the patient's body.

Botanical therapies, homeopathic treatment, **traditional Chinese medicine** treatments, nutritional focuses on diet and supplements, and **detoxification** can also be incorporated as complementary therapies.

Prognosis

The patient's prognosis depends on where the tumor is located, what type of cells it contains, the size of the tumor, and the effect its already had on adjacent brain structures. A patient whose tumor is discovered early and removed completely may make a full recovery, but the surgery itself can harm or destroy normal brain tissue and cause:

- problems with thought, speech, and coordination
- seizures
- weakness
- personality changes

KEY TERMS

Central nervous system (CNS)—The division of the nervous system that consists of the brain and spinal cord.

Cerebrospinal fluid (CSF)—Clear liquid that fills brain cavities and protects the brain and spinal cord.

Gamma knife—High-dose radiation treatment for intracranial tumors.

Intracranial—Located within or on the surface of the brain.

Although these post-operative problems may initially be more severe than the symptoms produced by the tumor, they will probably diminish or disappear in time.

Occupational therapy can teach patients and their families new ways to approach daily tasks. Physical therapy can benefit patients who have difficulty keeping their balance, expressing their thoughts, speaking, or swallowing. Children may need special tutors before and after returning to school. For patients who have incurable brain tumors, hospice care may be available. Hospices provide a supportive environment and help patients manage pain and remain comfortable.

Consequences of radiation therapy

Cells killed by radiation can cluster in the brain, resembling tumors. They can cause headaches, seizures, and memory loss. Children treated with radiation may lose some of their eyesight and develop learning problems. Radiation damage to the pituitary gland can hinder normal growth and development.

Consequences of chemotherapy

Some drugs used to treat brain tumors can cause kidney damage and temporary or permanent tingling in the fingers and ringing in the ears.

Inoperable tumors

Brain tumors that cannot be removed may cause irreversible brain damage and death.

Prevention

The cause of primary brain tumors has not been determined, so there is no known way to prevent them.

The best way to prevent secondary or metastatic brain tumors is to eliminate such risk factors as:

- poor **nutrition** and a low-fiber diet; since these contribute to development of intestinal cancers
- smoking, which causes lung cancer
- excessive use of alcohol, which is associated with liver cancer
- excessive exposure to the sun, which can cause melanoma (a deadly form of skin cancer).

Monthly self-examinations of the breasts and testicles can detect breast and **testicular cancer** at their earliest, most curable stages.

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American Brain Tumor Association. 2770 River Road, Des Plaines, IL 60018. (847) 827-9918, (800) 886-2289. <<http://www.abta.org>>.

Brain Tumor Foundation for Children, Inc. 2231 Perimeter Park Drive, Suite 9, Atlanta, GA 30341. (404) 454-5554.

Brain Tumor Information Services. Box 405, Room J341, University of Chicago Hospitals, 5841 S. Maryland Avenue, Chicago, IL 60637. (312) 684-1400.

MedHelp International. 6300 N. Wickham, Suite 130, Box 188, Melbourne, FL 32940. (407) 253-9048. <<http://www.medhlp.netusa.net/>>

National Brain Tumor Foundation. 785 Market Street, #1600, San Francisco, CA 94103. <<http://www.oncolink.penn.edu/>> psychosocial.

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Rosalyn Carson-DeWitt, M.D.

Breast biopsy

Definition

A breast biopsy is removal of breast tissue for examination by a pathologist. This can be accomplished surgically, or by withdrawing tissue through a needle.

Purpose

A biopsy is recommended when a significant abnormality is found, either on **physical examination** and/or by an imaging test. Examples of abnormality can include a breast lump felt during physical self examination or tissue changes noticed from a mammogram test. Before a biopsy is performed, it is important to make sure that the threat of **cancer** cannot be disproved or ruled out by a simpler, less invasive examination. A lump may be obviously harmless when examined by ultrasound. If this is not decisive, the presence of cancer or a variety of benign breast conditions can be determined using a biopsy.

Precautions

The type of biopsy recommended should be considered. This will depend on whether the area can be felt, how well it can be seen on mammogram or ultrasound, and how suspicious it feels or appears. Specialized equipment is needed for different types of biopsy and availability may vary. Generally, needle biopsy is less invasive than surgical biopsy. It is appropriate for most, but not all situations. However, some surgeons feel it is far less accurate.

Description

Surgical biopsy

If an abnormality is not felt during a self examination, there are signs that indicate the need for medical attention. These include:

- severe breast **pain**
- changes in the size of a breast or the nipple
- changes in the shape of both breast or nipple

- pitting, dumpling or redness of the breast skin
- nipple redness, irritation, or inversion
- changes in the pattern of veins visible on the surface of the breast
- some types of nipple discharge

If the abnormality is not felt, a needle localization must be done before the actual surgery. After local anesthetic is administered, a fine wire is placed in the area of concern. Either x ray or ultrasound guidance is used. The patient is awake and usually sitting up.

There are two types of breast biopsy considered here, excisional and incisional. An excisional biopsy is a surgical procedure, where the entire area of concern and some surrounding tissue is removed. It is usually done as an outpatient procedure, in a hospital or free standing surgery center. The patient may be awake, and is sometimes given medication to make her drowsy. The area to be operated on is numbed with local anesthetic. Infrequently, general anesthesia is used.

An excisional biopsy itself usually takes under one hour. The total amount of time spent at the facility depends on the type of anesthesia used, whether a needle localization was done, and the extent of the surgery.

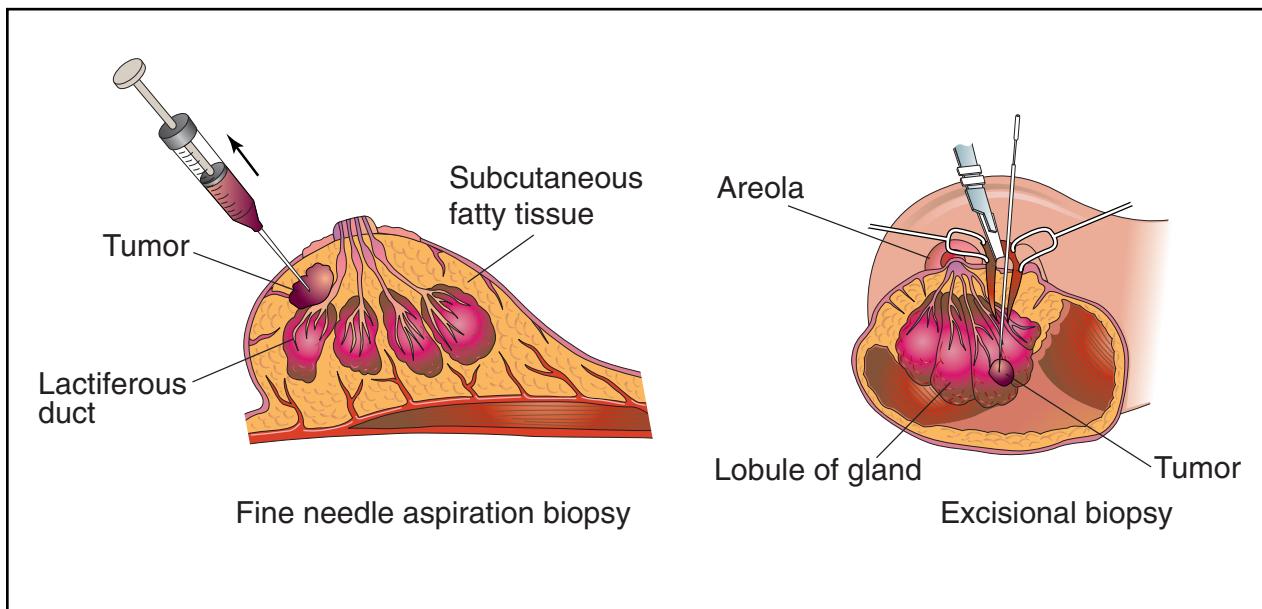
If a mass is very large, an incisional biopsy may be performed. In this case only a portion of the area is removed and sent for analysis. The procedure is the same as an excisional biopsy in other respects.

Needle biopsy

A needle biopsy removes part of the suspicious area for examination. There are two types, aspiration biopsy (using a fine needle), and large core needle biopsy. Either of these may be called a percutaneous needle biopsy. Percutaneous refers to a procedure done through the skin.

A fine needle aspiration biopsy uses a very thin needle to withdraw fluid and cells that can be studied. It can be done in a doctor's office, clinic, or hospital. Local anesthetic may be used, but is sometimes withheld, as it may be more painful than the biopsy needle. The area to place the needle may be located by touch. No specialized equipment is needed. However, using ultrasound guidance enables the physician to feel and see the lesion at the same time. The actual withdrawing of fluid and cells can be visualized as it occurs. This helps ensure that the specimen is taken from the right place.

A large core needle biopsy uses a larger diameter needle to remove small pieces of tissue, about the size of a grain of rice. It can be done in a clinic or hospital that has the appropriate facilities. Local anesthetic is routine-



A fine needle aspiration biopsy uses a very thin needle to withdraw fluid and cells from the breast to be examined. An excisional biopsy is a surgical procedure in which the entire area of concern and some surrounding tissue is removed for analysis. (Illustration by Electronic Illustrators Group.)

ly used. Ultrasound or x ray is used for guidance of a large core needle biopsy.

If the suspicious area is seen best with x ray, a stereotactic device is used. This means that x rays are taken from several angles. This information is fed into a computer, which analyzes the data and guides the needle to the correct place. The patient may be sitting up, or she may be lying on her stomach, with her breast positioned through an opening in the table. The breast is held firmly, but comfortably between a plastic paddle and a metal plate, similar to those used for mammograms (a set of x rays taken of the front and side of the breast). X rays may be taken before, during, and after the tissue is drawn into the needle, to confirm that the correct spot is biopsied. This procedure may also be referred to as a stereotactic core biopsy, or a mammotomy.

Ultrasound is used to guide needle placement for some lesions. The patient lies on her back or side. After the area is numbed, sterile gel is applied. The physician places a transducer, an instrument about the size of an electric shaver, over the skin. This produces an image from the reflection of sound waves. A special needle, usually in a spring loaded device, is used to obtain the tissue. The procedure is observed on a monitor as it is happening.

Preparation

A surgical breast biopsy may require the patient to have nothing to eat or drink for a period of time before

the operation. This will typically be from midnight the night before, if general anesthesia is planned. No food restrictions are necessary for needle biopsy. It is advisable to eat lightly before the procedure. This is especially important if the patient will be lying on her stomach for a stereotactic biopsy.

Aftercare

After a surgical biopsy, the incision will be closed with stitches, and covered with a bandage. The bandage can usually be removed in one or two days. Stitches are taken out approximately one week afterward. Depending on the extent of the operation, normal activities can be resumed in approximately one to three days. Vigorous exercise may be limited for one to three weeks.

The skin opening for a needle biopsy is minimal. It may be closed with thin, clear tape, called a steri strip, or covered with a bandaid and a small gauze bandage. The patient can return to her usual routine immediately after the biopsy. Strenuous activity or heavy lifting is not recommended for 24 hours. Any bandages can be removed one or two days after the biopsy.

Risks

Infection is always a possibility when the skin is broken, although this rarely occurs. Redness, swelling, or severe pain at the biopsy site would indicate a possible

infection. Another possible consequence of a breast biopsy is a hematoma. This is a collection of blood at the biopsy site. It is usually absorbed naturally by the body. If it is very large and uncomfortable, it may need to be drained. A surgical breast biopsy may produce a visible scar on the breast. Sometimes this may make future mammograms harder to interpret accurately.

A false negative pathology report is another risk. This means that no cancer was found when a cancer was present. The incidence of this varies with the biopsy technique. In general, fine needle aspiration biopsies have the highest rate of false negative results, but there may be variation in results between facilities.

Normal results

A normal pathology report indicates no malignancy is present. The tissue sample may be further classified as a benign breast condition, such as tumor of the breast (**fibroadenoma**) or connective tissue that resembles fiber (fibrosis). Studies have demonstrated that approximately 80% of all breast biopsies result in a benign pathology report.

Abnormal results

An abnormal pathology report indicates a cancer is present. If a fine needle aspiration biopsy was performed, the pathologist has viewed individual cells under a microscope to see if they appear cancerous. Large core needle biopsy and surgical biopsy will be able to give more information. This includes the type of cancer, whether it has invaded surrounding tissue, and how likely it is to spread quickly. There are some conditions which are not malignant but indicate high risk for future development of **breast cancer**. If these are identified, more frequent monitoring of the area may be recommended.

Resources

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KEY TERMS

Fine needle aspiration biopsy—A procedure using a thin needle to remove fluid and cells from a lump in the breast.

Large core needle biopsy—A procedure using a thicker needle to remove a core of tissue, about the size of a grain of rice, from the breast.

Weber, Ellen. "Questions and Answers About Breast Cancer Diagnosis." *American Journal of Nursing* 97 (Oct. 1997): 34-38.

ORGANIZATIONS

American Cancer Society. 1599 Clifton Rd., NE, Atlanta, GA 30329-4251. (800) 227-2345. <<http://www.cancer.org>>.

National Cancer Institute. Building 31, Room 10A31, 31 Center Drive, MSC 2580, Bethesda, MD 20892-2580. (800) 422-6237. <<http://www.nci.nih.gov>>.

Ellen S. Weber, MSN

Breast cancer

Definition

Breast **cancer** is caused by the development of malignant cells in the breast. The malignant cells originate in the lining of the milk glands or ducts of the breast (ductal epithelium), defining this malignancy as a cancer. Cancer cells are characterized by uncontrolled division leading to abnormal growth and the ability of these cells to invade normal tissue locally or to spread throughout the body, in a process called metastasis.

Description

Breast cancer arises in the milk-producing glands of the breast tissue. Groups of glands in normal breast tissue are called lobules. The products of these glands are secreted into a ductal system that leads to the nipple. Depending on where in the glandular or ductal unit of the breast the cancer arises, it will develop certain characteristics that are used to sub-classify breast cancer into types. The pathologist will denote the subtype at the time of evaluation with the microscope. Ductal carcinoma begins in the ducts, lobular carcinoma has a pattern involving the lobules or glands. The more important classification is related to the evaluated tumor's capability to

invade, as this characteristic defines the disease as a true cancer. The stage before invasive cancer is called *in situ*, meaning that the early malignancy has not yet become capable of invasion. Thus, ductal carcinoma *in situ* is considered a minimal breast cancer.

How breast cancer spreads

The primary tumor begins in the breast itself but once it becomes invasive, it may progress beyond the breast to the regional lymph nodes or travel (metastasize) to other organ systems in the body and become systemic in nature. Lymph is the clear, protein-rich fluid that bathes the cells throughout the body. Lymph will work its way back to the bloodstream via small channels known as lymphatics. Along the way, the lymph is filtered through cellular stations known as nodes, thus they are called lymph nodes. Nearly all organs in the body have a primary lymph node group filtering the tissue fluid, or lymph, that comes from that organ. In the breast, the primary lymph nodes are under the armpit, or axilla. Classically, the primary tumor begins in the breast and the first place to which it is likely to spread is the regional lymph nodes. Cancer, as it invades in its place of origin, may also work its way into blood vessels. If cancer gets into the blood vessels, the blood vessels provide yet another route for the cancer to spread to other organs of the body.

Breast cancer follows this classic progression though it often becomes systemic or widespread early in the course of the disease. By the time one can feel a lump in the breast it is often 0.4 inches, or one centimeter, in size and contains roughly a million cells. It is estimated that a tumor of this size may take one to five years to develop. During that time, the cancer may metastasize, or spread by lymphatics or blood to areas elsewhere in the body.

When primary breast cancer spreads, it may first go to the regional lymph nodes under the armpit, the axillary nodes. If this occurs, regional metastasis exists. If it proceeds elsewhere either by lymphatic or blood-borne spread, the patient develops systemic metastasis that may involve a number of other organs in the body. Favorite sites of systemic involvement for breast cancer are the lung, bones, liver, and the skin and soft tissue. As it turns out, the presence of, and the actual number of, regional lymph nodes containing cancer remains the single best indicator of whether or not the cancer has become widely metastatic. Because tests to discover metastasis in other organs may not be sensitive enough to reveal minute deposits, the evaluation of the axilla for regional metastasis becomes very important in making treatment decisions for this disease.

If breast cancer spreads to other major organs of the body, its presence will compromise the function of those

organs. **Death** is the result of extreme compromise of vital organ function.

Demographics

Every woman is at risk for breast cancer. If she lives to be 85, there is a one out of nine chance that she will develop the condition sometime during her life. As a woman ages, her risk of developing breast cancer rises dramatically regardless of her family history. The breast cancer risk of a 25-year-old woman is only one out of 19,608; by age 45, it is one in 93. In fact, less than 5% of cases are discovered before age 35 and the majority of all breast cancers are found in women over age 50.

In 1999, there were 180,000 new cases of breast cancer diagnosed. About 45,000 women die of breast cancer each year, accounting for 16% of deaths caused by cancer in women. For the first time ever, mortality rates decreased an average of 1.7% per year from 1995 through 1999, a reflection of earlier diagnosis and improving therapies.

Causes and symptoms

There are a number of risk factors for the development of breast cancer, including:

- family history of breast cancer in mother or sister
- early onset of menstruation and late **menopause**
- reproductive history: women who had no children or have children after age 30 and women who have never breastfed have increased risk
- history of abnormal breast biopsies

Though these are recognized risk factors, it is important to note that more than 70% of women who get breast cancer have no known risk factors. Having several risk factors may boost a woman's chances of developing breast cancer, but the interplay of predisposing factors is complex. In addition to those accepted factors listed above, some studies suggest that high-fat **diets**, **obesity**, or the use of alcohol may contribute to the risk profile. Another factor that may contribute to a woman's risk profile is **hormone replacement therapy** (HRT).

HRT provides significant relief of menopausal symptoms, prevention of **osteoporosis**, and possibly protection from cardiovascular disease and **stroke**. However, studies show that there is a small increased risk of developing breast cancer with HRT use. Thus, the use of hormone replacement therapy should be based on personal risk factors.

Of all the risk factors listed above, family history is the most important. In *The Biological Basis of Cancer*, the authors estimate that probably about half of all famil-

ial breast cancer cases (families in which there is a high breast cancer frequency) have mutations affecting the tumor suppressor gene BRCA-1. Another gene (BRCA-2) also appears to confer inherited vulnerability to early-onset breast cancers. However, breast cancer due to heredity is only a small proportion of breast cancer cases; only 5%–10% of all breast cancer cases will be women who inherited a susceptibility through their genes. Nevertheless, when the family history is strong for development of breast cancer, a woman's risk is increased.

Not all lumps detected in the breast are cancerous. Fibrocystic changes in the breast are extremely common. Also known as **fibrocystic condition of the breast**, fibrocystic changes are a leading cause of non-cancerous lumps in the breast. Fibrocystic changes also cause symptoms of **pain**, swelling, or discharge and may become evident to the patient or physician as a lump that is either solid or filled with fluid. Complete diagnostic evaluation of any significant breast abnormality is mandatory because though women commonly develop fibrocystic changes, breast cancer is common also, and the signs and symptoms of fibrocystic changes overlap with those of breast cancer.

Diagnosis

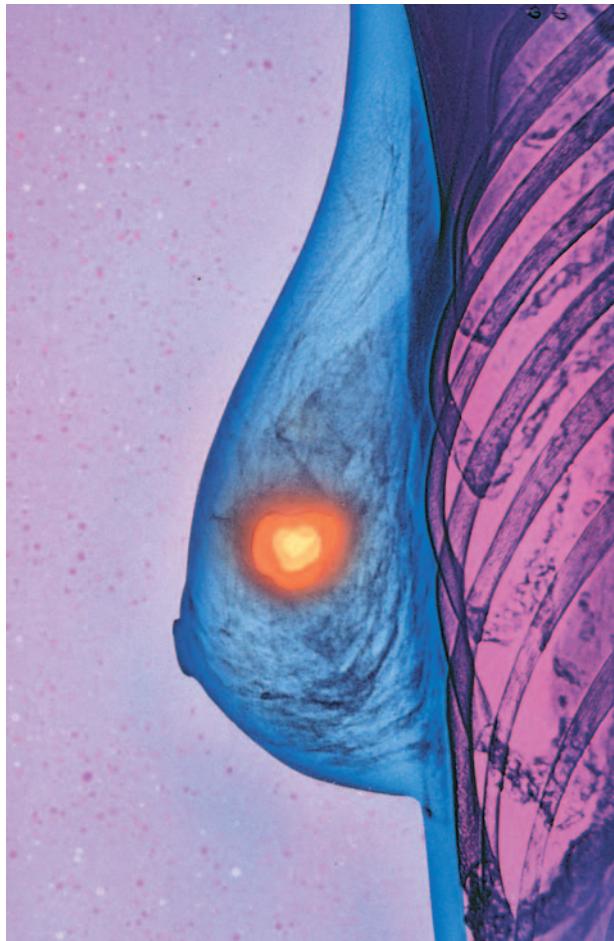
The diagnosis of breast cancer is accomplished by the biopsy of any suspicious lump or mammographic abnormality that has been identified. (A biopsy is the removal of tissue for examination by a pathologist. A mammogram is a low-dose, 2-view, x-ray examination of the breast.) The patient may be prompted to visit her doctor upon finding a lump in a breast, or she may have noticed skin dimpling, nipple retraction, or discharge from the nipple. Or, the patient may not have noticed anything abnormal, and a lump is detected by the mammogram.

When a patient has no signs or symptoms

Screening involves the evaluation of women who have no symptoms or signs of a breast problem, so when the screening mammogram leads to the evaluation, the patient has no symptoms and may not have any abnormality on examination of the breast. **Mammography** has been very helpful in detecting breast cancer that one cannot identify on **physical examination**. However, 10%–13% of breast cancer does not show up on mammography, and a similar number of patients with breast cancer have an abnormal mammogram and a normal physical examination. These figures emphasize the need for examination as part of the screening process.

Screening

It is recommended that women get into the habit of doing monthly breast self examinations to detect any



Mammogram indicating a tumor in the center of the breast.
(Chris Bjornberg, Photo Researchers. Reproduced by permission.)

lump at an early stage. If an uncertainty or a lump is found, evaluation by an experienced physician and mammography is recommended. The American Cancer Society (ACS) has made recommendations for the use of mammography on a screening basis. There has been controversy about the timing and appropriate frequency of mammography when used as a screening tool, but the ACS recommendations are as follows: Women should get annual mammograms after age 40. Those with a significant family history (one or more first-degree relatives who have been treated for breast cancer), should start annual mammograms 10 years younger than the youngest relative was when she was diagnosed, but not earlier than 35.

Because of the greater awareness of breast cancer in recent years, screening evaluations by examinations and mammography are performed much more frequently than in the past. The result is that the number of breast cancers diagnosed increased, but the disease is being diagnosed at an earlier stage than previously. The earlier the stage of

disease at the time of presentation, the better the long-term outcome after treatment, or prognosis, becomes.

When a patient has physical signs or symptoms

A very common finding that leads to diagnosis is the presence of a lump within the breast. Skin dimpling, nipple retraction, or discharge from the nipple are less frequent initial findings prompting biopsy. Though bloody nipple discharge is distressing, it is most often caused by benign disease. Skin dimpling or nipple retraction in the presence of an underlying breast mass on examination is a more advanced finding. Actual skin involvement, with **edema** or ulceration of the skin, are late findings.

A very common presenting sign is the presence of a breast lump. If the lump is suspicious and the patient has not had a mammogram by this point, a study should be done on both breasts prior to anything else so that the original characteristics of the lesion can be studied. The opposite breast should also be evaluated mammographically to determine if other problems exist that were undetected by physical examination.

Whether an abnormal screening mammogram or one of the signs mentioned above followed by a mammogram prompted suspicion, the diagnosis is established by obtaining tissue by biopsy of the area. There are different types of biopsy, each utilized with its own indication depending on the presentation of the patient. If signs of widespread metastasis are already present, biopsy of the metastasis itself may establish diagnosis.

Biopsy

Depending on the situation, different types of biopsy may be performed. The types include incisional and excisional biopsies. In an incisional biopsy, the physician takes a sample of tissue, and in excisional biopsy, the mass is removed. Fine needle aspiration biopsy and core needle biopsy are kinds of incisional biopsies.

FINE NEEDLE ASPIRATION BIOPSY. In a fine needle aspiration biopsy, a fine-gauge needle may be passed into the lesion and cells from the area suctioned into the needle can be quickly prepared for microscopic evaluation (cytology). (The patient experiencing nipple discharge can have a sample taken of the discharge for cytological evaluation, also.) Fine needle aspiration is a simple procedure that can be done under local anesthesia, and will tell if the lesion is a fluid-filled cyst or whether it is solid. The sample obtained will yield much diagnostic information. Fine needle aspiration biopsy is an excellent technique when the lump is palpable and the physician can easily hit the target with the needle. If the lesion is a simple cyst, the fluid will be evacuated and the mass will

disappear. If it is solid, the diagnosis may be obtained. Care must be taken, however, because if the mass is solid and the specimen is non-malignant, a complete removal of the lesion may be appropriate to be sure.

CORE NEEDLE BIOPSY. Core needle biopsies are also obtained simply under local anesthesia. The larger piece of tissue obtained with its preserved architecture may be helpful in confirming the diagnosis short of open surgical removal. An open surgical incisional biopsy is rarely needed for diagnosis because of the needle techniques. If there remains question as to diagnosis, a complete open surgical biopsy may be required.

EXCISIONAL BIOPSY. When performed, the excisional, (complete removal) biopsy is a minimal outpatient procedure often done under local anesthesia.

NON-PALPABLE LESIONS. As screening increases, non-palpable lesions demonstrated only by mammography are becoming more common. The use of x rays and computers to guide the needle for biopsy or to place markers for the surgeon performing the excisional biopsy are commonly employed. Some benign lesions can be fully removed by multiple directed core biopsies. These techniques are very appealing because they are minimally invasive; however, the physician needs to be careful to obtain a good sample.

Other tests

If a lesion is not palpable and has simple cystic characteristics on mammography, ultrasound may be utilized both to determine that it is a cyst and to guide its evacuation. Ultrasound may also be used in some cases to guide fine needle or core biopsies of the breast.

Computed tomography (CT scan, CAT scans), and **magnetic resonance imaging**, (MRI), have only a very occasional use in the evaluation of breast lesions.

Treatment

Staging

Once diagnosis is established, before treatment is rendered, more tests are done to determine if the cancer has spread beyond the breast. These tests include a **chest x ray** and **blood count** with **liver function tests**. Along with the liver function measured by the blood sample, the level of alkaline phosphatase, an enzyme from bone, is also determined. A radionuclear bone scan may be ordered. This test looks at the places in the body to which breast cancer usually metastasizes. A CT scan may also be ordered. The physician will do a careful examination of the axilla to assess likelihood of regional metastasis but unfortunately this exam is not very accurate. Since

the axillary node status is the best reflection of possible widespread disease, these nodes in part or all will be removed at the time of surgical treatment.

Using the results of these studies, clinical stage is defined for the patient. This helps define treatment protocol and prognosis. After surgical treatment, the final, or pathologic, stage is defined as the true axillary lymph node status is known. Detailed staging criteria are available from the American Joint Commission on Cancer Manual and are generalized here:

- Stage 1—The cancer is no larger than 2 cm (0.8 in) and no cancer cells are found in the lymph nodes.
- Stage 2—The cancer is between 2 cm and 5 cm, and the cancer has spread to the lymph nodes.
- Stage 3A—Tumor is larger than 5 cm (2 in) or is smaller than 5 cm, but has spread to the lymph nodes, which have grown into each other.
- Stage 3B—Cancer has spread to tissues near the breast, (local invasion), or to lymph nodes inside the chest wall, along the breastbone.
- Stage 4—Cancer has spread to skin and lymph nodes beyond the axilla or to other organs of the body.

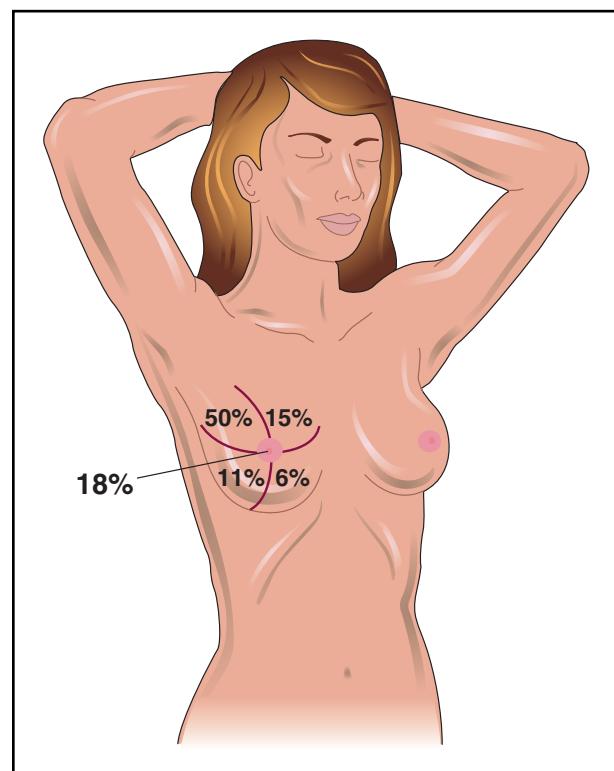
Treatment

Surgery, radiation, and **chemotherapy** are all utilized in the treatment of breast cancer. Depending on the stage, they will be used in different combinations or sequences to effect an appropriate strategy for the type and stage of the disease being treated.

SURGERY. Historically, surgical removal of the entire breast and axillary contents along with the muscles down to the chest wall was performed as the lone therapy, (**radical mastectomy**). In the last twenty-five years, as it has been appreciated that breast cancer is often systemic early in its course, the role of surgery is still primary but of less and less magnitude.

Today, surgical treatment is best thought of as a combination of removal of the primary tumor and staging of the axillary lymph nodes. If the whole breast is removed along with the entire axillary contents, but the muscles of the chest wall are not, the modified radical mastectomy has been performed.

If the tumor is less than 1.5 in (4 cm) in size and located so that it can be removed without destroying a reasonable cosmetic appearance of the residual breast, just the primary tumor and a rim of normal tissue will be removed. The axillary nodes will still be removed for staging purposes, usually through a separate incision. Because of the risk of recurrence in the remaining breast tissue, radiation is used to lessen the chance of local



This illustration shows the frequency of breast cancer developing in the four quadrants of the breast and the nipple. (Illustration by Electronic Illustrators Group.)

recurrence. This type of primary therapy is known as **lumpectomy**, (or segmental mastectomy), and axillary dissection.

Currently the necessary extent of the axillary dissection is being questioned. **Sentinel lymph node biopsy**, a technique for identifying which nodes in the axilla drain the tumor, has been developed to provide selective sampling and further lessen the degree of surgical trauma the patient experiences.

When patients are selected appropriately based on the preoperative clinical stage, all of these surgical approaches have been shown to produce similar results. In planning primary surgical therapy, it is imperative that the operation is tailored to fit the clinical circumstance of the patient.

The pathologic stage is determined after surgical treatment absolutely defines the local parameters. In addition to stage, there are other tests that are very necessary to aid in decisions regarding treatment. Handling of the surgical specimen is thus very important. The tissue needs to be analyzed for the presence or absence of hormone receptors and a receptor called HER-2. The presence of these receptors will influence additional thera-

pies. Microscopic evaluation may also include the assessment of lymphatic or blood vessel invasion as these predict a worse outcome. The DNA of the tumor cells is quantitatively analyzed to help decide the biologic aggressiveness of the tumor. These parameters will be utilized collectively along with the axillary lymph node status to define the anticipated aggressiveness of the cancer. This assessment, along with the age and general condition of the patient, will be considered when planning the adjuvant therapies. Adjuvant therapies are treatments utilized after the primary treatment to help ensure that no microscopic disease exists and to help prolong patients' survival time.

RADIATION. Like surgical therapy, **radiation therapy** is a local modality—it treats the tissue exposed to it and not the rest of the body. Radiation is usually given post-operatively after surgical **wounds** have healed. The pathologic stage of the primary tumor is now known and this aids in treatment planning. The extent of the local surgery also influences the planning. Radiation may not be needed at all after modified radical mastectomy for stage I disease, but is almost always utilized when breast-preserving surgery is performed. If the tumor was extensive or if multiple nodes were involved, the field of tissue exposed will vary accordingly. Radiation is utilized as an adjunct to surgical therapy and is considered an important modality in gaining local control of the tumor. The use of radiation therapy does not affect decisions for adjuvant treatment. In the past, radiation was used as an alternative to surgery on occasion. However, now that breast-preserving surgical protocols have been developed, primary radiation treatment of the tumor is no longer performed. Radiation also has an important role in the treatment of the patient with disseminated disease, particularly if it involves the skeleton. Radiation therapy can effect pain control and prevention of fracture in this circumstance.

DRUG THERAPY. Many breast cancers, particularly those originating in post-menopausal women, are responsive to hormones. These cancers have receptors on their cells for estrogen and progesterone. Part of primary tumor assessment after removal of the tumor is the evaluation for the presence of these estrogen and progesterone receptors. If they are present on the cancer cells, altering the hormone status of the patient will inhibit tumor growth and have a positive impact on survival. The drug tamoxifen binds up these receptors on the cancer cells so that the hormones can't have an effect and, in so doing, inhibits tumor growth. If the patient has these receptors present, tamoxifen is commonly prescribed for five years as an adjunct to primary treatment. Adjuvant hormonal therapy with tamoxifen has few side effects but they have to be kept in mind, particularly the need for yearly evaluation of the uterus. Other agents directed at altering hor-

mone environment are under study. Because of these agents, there is rarely any need for surgical removal of hormone-producing glands, such as the ovary or adrenal, that was sometimes necessary in the past.

Shortly after the modified radical mastectomy replaced the radical mastectomy as primary surgical treatment, it was appreciated that survival after local treatment in stage II breast cancer was improved by the addition of chemotherapy. Adjuvant chemotherapy for an interval of four to six months is now standard treatment for patients with stage II disease. The addition of systemic therapy to local treatment in patients who have no evidence of disease is performed on the basis that some patients have metastasis that are not currently demonstrable because they are microscopic. By treating the whole patient early, before widespread disease is diagnosed, the adjuvant treatment improves survival rates from roughly 60% for stage II to about 75% at five years after treatment. The standard regimen of cytoxan, methotrexate, and 5-flourouracil, (CMF), is given for six months and is well tolerated. The regimen of cytoxan, adriamycin (doxorubicin), and 5-floururacil, (CAF), is a bit more toxic but only requires four months. (Adriamycin and cytoxin may also be used alone, without the fluorouracil.) The two methods are about equivalent in results. Adjuvant hormonal therapy may be added to the adjuvant chemotherapy as they work through different routes.

As one would expect, the encouraging results from adjuvant therapy in stage II disease have led to the study of similar therapy in stage I disease. The results are not as dramatic, but they are real. Currently, stage I disease is divided into categories a, b, and c on the basis of tumor size. Stage Ia is less than a centimeter in diameter. Adjuvant hormonal or chemotherapy is now commonly recommended for stage Ib and Ic patients. The toxicity of the treatment must be weighed individually for the patient as patients with stage I disease have a survivorship of over 80% without adjuvant chemotherapy.

If patients are diagnosed with stage IV disease or, in spite of treatment, progress to a state of widespread disease, systemic chemotherapy is utilized in a more aggressive fashion. In addition to the adriamycin-containing regimens, the taxols (docetaxel and paclitaxel) have been found to be effective in inducing remission.

On the basis of prognostic factors such as total number of involved nodes over 10, aneuploid DNA with a high synthesis value, or aggressive findings on microscopic evaluation, some patients with stage II or III disease can be predicted to do poorly. If their performance status allows, they can be considered for treatment with highly aggressive chemotherapy. The toxicity is such that bone marrow failure will result. To get around this antici-

KEY TERMS

Adjuvant therapy—Treatment involving radiation, chemotherapy (drug treatment), or hormone therapy, or a combination of all three given after the primary treatment for the possibility of residual microscopic disease.

Aneuploid—An abnormal number of chromosomes in a cell.

Aspiration biopsy—The removal of cells in fluid or tissue from a mass or cyst using a needle for microscopic examination and diagnosis.

Benign—Not malignant, noncancerous.

Biopsy—A procedure in which suspicious tissue is removed and examined by a pathologist for cancer or other disease. For breast biopsies, the tissue may be obtained by open surgery, or through a needle.

Estrogen-receptor assay—A test to see if a breast cancer needs estrogen to grow.

Hormones—Chemicals produced by glands in the body which circulate in the blood and control the actions of cells and organs. Estrogens are hormones which affect breast cancer growth.

Hormone therapy—Treating cancers by changing the hormone balance of the body, instead of by using cell-killing drugs.

Lumpectomy—A surgical procedure in which only the cancerous tumor in the breast is removed, together with a rim of normal tissue.

Lymph nodes—Small, bean-shaped masses of tissue scattered along the lymphatic system that act as filters and immune monitors, removing fluids, bacteria, or cancer cells that travel through the lymph system. Breast cancer cells in the lymph nodes under the arm or in the chest are a sign that the cancer has spread, and that it might recur.

Malignant—Cancerous.

Mammography—X-ray imaging of the breast that can often detect lesions in the tissue too small or too deep to be felt.

Oncogene—A gene that has to do with regulation of cancer growth. An abnormality can produce cancer.

pated side effect of the aggressive therapy, either the patients will be transplanted with their own stem cells, (the cells that will give rise to new marrow), or a traditional **bone marrow transplantation** will be required. This therapy can be a high-risk procedure for patients. It is given with known risk to patients predicted to do poorly and then only if it is felt they can tolerate it. Most patients who receive this therapy receive it as part of a clinical trial. At present, it is unclear that such aggressive therapy can be justified and it is under study.

For patients who are diagnosed with advanced local disease, surgery may be preceded with chemotherapy and radiation therapy. The disease locally regresses allowing traditional surgical treatment to those who could not receive it otherwise. Chemotherapy and sometimes radiation therapy will continue after the surgery. The regimens of this type are referred to as neo-adjuvant therapy. This has been proven to be effective in stage III disease. Neo-adjuvant therapy is now being studied in patients with large tumors that are stage II in an effort to be able to offer breast preservation to these patients.

A drug known as Herceptin (trastuzumab), a monoclonal antibody, is now being used in the treatment of those with systemic disease. The product of the Human

Epidermal Growth Factor 2 gene, (HER-2) is overexpressed in 25%–30% of breast cancers. Herceptin binds to the HER-2 receptors on the cancer, resulting in the arrest of growth of these cells.

Prognosis

The prognosis for breast cancer depends on the type and stage of cancer. Over 80% of stage I patients are cured by current therapies. Stage II patients survive overall about 70% of the time, those with more extensive lymph nodal involvement doing worse than those with disease confined to the breast. About 40% of stage III patients survive five years, and about 20% of stage IV patients do so.

Coping with cancer treatment

Surgery for breast cancer is physically well-tolerated by the patient, especially those undergoing minimal surgery in the axilla. Most patients can return to a normal lifestyle within a month or so after surgery. Exercises can help the patient regain strength and flexibility. Arm, shoulder, and chest exercises help, and complete recovery of activity is to be expected.

About 5-7% of patients undergoing complete axillary lymph node resection as part of their therapy may develop clinically significant **lymphedema**, or swelling in the arm on the side of involvement. If present, elevation and massage may be needed intermittently. Though usually not serious, on occasion this complication may interfere with complete physical recovery. The incidence of lymphedema is less with less axillary surgery. This is the reason for the enthusiasm for sentinel node biopsy as the surgical staging procedure in the axilla.

It is common after breast cancer treatment to be depressed or moody, to cry, lose appetite, or feel unworthy or less interested in sex. The breast is involved with a woman's identity and loss of it may be disturbing. For some, counseling or a support group can help. Many women have found a support group of breast cancer survivors to be an invaluable help during this stage. Involvement with volunteers from the local chapter of the Reach to Recovery program may be very helpful.

Nearly all patients undergo some form of adjuvant therapy for breast cancer. The magnitude of the toxicity of these adjuvant therapies is usually small and many patients receiving chemotherapy on this basis are capable of normal activity during this time. Certainly, those who progress to advanced disease are treated with more toxic chemotherapeutic regimens in an attempt to induce remission.

Clinical trials

The use of tamoxifen and other agents which alter the hormone status of the patient are under study. The National Surgical Adjuvant Breast and Bowel Project (NSABP) with support from the National Cancer Institute began a study in 1992 (called the Breast Cancer Prevention Trial, or BCPT) studying the use of tamoxifen as a breast cancer preventative for high-risk women. The results yielded from the study showed that tamoxifen significantly reduced breast cancer risk, and the U.S. Food and Drug Administration approved the use of tamoxifen to reduce breast cancer risk for high-risk patients in 1998. Another NSABP study, known as STAR, is seeking to understand if another drug, raloxifene, is as effective as tamoxifen in reducing breast cancer risk in high-risk patients. That study was begun in 1999, and participants are to be monitored for five years.

Neo-adjuvant therapies to allow the use of breast preservation in those with more advanced local disease are under investigation.

Immune therapies have not been helpful to date though there are vaccines being developed against proteins such as that produced by HER-2 that may be beneficial in the future.

High-dose chemotherapy with bone marrow rescue remains controversial. Factors can be identified that predict certain patients will develop metastatic disease. This treatment has been offered to this select group of patients but the toxicity is such that defining a clear indication for this treatment remains under study.

Prevention

As mentioned above, because of the results yielded from the BCPT clinical trial, tamoxifen can now be prescribed to high-risk women to help prevent breast cancer.

And, while most breast cancer can't be prevented, it can be diagnosed from a mammogram at an early stage when it is most treatable. The results of awareness and routine screening have allowed earlier diagnosis, which results in a better prognosis for those discovered.

Special Concerns

Though breast-preserving therapy is being done more frequently than in years past, modified radical mastectomy remains an option when selecting therapy for the primary tumor. This option may allow treatment without radiation in earlier stage patients, or may be necessary if the presentation of the tumor does not allow breast preservation. Loss of the breast is disfiguring and many patients so treated desire reconstruction of the breast. **Breast reconstruction** is performed either at the time of initial surgery (immediate) or it may be delayed. Alternatives include placement of implants or the rotation of muscle flaps from the abdomen or back. Most agree that breast preservation gives superior results to any form of reconstruction. When the breast is removed as part of primary therapy, these reconstructions are available and do produce very reasonable results.

Resources

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- Shuster, et al. "Multidisciplinary Care For Patients With Breast Cancer." *Surgical Clinics of North America* Volume 80 No. 2 (April, 2000) p 505-533.

ORGANIZATIONS

- American Cancer Society. (800) ACS-2345. <<http://www.cancer.org>>.
- American Cancer Society's Reach to Recovery Program: <<http://www2.cancer.org/bcn/reach.html>>.
- Cancer Care, Inc. (800) 813-HOPE. <<http://www.cancercareinc.org>>.
- Cancer Information Service of the NCI. 1-800-4-CANCER. <<http://www.cancerinfo.nci.nih.gov>>.
- National Alliance of Breast Cancer Organizations. 9 East 37th St., 10th floor, New York, NY 10016. (888) 80-NABCO.
- National Coalition for Cancer Survivorship. 1010 Wayne Ave., 5th Floor, Silver Spring, MD 20910. (301) 650-8868.
- National Women's Health Resource Center. 2425 L St. NW, 3rd floor, Washington, DC 20037. (202) 293-6045.

OTHER

- Breast Cancer Online. <<http://www.bco.org>>.
- National Alliance of Breast Cancer Organizations. <<http://www.nabco.org>>.
- National Cancer Institute. <http://rex.nci.nih.gov/PATIENTS/INFO_PEOPL_DOC.html>.

Richard A. McCartney, M.D.

Breast enlargement see **Breast implants**

Breast-feeding see **Lactation**

■ Breast implants

Definition

Breast implantation is a surgical procedure for enlarging the breast. Breast-shaped sacks made of a silicone outer shell and filled with silicone gel or saline (salt water), called implants, are used.

Purpose

Breast implantation is usually performed to make normal breasts larger for cosmetic purposes. Sometimes a woman having a **breast reconstruction** after a **mastectomy** will need the opposite breast enlarged to make the



A silicone breast implant. (Photograph by Dale O'Dell, *The Stock Market*. Reproduced by permission.)

breasts more symmetric. Breasts that are very unequal in size due to trauma or congenital deformity may also be corrected with an enlargement procedure.

Precautions

A woman in poor health or with a severe chronic disease is not a good candidate for this procedure.

Description

A cosmetic breast enlargement is usually an outpatient procedure. It may be done under local or general anesthesia, depending on patient and physician preference. The incision is made through the armpit, under the breast, or around the areola (the darkened area around the nipple). These techniques create the most inconspicuous scars. The implant is placed between the breast tissue and underlying chest muscle, or under the chest muscle. The operation takes approximately one to two hours. The cost of a cosmetic procedure is rarely covered by insur-

ance. However, if enlargement is part of breast reconstruction after a mastectomy, health plans may pay for some or all of it. The surgeon's fee ranges from \$2,700-\$4,200 and up. The procedure may also be called breast augmentation or augmentation mammoplasty.

Preparation

Before the surgery is performed, the woman should have a clear understanding of what her new breasts will look like. She and her physician should agree about the desired final result. Many surgeons find it helpful to have the patient review before and after pictures, to clarify expectations.

Aftercare

Driving and normal activities may be restricted for up to one week. Stitches are usually removed in seven to 10 days. Typically, a woman can resume all routines, including vigorous **exercise**, in about three weeks. The scars will be red for approximately one month, but will fade to their final appearance within one or two years.

Risks

Risks which are common to any surgical procedure include bleeding, infection, anesthesia reaction, or unexpected scarring. A breast enlargement may also result in decreased sensation in the breast, or interference with breast-feeding. Implants can also make it more difficult to read and interpret mammograms, possibly delaying **breast cancer** detection. Also, the implant itself can rupture and leak, or become displaced. A thick scar that normally forms around the implant, called a capsule, can become very hard. This is called capsular contracture, and may result in **pain** and/or an altered appearance of the breast. The older the implant, the greater the chances that these problems will occur.

There has been intermittent publicity about possible health risks from breast implants. Most concerns have focused on silicone gel-filled implants. As of 1992, the Food and Drug Administration (FDA) restricted the use of this type of implant, and ordered further studies. Today only saline-filled implants are used for cosmetic breast surgery. Recent studies have shown no evidence long-term health risks from silicone implants. However, research on the possible links between these implants and autoimmune or connective tissue diseases is continuing.

Normal results

Breasts of expected size and appearance would be the normal results of this surgery.

Ellen S. Weber, MSN

Resources

BOOKS

Love, Susan M., with Karen Lindsey. *Dr. Susan Love's Breast Book*. 2nd ed. Reading, MA: Addison-Wesley, 1995.

PERIODICALS

"Breast Implant Update." *Harvard Women's Health Watch* 5 (Sept. 1997): 7.

ORGANIZATIONS

American Society of Plastic and Reconstructive Surgeons. 44 E. Algonquin Rd., Arlington Heights, IL 60005. (847) 228-9900. <<http://www.plasticsurgery.org>>.

Breast infection see **Mastitis**

Breast radiography see **Mammography**

Breast reconstruction

Definition

Breast reconstruction is a series of surgical procedures performed to recreate a breast. Reconstructions are commonly done after one or both breasts are removed as a treatment for **breast cancer**. Also, a breast may need to be refashioned for other reasons, such as trauma or abnormalities that occur during breast development.

Purpose

Many authorities consider reconstruction an integral part of the therapy for **breast cancer**. A breast that appears natural offers a sense of wholeness and normalcy, which can aid in the psychological recovery from breast cancer. It eliminates the need for an external prosthesis (false breast), which many women find physically uncomfortable as well as inconvenient.

Precautions

Not all women are good candidates for breast reconstruction. Overall poor physical health, or specific problems such as cigarette **smoking**, **obesity**, high blood pressure, or diabetes, will increase the chance of complications. Also, a difficult and/or prolonged recovery period or failure of the reconstruction may be a result. A woman's physical ability to cope with major surgery and recuperation also need to be considered.

Description

Breast reconstruction is done in two stages, with the ultimate goal of creating a breast which looks and feels as natural as possible. It is important to remember that