

located and tentatively identified with ultrasound. In particular, potentially malignant solid tumors can be distinguished from benign fluid-filled cysts and abscesses. Masses and malformations in any organ or part of the abdomen can be found.

- **Liver disease.** The types and underlying causes of liver disease are numerous, though **jaundice** tends to be a general symptom. Ultrasound can differentiate between many of the types and causes of liver malfunction, and is particularly good at identifying obstruction of the bile ducts and **cirrhosis**, which is characterized by abnormal fibrous growths and reduced blood flow.
- **Pancreatic disease.** Inflammation and malformation of the pancreas are readily identified by ultrasound, as are pancreatic stones (calculi), which can disrupt proper functioning.
- **Gallstones.** Gallstones cause more hospital admissions than any other digestive malady. These calculi can cause painful inflammation of the gallbladder and also obstruct the bile ducts that carry digestive enzymes from the gallbladder and liver to the intestines. Gallstones are readily identifiable with ultrasound.
- **Spleen disease.** The spleen is particularly prone to injury during abdominal trauma. It may also become painfully inflamed when beset with infection or **cancer**. These conditions also lend themselves well to ultrasonic inspection and diagnosis.
- **Kidney disease.** The kidneys are also prone to traumatic injury and are the organs most likely to form calculi, which can block the flow of urine and cause blood **poisoning** (uremia). A variety of diseases causing distinct changes in kidney morphology can also lead to complete kidney failure. Ultrasound imaging has proven extremely useful in diagnosing kidney disorders.
- **Abdominal aortic aneurysm.** This is a bulging weak spot in the abdominal aorta, which supplies blood directly from the heart to the entire lower body. These aneurysms are relatively common and increase in prevalence with age. A burst aortic aneurysm is imminently life-threatening. However, they can be readily identified and monitored with ultrasound before acute complications result.

Ultrasound technology can also be used for treatment purposes, most frequently as a visual aid during surgical procedures—such as guiding needle placement to drain fluid from a cyst, or to extract tumor cells for biopsy. Increasingly, direct therapeutic applications for ultrasound are being developed.

The direct therapeutic value of ultrasonic waves lies in their mechanical nature. They are shock waves, just like audible sound, and vibrate the materials through which

they pass. These vibrations are mild, virtually unnoticeable at the frequencies and intensities used for imaging. Properly focused however, high-intensity ultrasound can be used to heat and physically agitate targeted tissues.

High-intensity ultrasound is used routinely to treat soft tissue injuries, such as strains, tears and associated scarring. The heating and agitation are believed to promote rapid healing through increased circulation. Strongly focused, high-intensity, high-frequency ultrasound can also be used to physically destroy certain types of tumors, as well as gallstones and other types of calculi. Developing new treatment applications for ultrasound is an active area of medical research.

### Precautions

Properly performed, ultrasound imaging is virtually without risk or side effects. Some patients report feeling a slight tingling and/or warmth while being scanned, but most feel nothing at all. Ultrasound waves of appropriate frequency and intensity are not known to cause or aggravate any medical condition, though any woman who thinks she might be pregnant should raise the issue with her doctor before undergoing an abdominal ultrasound.

The value of ultrasound imaging as a medical tool, however, depends greatly on the quality of the equipment used and the skill of the medical personnel operating it. Improperly performed and/or interpreted, ultrasound can be worse than useless if it indicates that a problem exists where there is none, or fails to detect a significant condition. Basic ultrasound equipment is relatively inexpensive to obtain, and any doctor with the equipment can perform the procedure whether qualified or not. Patients should not hesitate to verify the credentials of technicians and doctors performing ultrasounds, as well as the quality of the equipment used and the benefits of the proposed procedure.

In cases where ultrasound is used as a treatment tool, patients should educate themselves about the proposed procedure with the help of their doctors—as is appropriate before any surgical procedure. Also, any abdominal ultrasound procedure, diagnostic or therapeutic, may be hampered by a patient's body type or other factors, such as the presence of excessive bowel gas (which is opaque to ultrasound). In particular, very obese people are often not good candidates for abdominal ultrasound.

### Description

Ultrasound includes all sound waves above the frequency of human hearing—about 20 thousand hertz, or cycles per second. Medical ultrasound generally uses frequencies between one and 10 million hertz (1-10 MHz).

## KEY TERMS

**Accessory organ**—A lump of tissue adjacent to an organ that is similar to it, but which serves no important purpose, if functional at all. While not necessarily harmful, such organs can cause problems if they grow too large or become cancerous. In any case, their presence points to an underlying abnormality in the parent organ.

**Benign**—In medical usage, benign is the opposite of malignant. It describes an abnormal growth that is stable, treatable and generally not life-threatening.

**Biopsy**—The surgical removal and analysis of a tissue sample for diagnostic purposes. Usually, the term refers to the collection and analysis of tissue from a suspected tumor to establish malignancy.

**Calculus**—Any type of hard concretion (stone) in the body, but usually found in the gallbladder, pancreas and kidneys. They are formed by the accumulation of excess mineral salts and other organic material such as blood or mucous. Calculi (pl.) can cause problems by lodging in and obstructing the proper flow of fluids, such as bile to the intestines or urine to the bladder.

**Cirrhosis**—A chronic liver disease characterized by the invasion of connective tissue and the degeneration of proper functioning—jaundice is often an accompanying symptom. Causes of cirrhosis include alcoholism, metabolic diseases, syphilis and congestive heart disease.

**Common bile duct**—The branching passage through which bile—a necessary digestive enzyme—travels from the liver and gallbladder into the small intestine. Digestive enzymes from the pancreas also enter the intestines through the common bile duct.

**Computed tomography scan (CT scan)**—A specialized type of x-ray imaging that uses highly focused and relatively low energy radiation to produce detailed two-dimensional images of soft tissue structures, particularly the brain. CT scans are the chief competitor to ultrasound and can yield higher quality images not disrupted by bone or gas. They are, however, more cumbersome, time consuming

and expensive to perform, and they use ionizing electromagnetic radiation.

**Doppler**—The Doppler effect refers to the apparent change in frequency of sound wave echoes returning to a stationary source from a moving target. If the object is moving toward the source, the frequency increases; if the object is moving away, the frequency decreases. The size of this frequency shift can be used to compute the object's speed—be it a car on the road or blood in an artery. The Doppler effect holds true for all types of radiation, not just sound.

**Frequency**—Sound, whether traveling through air or the human body, produces vibrations—molecules bouncing into each other—as the shock wave travels along. The frequency of a sound is the number of vibrations per second. Within the audible range, frequency means pitch—the higher the frequency, the higher a sound's pitch.

**Ionizing radiation**—Radiation that can damage living tissue by disrupting and destroying individual cells at the molecular level. All types of nuclear radiation—x rays, gamma rays and beta rays—are potentially ionizing. Sound waves physically vibrate the material through which they pass, but do not ionize it.

**Jaundice**—A condition that results in a yellow tint to the skin, eyes and body fluids. Bile retention in the liver, gallbladder and pancreas is the immediate cause, but the underlying cause could be as simple as obstruction of the common bile duct by a gallstone or as serious as pancreatic cancer. Ultrasound can distinguish between these conditions.

**Malignant**—The term literally means growing worse and resisting treatment. It is used as a synonym for cancerous and connotes a harmful condition that generally is life-threatening.

**Morphology**—Literally, the study of form. In medicine, morphology refers to the size, shape and structure rather than the function of a given organ. As a diagnostic imaging technique, ultrasound facilitates the recognition of abnormal morphologies as symptoms of underlying conditions.

Higher frequency ultrasound waves produce more detailed images, but are also more readily absorbed and so cannot penetrate as deeply into the body. Abdominal ultrasound imaging is generally performed at frequencies between 2-5 MHz.

An ultrasound machine consists of two parts: the transducer and the analyzer. The transducer both produces the sound waves that penetrate the body and receives the reflected echoes. Transducers are built around piezoelectric ceramic chips. (Piezoelectric refers to electricity that is produced when you put pressure on certain crystals such as quartz). These ceramic chips react to electric pulses by producing sound waves (they are transmitting waves) and react to sound waves by producing electric pulses (receiving). Bursts of high frequency electric pulses supplied to the transducer causes it to produce the scanning sound waves. The transducer then receives the returning echoes, translates them back into electric pulses and sends them to the analyzer—a computer that organizes the data into an image on a television screen.

Because sound waves travel through all the body's tissues at nearly the same speed—about 3,400 miles per hour—the microseconds it takes for each echo to be received can be plotted on the screen as a distance into the body. The relative strength of each echo, a function of the specific tissue or organ boundary that produced it, can be plotted as a point of varying brightness. In this way, the echoes are translated into a picture. Tissues surrounded by bone or filled with gas (the stomach, intestines and bowel) cannot be imaged using ultrasound, because the waves are blocked or become randomly scattered.

Four different modes of ultrasound are used in medical imaging:

- **A-mode.** This is the simplest type of ultrasound in which a single transducer scans a line through the body with the echoes plotted on screen as a function of depth. This method is used to measure distances within the body and the size of internal organs. Therapeutic ultrasound aimed at a specific tumor or calculus is also A-mode, to allow for pinpoint accurate focus of the destructive wave energy.
- **B-mode.** In B-mode ultrasound, a linear array of transducers simultaneously scans a plane through the body that can be viewed as a two-dimensional image on screen. Ultrasound probes containing more than 100 transducers in sequence form the basis for these most commonly used scanners, which cost about \$50,000.
- **M-Mode.** The M stands for motion. A rapid sequence of B-mode scans whose images follow each other in sequence on screen enables doctors to see and measure range of motion, as the organ boundaries that produce reflections move relative to the probe. M-

mode ultrasound has been put to particular use in studying heart motion.

- **Doppler mode.** **Doppler ultrasonography** includes the capability of accurately measuring velocities of moving material, such as blood in arteries and veins. The principle is the same as that used in radar guns that measure the speed of a car on the highway. Doppler capability is most often combined with B-mode scanning to produce images of blood vessels from which blood flow can be directly measured. This technique is used extensively to investigate valve defects, arteriosclerosis and **hypertension**, particularly in the heart, but also in the abdominal aorta and the portal vein of the liver. These machines cost about \$250,000.

The actual procedure for a patient undergoing an abdominal ultrasound is relatively simple, regardless of the type of scan or its purpose. **Fasting** for at least eight hours prior to the procedure ensures that the stomach is empty and as small as possible, and that the intestines and bowels are relatively inactive. Fasting also allows the gall bladder to be seen, as it contracts after eating and may not be seen if the stomach is full. In some cases, a full bladder helps to push intestinal folds out of the way so that the gas they contain does not disrupt the image. The patient's abdomen is then greased with a special gel that allows the ultrasound probe to glide easily across the skin while transmitting and receiving ultrasonic pulses.

This procedure is conducted by a doctor with the assistance of a technologist skilled in operating the equipment. The probe is moved around the abdomen to obtain different views of the target areas. The patient will likely be asked to change positions from side to side and to hold their breath as necessary to obtain the desired views. Discomfort during the procedure is minimal.

The many types and uses of ultrasound technology makes it difficult to generalize about the time and costs involved. Relatively simple imaging—scanning a suspicious abdominal mass or a suspected abdominal aortic aneurysm—will take about half an hour to perform and will cost a few hundred dollars or more, depending on the quality of the equipment, the operator and other factors. More involved techniques such as multiple M-mode and Doppler-enhanced scans, or cases where the targets not well defined in advance, generally take more time and are more expensive.

Regardless of the type of scan used and the potential difficulties encountered, ultrasound remains faster and less expensive than **computed tomography scans (CT)**, its primary rival in abdominal imaging. Furthermore, as abdominal ultrasounds are generally undertaken as “medically necessary” procedures designed to detect the presence of suspected abnormalities, they are covered

under most types of major medical insurance. As always, though, the patient would be wise to confirm that their coverage extends to the specific procedure proposed. For nonemergency situations, most underwriters stipulate prior approval as a condition of coverage.

Specific conditions for which ultrasound may be selected as a treatment option—certain types of tumors, lesions, **kidney stones** and other calculi, muscle and ligament injuries, etc.—are described in detail under the appropriate entries in this encyclopedia.

### Preparation

A patient undergoing abdominal ultrasound will be advised by their physician about what to expect and how to prepare. As mentioned above, preparations generally include fasting and arriving for the procedure with a full bladder, if necessary. This preparation is particularly useful if the gallbladder, ovaries or veins are to be examined.

### Aftercare

In general, no aftercare related to the abdominal ultrasound procedure itself is required.

### Risks

Abdominal ultrasound carries with it no recognized risks or side effects, if properly performed using appropriate frequency and intensity ranges. Sensitive tissues, particularly those of the reproductive organs, could possibly sustain damage if violently vibrated by overly intense ultrasound waves. In general though, such damage would only result from improper use of the equipment.

Any woman who thinks she might be pregnant should raise this issue with her doctor before undergoing an abdominal ultrasound, as a fetus in the early stages of development could be injured by ultrasound meant to probe deeply recessed abdominal organs.

### Normal results

As a diagnostic imaging technique, a normal abdominal ultrasound is one that indicates the absence of the suspected condition that prompted the scan. For example, symptoms such as a persistent **cough**, labored breathing, and upper abdominal pain suggest the possibility of, among other things, an abdominal aortic aneurysm. An ultrasound scan that indicates the absence of an aneurysm would rule out this life-threatening condition and point to other, less serious causes.

### Abnormal results

Because abdominal ultrasound imaging is generally undertaken to confirm a suspected condition, the results

of a scan often will prove abnormal—that is they will confirm the diagnosis, be it kidney stones, cirrhosis of the liver or an aortic aneurysm. At that point, appropriate medical treatment as prescribed by a patient's doctor is in order. See the relevant disease and disorder entries in this encyclopedia for more information.

### Resources

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#### ORGANIZATIONS

- American College of Gastroenterology. 4900 B South 31st St., Arlington, VA 22206-1656. (703) 820-7400. <<http://www.acg.gi.org>>.
- American Institute of Ultrasound in Medicine. 14750 Sweitzer Lane, Suite 100, Laurel, MD 20707-5906. (800) 638-5352. <<http://www.aium.org>>.
- American Society of Radiologic Technologists. 15000 Central Ave., SE, Albuquerque, NM 87123-3917. (505) 298-4500. <<http://www.asrt.org>>.

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## Abdominal wall defects

### Definition

Abdominal wall defects are birth (congenital) defects that allow the stomach or intestines to protrude.

## KEY TERMS

**Hernia**—Movement of a structure into a place it does not belong.

**Umbilical**—Referring to the opening in the abdominal wall where the blood vessels from the placenta enter.

**Viscera**—Any of the body's organs located in the chest or abdomen.

### Description

Many unexpected and fascinating events occur during the development of a fetus inside the womb. The stomach and intestines begin development outside the baby's abdomen and only later does the abdominal wall enclose them. Occasionally, either the umbilical opening is too large, or it develops improperly, allowing the bowels or stomach to remain outside or squeeze through the abdominal wall.

### Causes and symptoms

There are many causes for **birth defects** that still remain unclear. Presently, the cause(s) of abdominal wall defects is unknown, and any symptoms the mother may have to indicate that the defects are present in the fetus are nondescript.

### Diagnosis

At birth, the problem is obvious, because the base of the umbilical cord at the navel will bulge or, in worse cases, contain viscera (internal organs). Before birth, an ultrasound examination may detect the problem. It is always necessary in children with one birth defect to look for others, because birth defects are usually multiple.

### Treatment

Abdominal wall defects are effectively treated with surgical repair. Unless there are accompanying anomalies, the surgical procedure is not overly complicated. The organs are normal, just misplaced. However, if the defect is large, it may be difficult to fit all the viscera into the small abdominal cavity.

### Prognosis

If there are no other defects, the prognosis after surgical repair of this condition is relatively good. However,

10% of those with more severe or additional abnormalities die from it. The organs themselves are fully functional; the difficulty lies in fitting them inside the abdomen. The condition is, in fact, a **hernia** requiring only replacement and strengthening of the passageway through which it occurred. After surgery, increased pressure in the stretched abdomen can compromise the function of the organs inside.

### Prevention

Some, but by no means all, birth defects are preventable by early and attentive prenatal care, good **nutrition**, supplemental **vitamins**, diligent avoidance of all unnecessary drugs and chemicals—especially tobacco—and other elements of a healthy lifestyle.

### Resources

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J. Ricker Polsdorfer, MD

Abnormal heart rhythms see **Arrhythmias**

ABO blood typing see **Blood typing and crossmatching**

ABO incompatibility see **Erythroblastosis fetalis**

Abortion, habitual see **Recurrent miscarriage**

## Abortion, partial birth

### Definition

Partial birth abortion is a method of late-term abortion that terminates a **pregnancy** and results in the **death** and intact removal of a fetus. This procedure is most commonly referred to as intact dilatation and extraction (D & X).

### Purpose

Partial birth abortion, or D&X, is performed to end a pregnancy and results in the death of a fetus, typically in

the late second or third trimester. Although D&X is highly controversial, some physicians argue that it has advantages that make it a preferable procedure in some circumstances. One perceived advantage is that the fetus is removed largely intact, allowing for better evaluation and **autopsy** of the fetus in cases of known fetal anomalies. Intact removal of the fetus may also confer a lower risk of puncturing the uterus or damaging the cervix. Another perceived advantage is that D&X ends the pregnancy without requiring the woman to go through labor, which may be less emotionally traumatic than other methods of late-term abortion. In addition, D&X may offer a lower cost and shorter procedure time.

### Precautions

Women considering D&X should be aware of the highly controversial nature of this procedure. A controversy common to all late-term abortions is whether the fetus is viable, or able to survive outside of the woman's body. A specific area of controversy with D&X is that fetal death does not occur until after most of the fetal body has exited the uterus. Several states have taken legal action to limit or ban D&X and many physicians who perform abortions do not perform D&X. This may restrict the availability of this procedure to women seeking late-term abortion.

### Description

Intact D&X, or partial birth abortion first involves administration of medications to cause the cervix to dilate, usually over the course of several days. Next, the physician rotates the fetus to a footling breech position. The body of the fetus is then drawn out of the uterus feet first, until only the head remains inside the uterus. Then, the physician uses an instrument to puncture the base of the skull, which collapses the fetal head. Typically, the contents of the fetal head are then partially suctioned out, which results in the death of the fetus, and reduces the sizes of the fetal head enough to allow it to pass through the cervix. The dead and otherwise intact fetus is then removed from the woman's body.

### Preparation

Medical preparation for D&X involves an outpatient visit to administer medications, such as *laminaria*, to cause the cervix to begin dilating.

In addition, preparation may involve fulfilling local legal requirements, such as a mandatory waiting period, counseling, or an informed consent procedure reviewing stages of fetal development, **childbirth**, alternative abortion methods, and adoption.

## KEY TERMS

**Cervix**—The narrow outer end of the uterus that separates the uterus from the vaginal canal.

**Footling breech**—A position of the fetus while in the uterus where the feet of the fetus are nearest the cervix would be the first part of the fetus to exit the uterus, with the head of the fetus being the last part to exit the uterus.

**Laminaria**—A medical product made from a certain type of seaweed that is physically placed near the cervix to cause it to dilate.

### Aftercare

D&X typically does not require an overnight hospital stay, so a follow up appointment may be scheduled to monitor the woman for any complications.

### Risks

With all abortion, the later in pregnancy an abortion is performed, the more complicated the procedure and the greater the risk of injury to the woman. In addition to associated emotion reactions, D&X carries the risk of injury to the woman, including heavy bleeding, blood clots, damage to the cervix or uterus, pelvic infection, and anesthesia-related complications. There is also a risk of incomplete abortion, meaning that the fetus is not dead when removed from the woman's body. Possible long-term risks include difficulty becoming pregnant or carrying a future pregnancy to term.

### Normal results

The expected outcome of D&X is the termination of a pregnancy with removal of a dead fetus from the woman's body.

### Resources

#### PERIODICALS

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**ORGANIZATIONS**

Planned Parenthood Federation of America. 810 Seventh Ave., New York, NY 10019. (212) 541-7800. FAX: (212) 245-1845.

**OTHER**

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## Abortion, selective

**Definition**

Selective abortion, also known as selective reduction, refers to choosing to abort a fetus, typically in a multi-fetal **pregnancy**, to decrease the health risks to the mother in carrying and giving birth to more than one or two babies, and also to decrease the risk of complications to the remaining fetus(es). The term selective abortion also refers to choosing to abort a fetus for reasons such as the woman is carrying a fetus which likely will be born with some birth defect or impairment, or because the sex of the fetus is not preferred by the individual.

**Purpose**

A woman may decide to abort for health reasons, for example, she is at higher risk for complications during pregnancy because of a disorder or disease such as diabetes.

However, selective reduction is recommended often in cases of multi-fetal pregnancy, or the presence of more than one fetus, typically, at least three or more fetuses. In the general population, multi-fetal pregnancy happens in only about 1-2% of pregnant women. But multi-fetal pregnancies occur far more often in women using fertility drugs.

**Precautions**

Because women or couples who use fertility drugs have made an extra effort to become pregnant, it is possible that the individuals may be unwilling or uncomfortable with the decision to abort a fetus in cases of multi-fetal pregnancy. Individuals engaging in fertility treatment should be made aware of the risk of multi-fetal pregnancy and consider the prospect of recommended reduction before undergoing fertility treatment.

**Description**

Selective reduction is usually performed between nine and 12 weeks of pregnancy and is most successful

when performed in early pregnancy. It is a simple procedure and can be performed on an outpatient basis. A needle is inserted into the woman's stomach or vagina and potassium chloride is injected into the fetus.

**Preparation**

Individuals who have chosen selective reduction to safeguard the remaining fetuses should be counseled prior to the procedure. Individuals should receive information regarding the risks of a multi-fetal pregnancy to both the fetuses and the mother compared with the risks after the reduction.

Individuals seeking an abortion for any reason should consider the ethical implications whether it be because the fetus is not the preferred sex or because the fetus would be born with a severe birth defect.

**Aftercare**

Counseling should continue after the abortion because it is a traumatic event. Individuals may feel guilty about choosing one fetus over another. Mental health professionals should be consulted throughout the process.

**Risks**

About 75% of women who undergo selective reduction will go into **premature labor**. About 4-5% of women undergoing selective reduction also miscarry one or more of the remaining fetuses. The risks associated with multi-fetal pregnancy is considered higher.

**Normal results**

In cases where a multi-fetal pregnancy, three or more fetuses, is reduced to two, the twin fetuses typically develop as they would as if they were conceived as twins.

**Resources****BOOKS**

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## KEY TERMS

**Multi-fetal pregnancy**—A pregnancy of two or more fetuses.

**Selective reduction**—Typically referred to in cases of multifetal pregnancy, when one or more fetuses are aborted to preserve the viability of the remaining fetuses and decrease health risks to the mother.

## ORGANIZATIONS

The American Society for Reproductive Medicine. 1209 Montgomery Highway, Birmingham, AL 35216-2809. (205) 978-5000. <<http://www.asrm.org>>.

The Alan Guttmacher Institute. 120 Wall Street, New York, NY 10005. (212) 248-1111. <<http://www.agi-usa.org>>.

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Abortion, spontaneous see **Miscarriage**

## Abortion, therapeutic

### Definition

Therapeutic abortion is the intentional termination of a **pregnancy** before the fetus can live independently. Abortion has been a legal procedure in the United States since 1973.

### Purpose

An abortion may be performed whenever there is some compelling reason to end a pregnancy. Women have abortions because continuing the pregnancy would cause them hardship, endanger their life or health, or because prenatal testing has shown that the fetus will be born with severe abnormalities.

Abortions are safest when performed within the first six to 10 weeks after the last menstrual period. The calculation of this date is referred to as the gestational age and is used in determining the stage of pregnancy. For example, a woman who is two weeks late having her period is said to be six weeks pregnant, because it is six weeks since she last menstruated.

About 90% of women who have abortions do so before 13 weeks and experience few complications. Abortions performed between 13-24 weeks have a higher

rate of complications. Abortions after 24 weeks are extremely rare and are usually limited to situations where the life of the mother is in danger.

### Precautions

Most women are able to have abortions at clinics or outpatient facilities if the procedure is performed early in pregnancy. Women who have stable diabetes, controlled epilepsy, mild to moderate high blood pressure, or who are HIV positive can often have abortions as outpatients if precautions are taken. Women with heart disease, previous **endocarditis**, **asthma**, lupus erythematosus, uterine fibroid tumors, blood clotting disorders, poorly controlled epilepsy, or some psychological disorders usually need to be hospitalized in order to receive special monitoring and medications during the procedure.

### Description

#### *Very early abortions*

Between five and seven weeks, a pregnancy can be ended by a procedure called menstrual extraction. This procedure is also sometimes called menstrual regulation, mini-suction, or preemptive abortion. The contents of the uterus are suctioned out through a thin (3-4 mm) plastic tube that is inserted through the undilated cervix. Suction is applied either by a bulb syringe or a small pump.

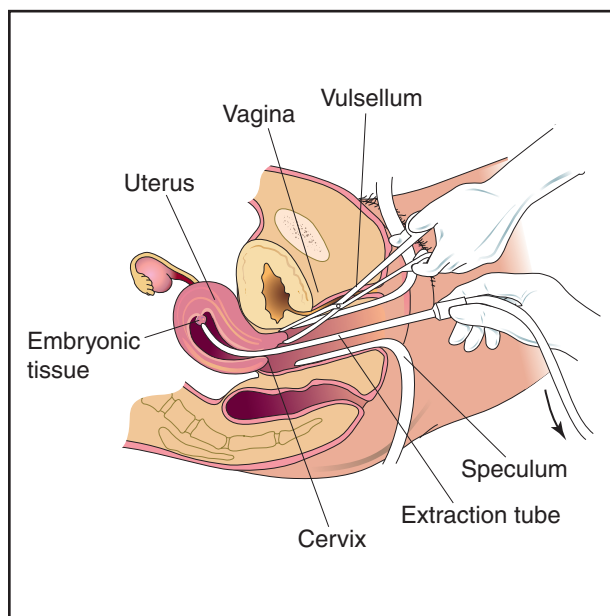
Another method is called the “morning after” pill, or emergency **contraception**. Basically, it involves taking high doses of birth control pills within 24 to 48 hours of having unprotected sex. The high doses of hormones causes the uterine lining to change so that it will not support a pregnancy. Thus, if the egg has been fertilized, it is simply expelled from the body.

There are two types of emergency contraception. One type is identical to ordinary birth control pills, and uses the hormones estrogen and progestin). This type is available with a prescription under the brand name Preven. But women can even use their regular birth control pills for emergency contraception, after they check with their doctor about the proper dose. About half of women who use birth control pills for emergency contraception get nauseated and 20 percent vomit. This method cuts the risk of pregnancy 75 percent.

The other type of morning-after pill contains only one hormone: progestin, and is available under the brand name Plan B. It is more effective than the first type with a lower risk of **nausea and vomiting**. It reduces the risk of pregnancy 89 percent.

Women should check with their physicians regarding the proper dose of pills to take, as it depends on the





Between 5 and 7 weeks, a pregnancy can be ended by a procedure called menstrual extraction. The contents of the uterus are suctioned out through a thin extraction tube that is inserted through the undilated cervix. (Illustration by Electronic Illustrators Group.)

brand of birth control pill. Not all birth control pills will work for emergency contraception.

Menstrual extractions are safe, but because the amount of fetal material is so small at this stage of development, it is easy to miss. This results in an incomplete abortion that means the pregnancy continues.

### *First trimester abortions*

The first trimester of pregnancy includes the first 13 weeks after the last menstrual period. In the United States, about 90% of abortions are performed during this period. It is the safest time in which to have an abortion, and the time in which women have the most choice of how the procedure is performed.

**MEDICAL ABORTIONS.** Medical abortions are brought about by taking medications that end the pregnancy. The advantages of a first trimester medical abortion are:

- The procedure is non-invasive; no surgical instruments are used.
- Anesthesia is not required.
- Drugs are administered either orally or by injection.
- The procedure resembles a natural **miscarriage**.

Disadvantages of a medical abortion are:

- The effectiveness decreases after the seventh week.

- The procedure may require multiple visits to the doctor.
- Bleeding after the abortion lasts longer than after a surgical abortion.
- The woman may see the contents of her womb as it is expelled.

Two different medications can be used to bring about an abortion. Methotrexate (Rheumatrex) works by stopping fetal cells from dividing which causes the fetus to die.

On the first visit to the doctor, the woman receives an injection of methotrexate. On the second visit, about a week later, she is given misoprostol (Cytotec), an oxygenated unsaturated cyclic fatty acid responsible for various hormonal reactions such as muscle contraction (prostaglandin), that stimulates contractions of the uterus. Within two weeks, the woman will expel the contents of her uterus, ending the pregnancy. A follow-up visit to the doctor is necessary to assure that the abortion is complete.

With this procedure, a woman will feel cramping and may feel nauseated from the misoprostol. This combination of drugs is 90-96% effective in ending pregnancy.

**Mifepristone** (RU-486), which goes by the brand name Mifeprex, works by blocking the action of progesterone, a hormone needed for pregnancy to continue, then stimulates uterine contractions thus ending the pregnancy. It can be taken as much as 49 days after the first day of a woman's last period. On the first visit to the doctor, a woman takes a mifepristone pill. Two days later she returns and, if the miscarriage has not occurred, takes two misoprostol pills, which causes the uterus to contract. Five percent of women won't need to take misoprostol. After an observation period, she returns home.

Within four days, 90% of women have expelled the contents of their uterus and completed the abortion. Within 14 days, 95-97% of women have completed the abortion. A third follow-up visit to the doctor is necessary to confirm through observation or ultrasound that the procedure is complete. In the event that it is not, a surgical abortion is performed. Studies show that 4.5 to 8 percent of women need surgery or a blood **transfusion** after taking mifepristone, and the pregnancy persists in about 1 percent of women. In this case, surgical abortion is recommended because the fetus may be damaged. Side effects include nausea, vaginal bleeding and heavy cramping. The bleeding is typically heavier than a normal period and may last up to 16 days.

Mifepristone is not recommended for women with **ectopic pregnancy**, an **IUD**, who have been taking long-

term steroidal therapy, have bleeding abnormalities or on blood-thinners such as Coumadin.

### *Surgical abortions*

First trimester surgical abortions are performed using vacuum aspiration. The procedure is also called dilation and evacuation (D & E), suction dilation, vacuum curettage, or suction curettage.

Advantages of a vacuum aspiration abortion are:

- It is usually done as a one-day outpatient procedure.
- The procedure takes only 10-15 minutes.
- Bleeding after the abortion lasts five days or less.
- The woman does not see the products of her womb being removed.

Disadvantages include:

- The procedure is invasive; surgical instruments are used.
- Infection may occur.

During a vacuum aspiration, the woman's cervix is gradually dilated by expanding rods inserted into the cervical opening. Once dilated, a tube attached to a suction pump is inserted through the cervix and the contents of the uterus are suctioned out. The procedure is 97-99% effective. The amount of discomfort a woman feels varies considerably. Local anesthesia is often given to numb the cervix, but it does not mask uterine cramping. After a few hours of rest, the woman may return home.

### *Second trimester abortions*

Although it is better to have an abortion during the first trimester, some second trimester abortions may be inevitable. The results of **genetic testing** are often not available until 16 weeks. In addition, women, especially teens, may not have recognized the pregnancy or come to terms with it emotionally soon enough to have a first trimester abortion. Teens make up the largest group having second trimester abortions.

Some second trimester abortions are performed as a D & E. The procedures are similar to those used in the first trimester, but a larger suction tube must be used because more material must be removed. This increases the amount of cervical dilation necessary and increases the risk of the procedure. Many physicians are reluctant to perform a D & E this late in pregnancy, and for some women it is not a medically safe option.

The alternative to a D & E in the second trimester is an abortion by induced labor. Induced labor may require an overnight stay in a hospital. The day before the procedure, the woman visits the doctor for tests, and to either

## KEY TERMS

**Endocarditis**—An infection of the inner membrane lining of the heart.

**Fibroid tumors**—Fibroid tumors are non-cancerous (benign) growths in the uterus. They occur in 30-40% of women over age 40, and do not need to be removed unless they are causing symptoms that interfere with a woman's normal activities.

**Lupus erythematosus**—A chronic inflammatory disease in which inappropriate immune system reactions cause abnormalities in the blood vessels and connective tissue.

**Prostaglandin**—Oxygenated unsaturated cyclic fatty acids responsible for various hormonal reactions such as muscle contraction.

**Rh negative**—Lacking the Rh factor, genetically determined antigens in red blood cells that produce immune responses. If an Rh negative woman is pregnant with an Rh positive fetus, her body will produce antibodies against the fetus's blood, causing a disease known as Rh disease. Sensitization to the disease occurs when the woman's blood is exposed to the fetus's blood. Rh immune globulin (RhoGAM) is a vaccine that must be given to a woman after an abortion, miscarriage, or prenatal tests in order to prevent sensitization to Rh disease.

have rods inserted in her cervix to help dilate it or to receive medication that will soften the cervix and speed up labor.

On the day of the abortion, drugs, usually prostaglandins to induce contractions, and a salt water solution, are injected into the uterus. Contractions begin, and within eight to 72 hours the woman delivers the fetus.

Side effects of this procedure include nausea, vomiting, and **diarrhea** from the prostaglandins, and **pain** from uterine cramps. Anesthesia of the sort used in **childbirth** can be given to mask the pain. Many women are able to go home a few hours after the procedure.

Very early abortions cost between \$200-\$400. Later abortions cost more. The cost increases about \$100 per week between the thirteenth and sixteenth week. Second trimester abortions are much more costly because they often involve more risk, more services, anesthesia, and sometimes a hospital stay. Insurance carriers and HMOs may or may not cover the procedure. Federal law pro-

hibits federal funds including Medicaid funds, from being used to pay for an elective abortion.

### Preparation

The doctor must know accurately the stage of a woman's pregnancy before an abortion is performed. The doctor will ask the woman questions about her menstrual cycle and also do a **physical examination** to confirm the stage of pregnancy. This may be done at an office visit before the abortion or on the day of the abortion. Some states require a waiting period before an abortion can be performed. Others require parental or court consent for a child under age 18 to receive an abortion.

Despite the fact that almost half of all women in the United States have had at least one abortion by the time they reach age 45, abortion is surrounded by controversy. Women often find themselves in emotional turmoil when deciding if an abortion is a procedure they wish to undergo. Pre-abortion counseling is important in helping a woman resolve any questions she may have about having the procedure.

### Aftercare

Regardless of the method used to perform the abortion, a woman will be observed for a period of time to make sure her blood pressure is stable and that bleeding is controlled. The doctor may prescribe **antibiotics** to reduce the chance of infection. Women who are Rh negative (lacking genetically determined antigens in their red blood cells that produce immune responses) should be given a human Rh immune globulin (RhoGAM) after the procedure unless the father of the fetus is also Rh negative. This prevents blood incompatibility complications in future pregnancies.

Bleeding will continue for about five days in a surgical abortion and longer in a medical abortion. To decrease the risk of infection, a woman should avoid intercourse and not use tampons and douches for two weeks after the abortion.

A follow-up visit is a necessary part of the woman's aftercare. Contraception will be offered to women who wish to avoid future pregnancies, because menstrual periods normally resume within a few weeks.

### Risks

Serious complications resulting from abortions performed before 13 weeks are rare. Of the 90% of women who have abortions in this time period, 2.5% have minor complications that can be handled without hospitalization. Less than 0.5% have complications that require a hospital stay. The rate of complications increases as the pregnancy progresses.

Complications from abortions can include:

- uncontrolled bleeding
- infection
- blood clots accumulating in the uterus
- a tear in the cervix or uterus
- missed abortion where the pregnancy continues
- incomplete abortion where some material from the pregnancy remains in the uterus

Women who experience any of the following symptoms of post-abortion complications should call the clinic or doctor who performed the abortion immediately.

- severe pain
- fever over 100.4°F (38.2°C)
- heavy bleeding that soaks through more than one sanitary pad per hour
- foul-smelling discharge from the vagina
- continuing symptoms of pregnancy

### Normal results

Usually the pregnancy is ended without complication and without altering future fertility.

### Resources

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DeCherney, Alan H., and Martin L. Peroll. "Contraception and Family Planning." In *Current Obstetric and Gynecologic Diagnosis and Treatment*. Norwalk, CT: Appleton & Lange, 1994.

#### ORGANIZATION

National Abortion Federation. (800) 772-9100. <<http://www.prochoice.org>>.

Debra Gordon

Abrasions see **Wounds**

Abruptio placentae see **Placental abruption**

## Abscess

### Definition

An abscess is an enclosed collection of liquefied tissue, known as pus, somewhere in the body. It is the result of the body's defensive reaction to foreign material.

## Description

There are two types of abscesses, septic and sterile. Most abscesses are septic, which means that they are the result of an infection. Septic abscesses can occur anywhere in the body. Only a germ and the body's immune response are required. In response to the invading germ, white blood cells gather at the infected site and begin producing chemicals called enzymes that attack the germ by digesting it. These enzymes act like acid, killing the germs and breaking them down into small pieces that can be picked up by the circulation and eliminated from the body. Unfortunately, these chemicals also digest body tissues. In most cases, the germ produces similar chemicals. The result is a thick, yellow liquid—pus—containing digested germs, digested tissue, white blood cells, and enzymes.

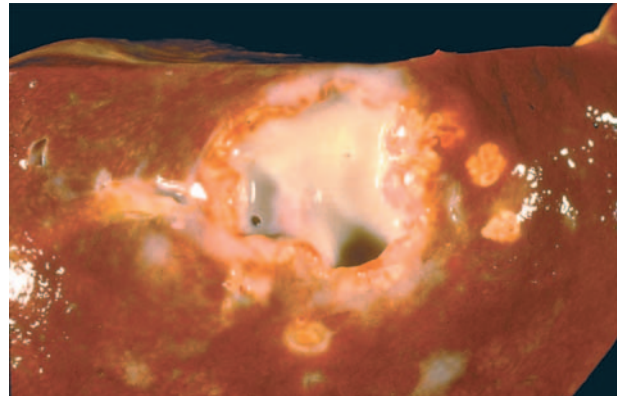
An abscess is the last stage of a tissue infection that begins with a process called inflammation. Initially, as the invading germ activates the body's immune system, several events occur:

- Blood flow to the area increases.
- The temperature of the area increases due to the increased blood supply.
- The area swells due to the accumulation of water, blood, and other liquids.
- It turns red.
- It hurts, because of the irritation from the swelling and the chemical activity.

These four signs—heat, swelling, redness, and pain—characterize inflammation.

As the process progresses, the tissue begins to turn to liquid, and an abscess forms. It is the nature of an abscess to spread as the chemical digestion liquefies more and more tissue. Furthermore, the spreading follows the path of least resistance—the tissues most easily digested. A good example is an abscess just beneath the skin. It most easily continues along beneath the skin rather than working its way through the skin where it could drain its toxic contents. The contents of the abscess also leak into the general circulation and produce symptoms just like any other infection. These include chills, **fever**, aching, and general discomfort.

Sterile abscesses are sometimes a milder form of the same process caused not by germs but by non-living irritants such as drugs. If an injected drug like penicillin is not absorbed, it stays where it was injected and may cause enough irritation to generate a sterile abscess—sterile because there is no infection involved. Sterile abscesses are quite likely to turn into hard, solid lumps as they scar, rather than remaining pockets of pus.



**An amoebic abscess caused by *Entamoeba histolytica*.**  
(Phototake NYC. Reproduced by permission.)

## Causes and symptoms

Many different agents cause abscesses. The most common are the pus-forming (pyogenic) bacteria like *Staphylococcus aureus*, which is nearly always the cause of abscesses under the skin. Abscesses near the large bowel, particularly around the anus, may be caused by any of the numerous bacteria found within the large bowel. Brain abscesses and liver abscesses can be caused by any organism that can travel there through the circulation. Bacteria, amoeba, and certain fungi can travel in this fashion. Abscesses in other parts of the body are caused by organisms that normally inhabit nearby structures or that infect them. Some common causes of specific abscesses are:

- skin abscesses by normal skin flora
- dental and throat abscesses by mouth flora
- lung abscesses by normal airway flora, **pneumonia** germs, or **tuberculosis**
- abdominal and anal abscesses by normal bowel flora

## Specific types of abscesses

Listed below are some of the more common and important abscesses.

- Carbuncles and other **boils**. Skin oil glands (sebaceous glands) on the back or the back of the neck are the ones usually infected. The most common germ involved is *Staphylococcus aureus*. **Acne** is a similar condition of sebaceous glands on the face and back.
- Pilonidal abscess. Many people have as a birth defect a tiny opening in the skin just above the anus. Fecal bacteria can enter this opening, causing an infection and subsequent abscess.

## KEY TERMS

**Cellulitis**—Inflammation of tissue due to infection.

**Enzyme**—Any of a number of protein chemicals that can change other chemicals.

**Fallopian tubes**—Part of the internal female anatomy that carries eggs from the ovaries to the uterus.

**Flora**—Living inhabitants of a region or area.

**Pyogenic**—Capable of generating pus. *Streptococcus*, *Staphylococcus*, and bowel bacteria are the primary pyogenic organisms.

**Sebaceous glands**—Tiny structures in the skin that produce oil (sebum). If they become plugged, sebum collects inside and forms a nurturing place for germs to grow.

**Septicemia**—The spread of an infectious agent throughout the body by means of the blood stream.

**Sinus**—A tubular channel connecting one body part with another or with the outside.

- Retropharyngeal, parapharyngeal, peritonsillar abscess. As a result of throat infections like **strep throat** and **tonsillitis**, bacteria can invade the deeper tissues of the throat and cause an abscess. These abscesses can compromise swallowing and even breathing.
- Lung abscess. During or after pneumonia, whether it's due to bacteria [common pneumonia], tuberculosis, fungi, parasites, or other germs, abscesses can develop as a complication.
- Liver abscess. Bacteria or amoeba from the intestines can spread through the blood to the liver and cause abscesses.
- Psoas abscess. Deep in the back of the abdomen on either side of the lumbar spine lie the psoas muscles. They flex the hips. An abscess can develop in one of these muscles, usually when it spreads from the appendix, the large bowel, or the fallopian tubes.

## Diagnosis

The common findings of inflammation—heat, redness, swelling, and pain—easily identify superficial abscesses. Abscesses in other places may produce only generalized symptoms such as fever and discomfort. If the patient's symptoms and **physical examination** do not help, a physician may have to resort to a battery of tests to

locate the site of an abscess, but usually something in the initial evaluation directs the search. Recent or chronic disease in an organ suggests it may be the site of an abscess. Dysfunction of an organ or system—for instance, seizures or altered bowel function—may provide the clue. **Pain** and tenderness on physical examination are common findings. Sometimes a deep abscess will eat a small channel (sinus) to the surface and begin leaking pus. A sterile abscess may cause only a painful lump deep in the buttock where a shot was given.

## Treatment

Since skin is very resistant to the spread of infection, it acts as a barrier, often keeping the toxic chemicals of an abscess from escaping the body on their own. Thus, the pus must be drained from the abscess by a physician. The surgeon determines when the abscess is ready for drainage and opens a path to the outside, allowing the pus to escape. Ordinarily, the body handles the remaining infection, sometimes with the help of **antibiotics** or other drugs. The surgeon may leave a drain (a piece of cloth or rubber) in the abscess cavity to prevent it from closing before all the pus has drained out.

## Alternative treatment

If an abscess is directly beneath the skin, it will be slowly working its way through the skin as it is more rapidly working its way elsewhere. Since chemicals work faster at higher temperatures, applications of hot compresses to the skin over the abscess will hasten the digestion of the skin and eventually result in its breaking down, releasing the pus spontaneously. This treatment is best reserved for smaller abscesses in relatively less dangerous areas of the body—limbs, trunk, back of the neck. It is also useful for all superficial abscesses in their very early stages. It will “ripen” them.

Contrast **hydrotherapy**, alternating hot and cold compresses, can also help assist the body in resorption of the abscess. There are two homeopathic remedies that work to rebalance the body in relation to abscess formation, *Silica* and *Hepar sulphuris*. In cases of septic abscesses, bentonite clay packs (bentonite clay and a small amount of *Hydrastis* powder) can be used to draw the infection from the area.

## Prognosis

Once the abscess is properly drained, the prognosis is excellent for the condition itself. The reason for the abscess (other diseases the patient has) will determine the overall outcome. If, on the other hand, the abscess ruptures into neighboring areas or permits the infectious

agent to spill into the bloodstream, serious or fatal consequences are likely. Abscesses in and around the nasal sinuses, face, ears, and scalp may work their way into the brain. Abscesses within an abdominal organ such as the liver may rupture into the abdominal cavity. In either case, the result is life threatening. Blood **poisoning** is a term commonly used to describe an infection that has spilled into the blood stream and spread throughout the body from a localized origin. Blood poisoning, known to physicians as septicemia, is also life threatening.

Of special note, abscesses in the hand are more serious than they might appear. Due to the intricate structure and the overriding importance of the hand, any hand infection must be treated promptly and competently.

### Prevention

Infections that are treated early with heat (if superficial) or antibiotics will often resolve without the formation of an abscess. It is even better to avoid infections altogether by taking prompt care of open injuries, particularly puncture **wounds**. Bites are the most dangerous of all, even more so because they often occur on the hand.

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- Current Medical Diagnosis and Treatment*, 1996. 35th ed. Ed. Stephen McPhee, et al. Stamford: Appleton & Lange, 1995.
- Harrison's Principles of Internal Medicine*. Ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.

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Abscess drainage see **Abscess incision and drainage**

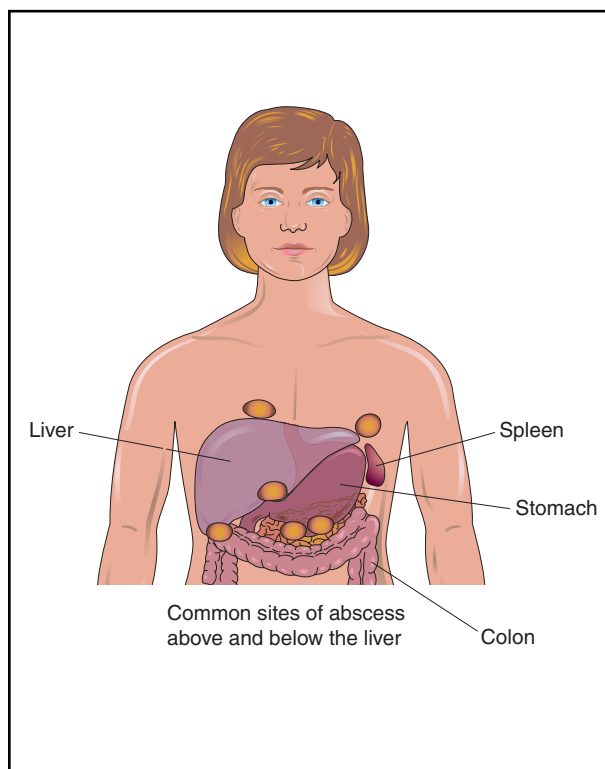
## Abscess incision & drainage

### Definition

An infected skin nodule that contains pus may need to be drained via a cut if it does not respond to **antibiotics**. This allows the pus to escape, and the infection to heal.

### Purpose

An **abscess** is a pus-filled sore, usually caused by a bacterial infection. The pus is made up of both live and dead organisms and destroyed tissue from the white



**Although abscesses are often found in the soft tissue under the skin, such as the armpit or the groin, they may develop in any organ, such as the liver.** (Illustration by Electronic Illustrators Group.)

blood cells that were carried to the area to fight the infection. Abscesses are often found in the soft tissue under the skin, such as the armpit or the groin. However, they may develop in any organ, and are commonly found in the breast and gums. Abscesses are far more serious and call for more specific treatment if they are located in deep organs such as the lung, liver or brain.

Because the lining of the abscess cavity tends to interfere with the amount of the drug that can penetrate the source of infection from the blood, the cavity itself may require draining. Once an abscess has fully formed, it often does not respond to antibiotics. Even if the antibiotic does penetrate into the abscess, it doesn't function as well in that environment.

### Precautions

An abscess can usually be diagnosed visually, although an imaging technique such as a computed tomography scan may be used to confirm the extent of the abscess before drainage. Such procedures may also be needed to localize internal abscesses, such as those in the abdominal cavity or brain.

## KEY TERMS

**White blood cells**—Cells that protect the body against infection.

### Description

A doctor will cut into the lining of the abscess, allowing the pus to escape either through a drainage tube or by leaving the cavity open to the skin. How big the incision is depends on how quickly the pus is encountered.

Once the abscess is opened, the doctor will clean and irrigate the wound thoroughly with saline. If it is not too large or deep, the doctor may simply pack the abscess wound with gauze for 24–48 hours to absorb the pus and discharge.

If it is a deeper abscess, the doctor may insert a drainage tube after cleaning out the wound. Once the tube is in place, the surgeon closes the incision with simple stitches, and applies a sterile dressing. Drainage is maintained for several days to help prevent the abscess from reforming.

### Preparation

The skin over the abscess will be cleansed by swabbing gently with an antiseptic solution.

### Aftercare

Much of the **pain** around the abscess will be gone after the surgery. Healing is usually very fast. After the tube is taken out, antibiotics may be continued for several days. Applying heat and keeping the affected area elevated may help relieve inflammation.

### Risks

If there is any scarring, it is likely to become much less noticeable as time goes on, and eventually almost invisible. Occasionally, an abscess within a vital organ (such as the brain) damages enough surrounding tissue that there is some permanent loss of normal function.

### Normal results

Most abscesses heal after drainage alone; others require drainage and antibiotic drug treatment.

### Resources

#### BOOKS

Turkington, Carol A., and Jeffrey S. Dover. *Skin Deep*. New York: Facts on File, 1998.

### ORGANIZATIONS

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 9000 Rockville Pike, Bldg. 31, Rm 9A04, Bethesda, MD 20892.

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## Abuse

### Definition

Abuse is defined as any thing that is harmful, injurious, or offensive. Abuse also includes excessive and wrongful misuse of anything. There are several major types of abuse: physical and sexual abuse of a child or an adult, substance abuse, elderly abuse, and emotional abuse.

### Description

Physical abuse of a child is the infliction of injury by an other person. The injuries can include punching, kicking, biting, burning, beating, or pulling the victim's hair. The physical abuse inflicted on a child can result in **bruises, burns, poisoning**, broken bones, and internal hemorrhages. Physical assault against an adult primarily occurs with women, usually in the form of domestic violence. It is estimated that approximately three million children witness domestic violence every year.

Sexual abuse of a child refers to sexual behavior between an adult and child or between two children, one of whom is dominant or significantly older. The sexual behaviors can include touching breasts, genitals, and buttocks; either dressed or undressed. The behavior can also include exhibitionism, cunnilingus, fellatio, or penetration of the vagina or anus with sexual organs or objects.

Pornographic photography is also used in sexual abuse with children. Reported sex offenders are 97% male. Females are more often perpetrators in child-care settings, since children may confuse sexual abuse by a female with normal hygiene care. Sexual abuse by stepfathers is five times more common than with biological fathers. Sexual abuse of daughters by stepfathers or fathers is the most common form of incest.

Sexual abuse can also take the form of rape. The legal definition of rape includes only slight penile penetration in the victim's outer vulva area. Complete erection and ejaculation are not necessary. Rape is the perpetration of an act of sexual intercourse whether:

- will is overcome by force or fear (from threats or by use of drugs).



- mental impairment renders the victim incapable of rational judgment.
- if the victim is below the legal age established for consent.

Substance abuse is an abnormal pattern of substance usage leading to significant distress or impairment. The criteria include one or more of the following occurring within a 12-month period:

- recurrent substance use resulting in failure to fulfill obligations at home, work, or school.
- using substance in situations that are physically dangerous (i.e., while driving).
- recurrent substance-related legal problems.
- continued usage despite recurrent social and interpersonal problems (i.e., arguments and fights with significant other).

Abuse in the elderly is common and occurs mostly as a result of caretaker burnout, due to the high level of dependency frail, elderly patients usually require. Abuse can be manifested by physical signs, fear, and delaying or not reporting the need for advanced medical care. Elderly patients may also exhibit financial abuse (money or possessions taken away) and abandonment.

Emotional abuse generally continues even after physical assaults have stopped. In most cases it is a personally tailored form of verbal or gesture abuse expressed to illicit a provoked response.

### Causes and symptoms

Children who have been abused usually have a variety of symptoms that encompass behavioral, emotional, and psychosomatic problems. Children who have been physically abused tend to be more aggressive, angry, hostile, depressed, and have low self-esteem. Additionally, they exhibit fear, **anxiety**, and nightmares. Severe psychological problems may result in suicidal behavior or posttraumatic **stress** disorder. Physically abused children may complain of physical illness even in the absence of a cause. They may also suffer from eating disorders and encopresis. Children who are sexually abused may exhibit abnormal sexual behavior in the form of aggressiveness and hyperarousal. Adolescents may display promiscuity, sexual acting out, and—in some situations—homosexual contact.

Physical abuse directed towards adults can ultimately lead to **death**. Approximately 50% of women murdered in the United States were killed by a former or current male partner. Approximately one-third of emergency room consultations by women were prompted due to domestic violence. Female victims who are married also have a higher rate of internal injuries and unconscious-

## KEY TERMS

**Encopresis**—Abnormalities relating to bowel movements that can occur as a result of stress or fear.

ness than victims of stranger assault (mugging, robbery). Physical abuse or rape can also occur between married persons and persons of the same gender. Perpetrators usually sexually assault their victims to dominate, hurt, and debase them. It is common for physical and sexual violence to occur at the same time. A large percentage of sexually assaulted persons were also physically abused in the form of punching, beating, or threatening the victim with a weapon such as a gun or knife. Usually males who are hurt and humiliated tend to physical assault persons whom they are intimately involved with, such as spouses and/or children. Males who assault a female tend to have experienced or witnessed violence during childhood. They also tend to abuse alcohol, to be sexually assaultive, and are at increased risk for assaultive behavior directed against children. Jealous males tend to monitor the women's movements and whereabouts and to isolate other sources of protection and support. They interpret their behavior as betrayal of trust and this causes resentment and explosive anger outbursts during periods of losing control. Males may also use aggression against females in an effort to control and intimidate partners.

Abuse in the elderly usually occurs in the frail, elderly community. The caretaker is usually the perpetrator. Caretaker abuse can be suspected if there is evidence suggesting behavioral changes in the elderly person when the caretaker is present. Additionally, elderly abuse can be possible if there are delays between injuries and treatment, inconsistencies between injury and explanations, lack of hygiene or clothing, and prescriptions not being filled.

### Diagnosis

Children who are victims of domestic violence are frequently injured attempting to protect their mother from an abusive partner. Injuries are visible by inspection or self-report. Physical abuse of an adult may be also be evident by inspection with visible cuts and/or bruises or self report.

Sexual abuse of both a child and an adult can be diagnosed with a history from the victim. Victims can be assessed for ejaculatory evidence from the perpetrator. Ejaculatory specimens can be retrieved from the mouth, rectum, and clothing. Tests for **sexually transmitted diseases** may be performed.



Elderly abuse can be suspected if the elderly patient demonstrates a fear from the caretaker. Additionally, elderly abuse can be suspected if there are signs indicating intentional delay of required medical care or a change in medical status.

Substance abuse can be suspected in a person who continues to indulge in their drug of choice despite recurrent negative consequences. The diagnosis can be made after administration of a comprehensive bio-psychosocial exam and standardized chemical abuse assessments by a therapist.

### Treatment

Children who are victims of physical or sexual abuse typically require psychological support and medical attention. A complaint may be filed with the local family social services that will initiate investigations. The authorities will usually follow up the allegation or offense. Children may also be referred for psychological evaluation and/or treatment. The victim may be placed in foster care pending the investigation outcome. The police may also investigate physical and sexual abuse of an adult. The victim may require immediate medical care and long-term psychological treatment. It is common for children to be adversely affected by domestic violence situations and the local family services agency may be involved.

Substance abusers should elect treatment, either inpatient or outpatient, depending on severity of **addiction**. Long term treatment and/or medications may be utilized to assist in abstinence. The patient should be encouraged to participate in community centered support groups.

### Prognosis

The prognosis depends on the diagnosis. Usually victims of physical and sexual abuse require therapy to deal with emotional distress associated with the incident. Perpetrators require further psychological evaluation and treatment. Victims of abuse may have a variety of emotional problems including depression, acts of suicide, or anxiety. Children of sexual abuse may as adults enter abusive relationships or have problems with intimacy. The substance abuser may experience relapses, since the cardinal feature of all addictive disorders is a tendency to return to symptoms. Elderly patients may suffer from further medical problems and/or anxiety, and in some cases neglect may precipitate death.

### Prevention

Prevention programs are geared to education and awareness. Detection of initial symptoms or characteris-

tic behaviors may assist in some situations. In some cases treatment may be sought before incident. The professional treating the abused persons must develop a clear sense of the relationship dynamics and the chances for continued harm.

### Resources

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- Narendra, K., and S. Lazoritz. "Physical Assessment: Evaluation for Possible Physical and Sexual Abuse." *Pediatric Clinics of North America* 45 (Feb. 1998).
- Stringham, P. "Mental Health: Domestic Violence." *Primary Care; Clinics in Office Practice* 26 (June 1999).

#### ORGANIZATIONS

- National Clearinghouse on Child Abuse and Neglect Information. 330 C Street SW, Washington, DC 20447. (800) 392-3366.

#### OTHER

- Elder Abuse Prevention. <<http://www.oaktrees.org/elder>>.
- National Institute on Drug Abuse. <<http://www.nida.nih.gov>>.

Laith Farid Gulli, M.D.  
Bilal Nasser, M.Sc.

Acceleration-deceleration cervical injury  
see **Whiplash**

ACE inhibitors see **Angiotensin-converting enzyme inhibitors**

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## Acetaminophen

### Definition

Acetaminophen is a medicine used to relieve **pain** and reduce **fever**.

### Purpose

Acetaminophen is used to relieve many kinds of minor aches and pains—headaches, muscle aches, backaches, toothaches, menstrual cramps, arthritis, and the aches and pains that often accompany colds.

## Description

This drug is available without a prescription. Acetaminophen—or APAP—is sold under various brand names, including Tylenol, Panadol, **Aspirin** Free Anacin, and Bayer Select Maximum Strength **Headache** Pain Relief Formula. Many multi-symptom cold, flu, and sinus medicines also contain acetaminophen. Check the ingredients listed on the container to see if acetaminophen is included in the product.

Studies have shown that acetaminophen relieves pain and reduces fever about as well as aspirin. But differences between these two common drugs exist. Acetaminophen is less likely than aspirin to irritate the stomach. However, unlike aspirin, acetaminophen does not reduce the redness, stiffness, or swelling that accompany arthritis.

## Recommended dosage

The usual dosage for adults and children age 12 and over is 325-650 mg every 4- 6 hours as needed. No more than 4 grams (4000 mg) should be taken in 24 hours. Because the drug can potentially harm the liver, people who drink alcohol in large quantities should take considerably less acetaminophen and possibly should avoid the drug completely.

For children ages 6-11 years, the usual dose is 150-300 mg, three to four times a day. Check with a physician for dosages for children under age 6 years.

## Precautions

Never take more than the recommended dosage of acetaminophen unless told to do so by a physician or dentist.

Patients should not use acetaminophen for more than 10 days to relieve pain (5 days for children) or for more than 3 days to reduce fever, unless directed to do so by a physician. If symptoms do not go away—or if they get worse—contact a physician. Anyone who drinks three or more alcoholic beverages a day should check with a physician before using this drug and should never take more than the recommended dosage. A risk of liver damage exists from combining large amounts of alcohol and acetaminophen. People who already have kidney or liver disease or liver infections should also consult with a physician before using the drug. So should women who are pregnant or breastfeeding.

**Smoking** cigarettes may interfere with the effectiveness of acetaminophen. Smokers may need to take higher doses of the medicine, but should not take more than the recommended daily dosage unless told by a physician to do so.

## KEY TERMS

**Arthritis**—Inflammation of the joints. The condition causes pain and swelling.

**Fatigue**—Physical or mental weariness.

**Inflammation**—A response to irritation, infection, or injury, resulting in pain, redness, and swelling.

Many drugs can interact with one another. Consult a physician or pharmacist before combining acetaminophen with any other medicine. Do not use two different acetaminophen-containing products at the same time.

Acetaminophen interferes with the results of some medical tests. Before having medical tests done, check to see whether taking acetaminophen will affect the results. Avoiding the drug for a few days before the tests may be necessary.

## Side effects

Acetaminophen causes few side effects. The most common one is lightheadedness. Some people may experience trembling and pain in the side or the lower back. Allergic reactions do occur in some people, but they are rare. Anyone who develops symptoms such as a rash, swelling, or difficulty breathing after taking acetaminophen should stop taking the drug and get immediate medical attention. Other rare side effects include yellow skin or eyes, unusual bleeding or bruising, weakness, **fatigue**, bloody or black stools, bloody or cloudy urine, and a sudden decrease in the amount of urine.

Overdoses of acetaminophen may cause nausea, vomiting, sweating, and exhaustion. Very large overdoses can cause liver damage. In case of an overdose, get immediate medical attention.

## Interactions

Acetaminophen 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. Among the drugs that may interact with acetaminophen are alcohol, **nonsteroidal anti-inflammatory drugs** (NSAIDs) such as Motrin, **oral contraceptives**, the antiseizure drug phenytoin (Dilantin), the blood-thinning drug warfarin (Coumadin), the cholesterol-lowering drug cholestyramine (Questran), the antibiotic Isoniazid, and zidovudine (Retrovir, AZT).

Check with a physician or pharmacist before combining acetaminophen with any other prescription or nonprescription (over-the-counter) medicine.

Nancy Ross-Flanigan

Acetylsalicylic acid see **Aspirin**

## Achalasia

### Definition

Achalasia is a disorder of the esophagus that prevents normal swallowing.

### Description

Achalasia affects the esophagus, the tube that carries swallowed food from the back of the throat down into the stomach. A ring of muscle called the lower esophageal sphincter encircles the esophagus just above the entrance to the stomach. This sphincter muscle is normally contracted to close the esophagus. When the sphincter is closed, the contents of the stomach cannot flow back into the esophagus. Backward flow of stomach contents (reflux) can irritate and inflame the esophagus, causing symptoms such as **heartburn**. The act of swallowing causes a wave of esophageal contraction called peristalsis. Peristalsis pushes food along the esophagus. Normally, peristalsis causes the esophageal sphincter to relax and allow food into the stomach. In achalasia, which means “failure to relax,” the esophageal sphincter remains contracted. Normal peristalsis is interrupted and food cannot enter the stomach.

### Causes and symptoms

#### Causes

Achalasia is caused by degeneration of the nerve cells that normally signal the brain to relax the esophageal sphincter. The ultimate cause of this degeneration is unknown. Autoimmune disease or hidden infection is suspected.

#### Symptoms

Dysphagia, or difficulty swallowing, is the most common symptom of achalasia. The person with achalasia usually has trouble swallowing both liquid and solid foods, often feeling that food “gets stuck” on the way down. The person has chest **pain** that is often mistaken for **angina pectoris** (cardiac pain). Heartburn and difficulty belching

are common. Symptoms usually get steadily worse. Other symptoms may include nighttime **cough** or recurrent **pneumonia** caused by food passing into the lower airways.

### Diagnosis

Diagnosis of achalasia begins with a careful medical history. The history should focus on the timing of symptoms and on eliminating other medical conditions that may cause similar symptoms. Tests used to diagnose achalasia include:

- Esophageal manometry. In this test, a thin tube is passed into the esophagus to measure the pressure exerted by the esophageal sphincter.
- X ray of the esophagus. Barium may be swallowed to act as a contrast agent. Barium reveals the outlines of the esophagus in greater detail and makes it easier to see its constriction at the sphincter.
- Endoscopy. In this test, a tube containing a lens and a light source is passed into the esophagus. Endoscopy is used to look directly at the surface of the esophagus. This test can also detect tumors that cause symptoms like those of achalasia. **Cancer** of the esophagus occurs as a complication of achalasia in 2-7% of patients.

### Treatment

The first-line treatment for achalasia is balloon dilation. In this procedure, an inflatable membrane or balloon is passed down the esophagus to the sphincter and inflated to force the sphincter open. Dilation is effective in about 70% of patients.

Three other treatments are used for achalasia when balloon dilation is inappropriate or unacceptable.

- Botulinum toxin injection. Injected into the sphincter, botulinum toxin paralyzes the muscle and allows it to relax. Symptoms usually return within one to two years.
- Esophagomyotomy. This surgical procedure cuts the sphincter muscle to allow the esophagus to open. Esophagomyotomy is becoming more popular with the development of techniques allowing very small abdominal incisions.
- Drug therapy. Nifedipine, a calcium-channel blocker, reduces muscle contraction. Taken daily, this drug provides relief for about two-thirds of patients for as long as two years.

### Prognosis

Most patients with achalasia can be treated effectively. Achalasia does not reduce life expectancy unless esophageal carcinoma develops.

## KEY TERMS

**Botulinum toxin**—Any of a group of potent bacterial toxins or poisons produced by different strains of the bacterium *Clostridium botulinum*. The toxins cause muscle paralysis.

**Dysphagia**—Difficulty in swallowing.

**Endoscopy**—A test in which a viewing device and a light source are introduced into the esophagus by means of a flexible tube. Endoscopy permits visual inspection of the esophagus for abnormalities.

**Esophageal manometry**—A test in which a thin tube is passed into the esophagus to measure the degree of pressure exerted by the muscles of the esophageal wall.

**Esophageal sphincter**—A circular band of muscle that closes the last few centimeters of the esophagus and prevents the backward flow of stomach contents.

**Esophagomyotomy**—A surgical incision through the muscular tissue of the esophagus.

**Esophagus**—The muscular tube that leads from the back of the throat to the entrance of the stomach.

**Peristalsis**—The coordinated, rhythmic wave of smooth muscle contraction that forces food through the digestive tract.

**Reflux**—An abnormal backward or return flow of a fluid.

## Prevention

There is no known way to prevent achalasia.

## Resources

### BOOKS

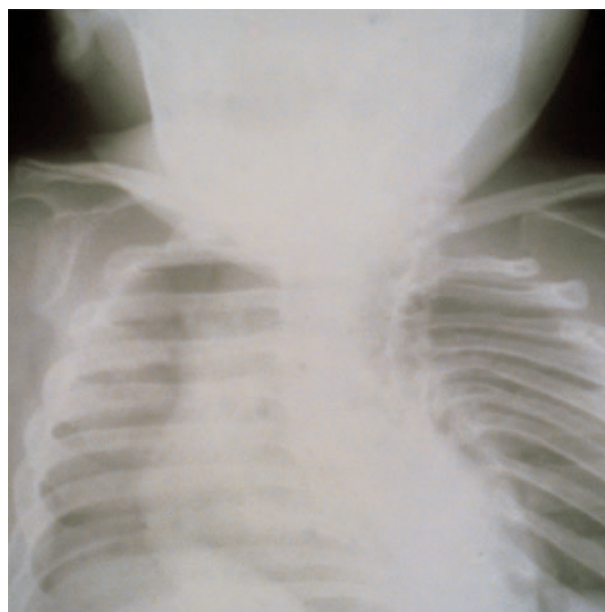
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Richard Robinson

# Achondroplasia

## Definition

Achondroplasia is the most common cause of dwarfism, or significantly abnormal short stature.



An x-ray image of an achondroplastic person's head and chest. (Custom Medical Stock Photo. Reproduced by permission.)

## Description

Achondroplasia is one of a number of chondrodystrophies, in which the development of cartilage, and therefore, bone is disturbed. The disorder appears in approximately one in every 10,000 births. Achondroplasia is usually diagnosed at birth, owing to the characteristic appearance of the newborn.

Normal bone growth depends on the production of cartilage (a fibrous connective tissue). Over time, calcium is deposited within the cartilage, causing it to harden and become bone. In achondroplasia, abnormalities of this process prevent the bones (especially those in the limbs) from growing as long as they normally should, at the same time allowing the bones to become abnormally thickened. The bones in the trunk of the body and the skull are mostly not affected, although the opening from the skull through which the spinal cord passes (foramen magnum) is often narrower than normal, and the opening (spinal canal) through which the spinal cord runs in the back bones (vertebrae) becomes increasingly and abnormally small down the length of the spine.

## Causes and symptoms

Achondroplasia is caused by a genetic defect. It is a dominant trait, meaning that anybody with the genetic defect will display all the symptoms of the disorder. A parent with the disorder has a 50% chance of passing it

## KEY TERMS

**Cartilage**—A flexible, fibrous type of connective tissue which serves as a base on which bone is built.

**Foramen magnum**—The opening at the base of the skull, through which the spinal cord and the brain-stem pass.

**Hydrocephalus**—An abnormal accumulation of fluid within the brain. This accumulation can be destructive by pressing on brain structures, and damaging them.

**Mutation**—A new, permanent change in the structure of a gene, which can result in abnormal structure or function somewhere in the body.

**Spinal canal**—The opening that runs through the center of the column of spinal bones (vertebrae), and through which the spinal cord passes.

**Vertebrae**—The individual bones of the spinal column which are stacked on top of each other. There is a hole in the center of each bone, through which the spinal cord passes.

on to the offspring. Although achondroplasia can be passed on to subsequent offspring, the majority of cases occur due to a new mutation (change) in a gene. Interestingly enough, the defect seen in achondroplasia is one of only a few defects known to increase in frequency with increasing age of the father (many genetic defects are linked to increased age of the mother).

People with achondroplasia have abnormally short arms and legs. Their trunk is usually of normal size, as is their head. The appearance of short limbs and normal head size actually makes the head appear to be oversized. The bridge of the nose often has a scooped out appearance termed "saddle nose." The lower back has an abnormal curvature, or sway back. The face often displays an overly prominent forehead, and a relative lack of development of the face in the area of the upper jaw. Because the foramen magnum and spinal canal are abnormally narrowed, nerve damage may occur if the spinal cord or nerves become compressed. The narrowed foramen magnum may disrupt the normal flow of fluid between the brain and the spinal cord, resulting in the accumulation of too much fluid in the brain (**hydrocephalus**). Children with achondroplasia have a very high risk of serious and repeated middle ear infections, which can result in **hearing loss**. The disease does not affect either mental capacity, or reproductive ability.

## Diagnosis

Diagnosis is often made at birth due to the characteristically short limbs, and the appearance of a large head. X-ray examination will reveal a characteristic appearance to the bones, with the bones of the limbs appearing short in length, yet broad in width. A number of measurements of the bones in x-ray images will reveal abnormal proportions.

## Treatment

No treatment will reverse the defect present in achondroplasia. All patients with the disease will be short, with abnormally proportioned limbs, trunk, and head. Treatment of achondroplasia primarily addresses some of the complications of the disorder, including problems due to nerve compression, hydrocephalus, bowed legs, and abnormal curves in the spine. Children with achondroplasia who develop middle ear infections (acute **otitis media**) will require quick treatment with **antibiotics** and careful monitoring in order to avoid hearing loss.

## Prognosis

Achondroplasia is a disease which causes considerable deformity. However, with careful attention paid to the development of dangerous complications (nerve compression, hydrocephalus), most people are in good health, and can live a normal lifespan.

## Prevention

The only form of prevention is through **genetic counseling**, which could help parents assess their risk of having a child with achondroplasia.

## Resources

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### ORGANIZATIONS

- Little People of America, c/o Mary Carten. 7238 Piedmont Drive, Dallas, TX 75227-9324. (800) 243-9273.

Rosalyn Carson-DeWitt, MD

Achromatopsia see **Color blindness**

Acid indigestion see **Heartburn**

## Acid phosphatase test

### Definition

Acid phosphatase is an enzyme found throughout the body, but primarily in the prostate gland. Like all enzymes, it is needed to trigger specific chemical reactions. Acid phosphatase testing is done to diagnose whether **prostate cancer** has spread to other parts of the body (metastasized), and to check the effectiveness of treatment. The test has been largely supplanted by the prostate specific antigen test (PSA).

### Purpose

The male prostate gland has 100 times more acid phosphatase than any other body tissue. When prostate **cancer** spreads to other parts of the body, acid phosphatase levels rise, particularly if the cancer spreads to the bone. One-half to three-fourths of persons who have metastasized prostate cancer have high acid phosphatase levels. Levels fall after the tumor is removed or reduced through treatment.

Tissues other than prostate have small amounts of acid phosphatase, including bone, liver, spleen, kidney, and red blood cells and platelets. Damage to these tissues causes a moderate increase in acid phosphatase levels.

Acid phosphatase is very concentrated in semen. Rape investigations will often include testing for the presence of acid phosphatase in vaginal fluid.

### Precautions

This is not a screening test for prostate cancer. Acid phosphatase levels rise only after prostate cancer has metastasized.

### Description

Laboratory testing measures the amount of acid phosphatase in a person's blood, and can determine from what tissue the enzyme is coming. For example, it is important to know if the increased acid phosphatase is from the prostate or red blood cells. Acid phosphatase from the prostate, called prostatic acid phosphatase (PAP), is the most medically significant type of acid phosphatase.

## KEY TERMS

**Enzyme**—A substance needed to trigger specific chemical reactions.

**Metastasize**—Spread to other parts of the body; usually refers to cancer.

**Prostate gland**—A gland of the male reproductive system.

Subtle differences between prostatic acid phosphatase and acid phosphatases from other tissues cause them to react differently in the laboratory when mixed with certain chemicals. For example, adding the chemical tartrate to the test mixture inhibits the activity of prostatic acid phosphatase but not red blood cell acid phosphatase. Laboratory test methods based on these differences reveal how much of a person's total acid phosphatase is derived from the prostate. Results are usually available the next day.

### Preparation

This test requires drawing about 5-10 mL of blood. The patient should not have a rectal exam or prostate massage for two to three days prior to the test.

### Aftercare

Discomfort or bruising may occur at the puncture site, and the person may feel dizzy or faint. Applying pressure to the puncture site until the bleeding stops will reduce bruising. Warm packs to the puncture site will relieve discomfort.

### Normal results

Normal results vary based on the laboratory and the method used.

### Abnormal results

The highest levels of acid phosphatase are found in metastasized prostate cancer. Diseases of the bone, such as Paget's disease or **hyperparathyroidism**; diseases of blood cells, such as **sickle cell disease** or **multiple myeloma**; or lysosomal disorders, such as Gaucher's disease, will show moderately increased levels.

Certain medications can cause temporary increases or decreases in acid phosphatase levels. Manipulation of the prostate gland through massage, biopsy, or rectal exam before a test can increase the level.

## Resources

### BOOKS

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Nancy J. Nordenson

Acid reflux see **Heartburn**

Acidosis see **Respiratory acidosis; Renal tubular acidosis; Metabolic acidosis**

## Acne

### Definition

Acne is a common skin disease characterized by pimples on the face, chest, and back. It occurs when the pores of the skin become clogged with oil, dead skin cells, and bacteria.

### Description

Acne vulgaris, the medical term for common acne, is the most common skin disease. It affects nearly 17 million people in the United States. While acne can arise at any age, it usually begins at **puberty** and worsens during adolescence. Nearly 85% of people develop acne at some time between the ages of 12-25 years. Up to 20% of women develop mild acne. It is also found in some newborns.

The sebaceous glands lie just beneath the skin's surface. They produce an oil called sebum, the skin's natural moisturizer. These glands and the hair follicles within which they are found are called sebaceous follicles. These follicles open onto the skin through pores. At puberty, increased levels of androgens (male hormones) cause the glands to produce too much sebum. When excess sebum combines with dead, sticky skin cells, a hard plug, or comedo, forms that blocks the pore. Mild noninflammatory acne consists of the two types of comedones, whiteheads and blackheads.

Moderate and severe inflammatory types of acne result after the plugged follicle is invaded by *Propionibacterium acnes*, a bacteria that normally lives on the

skin. A pimple forms when the damaged follicle weakens and bursts open, releasing sebum, bacteria, and skin and white blood cells into the surrounding tissues. Inflamed pimples near the skin's surface are called papules; when deeper, they are called pustules. The most severe type of acne consists of cysts (closed sacs) and nodules (hard swellings). Scarring occurs when new skin cells are laid down to replace damaged cells.

The most common sites of acne are the face, chest, shoulders, and back since these are the parts of the body where the most sebaceous follicles are found.

### Causes and symptoms

The exact cause of acne is unknown. Several risk factors have been identified:

- **Age.** Due to the hormonal changes they experience, teenagers are more likely to develop acne.
- **Gender.** Boys have more severe acne and develop it more often than girls.
- **Disease.** Hormonal disorders can complicate acne in girls.
- **Heredity.** Individuals with a family history of acne have greater susceptibility to the disease.
- **Hormonal changes.** Acne can flare up before menstruation, during **pregnancy**, and **menopause**.
- **Diet.** No foods cause acne, but certain foods may cause flare-ups.
- **Drugs.** Acne can be a side effect of drugs including tranquilizers, antidepressants, **antibiotics**, **oral contraceptives**, and anabolic steroids.
- **Personal hygiene.** Abrasive soaps, hard scrubbing, or picking at pimples will make them worse.
- **Cosmetics.** Oil-based makeup and hair sprays worsen acne.
- **Environment.** Exposure to oils and greases, polluted air, and sweating in hot weather aggravate acne.
- **Stress.** Emotional stress may contribute to acne.

Acne is usually not conspicuous, although inflamed lesions may cause **pain**, tenderness, **itching**, or swelling. The most troubling aspects of these lesions are the negative cosmetic effects and potential for scarring. Some people, especially teenagers, become emotionally upset about their condition, and have problems forming relationships or keeping jobs.

### Diagnosis

Acne patients are often treated by family doctors. Complicated cases are referred to a dermatologist, a skin



disease specialist, or an endocrinologist, a specialist who treats diseases of the body's endocrine (hormones and glands) system.

Acne has a characteristic appearance and is not difficult to diagnose. The doctor takes a complete medical history, including questions about skin care, diet, factors causing flare-ups, medication use, and prior treatment. **Physical examination** includes the face, upper neck, chest, shoulders, back, and other affected areas. Under good lighting, the doctor determines what types and how many blemishes are present, whether they are inflamed, whether they are deep or superficial, and whether there is scarring or skin discoloration.

In teenagers, acne is often found on the forehead, nose, and chin. As people get older, acne tends to appear towards the outer part of the face. Adult women may have acne on their chins and around their mouths. The elderly may develop whiteheads and blackheads on the upper cheeks and skin around the eyes.

Laboratory tests are not done unless the patient appears to have a hormonal disorder or other medical problem. In this case, blood analyses or other tests may be ordered. Most insurance plans cover the costs of diagnosing and treating acne.

## Treatment

Acne treatment consists of reducing sebum production, removing dead skin cells, and killing bacteria with topical drugs and oral medications. Treatment choice depends upon whether the acne is mild, moderate, or severe.

## Drugs

**TOPICAL DRUGS.** Treatment for mild noninflammatory acne consists of reducing the formation of new comedones with topical tretinoin, benzoyl peroxide, adapalene, or salicylic acid. Tretinoin is especially effective because it increases turnover (**death** and replacement) of skin cells. When complicated by inflammation, topical antibiotics may be added to the treatment regimen. Improvement is usually seen in two to four weeks.

Topical medications are available as cream, gel, lotion, or pad preparations of varying strengths. They include antibiotics (agents that kill bacteria), such as erythromycin, clindamycin (Cleocin-T), and meclocycline (Meclan); comedolytics (agents that loosen hard plugs and open pores) such as the vitamin A acid tretinoin (Retin-A), salicylic acid, adapalene (Differin), resorcinol, and sulfur. Drugs that act as both comedolytics and antibiotics, such as benzoyl peroxide, azelaic acid (Azelex), or benzoyl peroxide plus erythromycin (Benza-



**Acne vulgaris affecting a woman's face. Acne is the general name given to a skin disorder in which the sebaceous glands become inflamed.** (Photograph by Biophoto Associates, Photo Researchers, Inc. Reproduced by permission.)

mycin), are also used. These drugs may be used for months to years to achieve disease control.

After washing with mild soap, the drugs are applied alone or in combination, once or twice a day over the entire affected area of skin. Possible side effects include mild redness, peeling, irritation, dryness, and an increased sensitivity to sunlight that requires use of a sunscreen.

**ORAL DRUGS.** Oral antibiotics are taken daily for two to four months. The drugs used include tetracycline, erythromycin, minocycline (Minocin), doxycycline, clindamycin (Cleocin), and trimethoprim-sulfamethoxazole (Bactrim, Septra). Possible side effects include allergic reactions, stomach upset, vaginal yeast infections, **dizziness**, and tooth discoloration.

The goal of treating moderate acne is to decrease inflammation and prevent new comedone formation. One effective treatment is topical tretinoin along with a topical



## KEY TERMS

**Androgens**—Male sex hormones that are linked with the development of acne.

**Antiandrogens**—Drugs that inhibit the production of androgens.

**Antibiotics**—Medicines that kill bacteria.

**Comedo**—A hard plug composed of sebum and dead skin cells. The mildest type of acne.

**Comedolytic**—Drugs that break up comedones and open clogged pores.

**Corticosteroids**—A group of hormones produced by the adrenal glands with different functions, including regulation of fluid balance, androgen activity, and reaction to inflammation.

**Estrogens**—Hormones produced by the ovaries, the female sex glands.

**Isotretinoin**—A drug that decreases sebum production and dries up acne pimples.

**Sebaceous follicles**—A structure found within the skin that houses the oil-producing glands and hair follicles, where pimples form.

**Sebum**—An oily skin moisturizer produced by sebaceous glands.

**Tretinoin**—A drug that works by increasing the turnover (death and replacement) of skin cells.

or oral antibiotic. A combination of topical benzoyl peroxide and erythromycin is also very effective. Improvement is normally seen within four to six weeks, but treatment is maintained for at least two to four months.

A drug reserved for the treatment of severe acne, oral isotretinoin (Accutane), reduces sebum production and cell stickiness. It is the treatment of choice for severe acne with cysts and nodules, and is used with or without topical or oral antibiotics. Taken for four to five months, it provides long-term disease control in up to 60% of patients. If the acne reappears, another course of isotretinoin may be needed by about 20% of patients, while another 20% may do well with topical drugs or oral antibiotics. Side effects include temporary worsening of the acne, dry skin, nosebleeds, vision disorders, and elevated liver enzymes, blood fats and cholesterol. This drug must not be taken during pregnancy since it causes **birth defects**.

Anti-androgens, drugs that inhibit androgen production, are used to treat women who are unresponsive to other therapies. Certain types of oral contraceptives (for

example, Ortho-Tri-Cyclen) and female sex hormones (estrogens) reduce hormone activity in the ovaries. Other drugs, for example, spironolactone and **corticosteroids**, reduce hormone activity in the adrenal glands. Improvement may take up to four months.

Oral corticosteroids, or anti-inflammatory drugs, are the treatment of choice for an extremely severe, but rare type of destructive inflammatory acne called acne fulminans, found mostly in adolescent males. Acne conglobata, a more common form of severe inflammation, is characterized by numerous, deep, inflammatory nodules that heal with scarring. It is treated with oral isotretinoin and corticosteroids.

### Other treatments

Several surgical or medical treatments are available to alleviate acne or the resulting scars:

- Comedone extraction. The comedo is removed from the pore with a special tool.
- Chemical peels. Glycolic acid is applied to peel off the top layer of skin to reduce scarring.
- Dermabrasion. The affected skin is frozen with a chemical spray, and removed by brushing or planing.
- Punch grafting. Deep scars are excised and the area repaired with small skin grafts.
- Intralesional injection. Corticosteroids are injected directly into inflamed pimples.
- Collagen injection. Shallow scars are elevated by collagen (protein) injections.

### Alternative treatment

Alternative treatments for acne focus on proper cleansing to keep the skin oil-free; eating a well-balanced diet high in fiber, zinc, and raw foods; and avoiding alcohol, dairy products, **smoking**, **caffeine**, sugar, processed foods, and foods high in iodine, such as salt. Supplementation with herbs such as burdock root (*Arctium lappa*), red clover (*Trifolium pratense*), and milk thistle (*Silybum marianum*), and with nutrients such as essential fatty acids, vitamin B complex, zinc, vitamin A, and chromium is also recommended. Chinese herbal remedies used for acne include cnidium seed (*Cnidium monnieri*) and honeysuckle flower (*Lonicera japonica*). Wholistic physicians or nutritionists can recommend the proper amounts of these herbs.

### Prognosis

Acne is not curable, although long-term control is achieved in up to 60% of patients treated with

isotretinoin. It can be controlled by proper treatment, with improvement taking two or more months. Acne tends to reappear when treatment stops, but spontaneously improves over time. Inflammatory acne may leave scars that require further treatment.

### Prevention

There are no sure ways to prevent acne, but the following steps may be taken to minimize flare-ups:

- gentle washing of affected areas once or twice every day
- avoid abrasive cleansers
- use noncomedogenic makeup and moisturizers
- shampoo often and wear hair off face
- eat a well-balanced diet, avoiding foods that trigger flare-ups
- unless told otherwise, give dry pimples a limited amount of sun exposure
- do not pick or squeeze blemishes
- reduce stress

### 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>>.

Mercedes McLaughlin

Acne rosacea see **Rosacea**

Acoustic neurinoma see **Acoustic neuroma**

## Acoustic neuroma

### Definition

An acoustic neuroma is a benign tumor involving cells of the myelin sheath that surrounds the vestibulocochlear nerve (eighth cranial nerve).

### Description

The vestibulocochlear nerve extends from the inner ear to the brain and is made up of a vestibular branch, often called the vestibular nerve, and a cochlear branch, called the cochlear nerve. The vestibular and cochlear nerves lie next to one another. They also run along side other cranial nerves. People possess two of each type of vestibulocochlear nerve, one that extends from the left ear and one that extends from the right ear.

The vestibular nerve transmits information concerning balance from the inner ear to the brain and the cochlear nerve transmits information about hearing. The vestibular nerve, like many nerves, is surrounded by a cover called a myelin sheath. A tumor, called a schwannoma, can sometimes develop from the cells of the myelin sheath. A tumor is an abnormal growth of tissue that results from the uncontrolled growth of cells. Acoustic neuromas are often called vestibular schwannomas because they are tumors that arise from the myelin sheath that surrounds the vestibular nerve. Acoustic neuromas are considered benign (non-cancerous) tumors since they do not spread to other parts of the body. They can occur anywhere along the vestibular nerve but are most likely to occur where the vestibulocochlear nerve passes through the tiny bony canal that connects the brain and the inner ear.

An acoustic neuroma can arise from the left vestibular nerve or the right vestibular nerve. A unilateral tumor is a tumor arising from one nerve and a bilateral tumor arises from both vestibular nerves. Unilateral acoustic neuromas usually occur spontaneously (by chance). Bilateral acoustic neuromas occur as part of a hereditary con-

dition called **Neurofibromatosis Type 2 (NF2)**. A person with NF2 has inherited a predisposition for developing acoustic neuromas and other tumors of the nerve cells.

Acoustic neuromas usually grow slowly and can take years to develop. Some acoustic neuromas remain so small that they do not cause any symptoms. As the acoustic neuroma grows it can interfere with the functioning of the vestibular nerve and can cause vertigo and balance difficulties. If the acoustic nerve grows large enough to press against the cochlear nerve, then **hearing loss** and a ringing (**tinnitus**) in the affected ear will usually occur. If untreated and the acoustic neuroma continues to grow it can press against other nerves in the region and cause other symptoms. This tumor can be life threatening if it becomes large enough to press against and interfere with the functioning of the brain.

## Causes and symptoms

### Causes

An acoustic neuroma is caused by a change or absence of both of the NF2 tumor suppressor genes in a nerve cell. Every person possesses a pair of NF2 genes in every cell of their body including their nerve cells. One NF2 gene is inherited from the egg cell of the mother and one NF2 gene is inherited from the sperm cell of the father. The NF2 gene is responsible for helping to prevent the formation of tumors in the nerve cells. In particular the NF2 gene helps to prevent acoustic neuromas.

Only one unchanged and functioning NF2 gene is necessary to prevent the formation of an acoustic neuroma. If both NF2 genes become changed or missing in one of the myelin sheath cells of the vestibular nerve then an acoustic neuroma will usually develop. Most unilateral acoustic neuromas result when the NF2 genes become spontaneously changed or missing. Someone with a unilateral acoustic neuroma that has developed spontaneously is not at increased risk for having children with an acoustic neuroma. Some unilateral acoustic neuromas result from the hereditary condition NF2. It is also possible that some unilateral acoustic neuromas may be caused by changes in other genes responsible for preventing the formation of tumors.

Bilateral acoustic neuromas result when someone is affected with the hereditary condition NF2. A person with NF2 is typically born with one unchanged and one changed or missing NF2 gene in every cell of their body. Sometimes they inherit this change from their mother or father. Sometimes the change occurs spontaneously when the egg and sperm come together to form the first cell of the baby. The children of a person with NF2 have a 50% chance of inheriting the changed or missing NF2 gene.

A person with NF2 will develop an acoustic neuroma if the remaining unchanged NF2 gene becomes spontaneously changed or missing in one of the myelin sheath cells of their vestibular nerve. People with NF2 often develop acoustic neuromas at a younger age. The mean age of onset of acoustic neuroma in NF2 is 31 years of age versus 50 years of age for sporadic acoustic neuromas. Not all people with NF2, however, develop acoustic neuromas. People with NF2 are at increased risk for developing **cataracts** and tumors in other nerve cells.

Most people with a unilateral acoustic neuroma are not affected with NF2. Some people with NF2, however, only develop a tumor in one of the vestibulocochlear nerves. Others may initially be diagnosed with a unilateral tumor but may develop a tumor in the other nerve a number of years later. NF2 should be considered in someone under the age of 40 who has a unilateral acoustic neuroma. Someone with a unilateral acoustic neuroma and other family members diagnosed with NF2 probably is affected with NF2. Someone with a unilateral acoustic neuroma and other symptoms of NF2 such as cataracts and other tumors may also be affected with NF2. On the other hand, someone over the age of 50 with a unilateral acoustic neuroma, no other tumors and no family history of NF2 is very unlikely to be affected with NF2.

### Symptoms

Small acoustic neuromas usually only interfere with the functioning of the vestibulocochlear nerve. The most common first symptom of an acoustic neuroma is hearing loss, which is often accompanied by a ringing sound (tinnitus). People with acoustic neuromas sometimes report difficulties in using the phone and difficulties in perceiving the tone of a musical instrument or sound even when their hearing appears to be otherwise normal. In most cases the hearing loss is initially subtle and worsens gradually over time until deafness occurs in the affected ear. In approximately 10% of cases the hearing loss is sudden and severe.

Acoustic neuromas can also affect the functioning of the vestibular branch of the vestibulocochlear nerve and can cause vertigo and dysequilibrium. Twenty percent of small tumors are associated with periodic vertigo, which is characterized by **dizziness** or a whirling sensation. Larger acoustic neuromas are less likely to cause vertigo but more likely to cause dysequilibrium. Dysequilibrium, which is characterized by minor clumsiness and a general feeling of instability, occurs in nearly 50% of people with an acoustic neuroma.

As the tumor grows larger it can press on the surrounding cranial nerves. Compression of the fifth cranial nerve can result in facial **pain** and or numbness. Compression of the seventh cranial nerve can cause spasms, weakness or

## KEY TERMS

**Benign tumor**—A localized overgrowth of cells that does not spread to other parts of the body.

**Chromosome**—A microscopic structure, made of a complex of proteins and DNA, that is found within each cell of the body.

**Computed tomography (CT)**—An examination that uses a computer to compile and analyze the images produced by x rays projected at a particular part of the body.

**Cranial nerves**—The set of twelve nerves found on each side of the head and neck that control the sensory and muscle functions of a number of organs such as the eyes, nose, tongue face and throat.

**DNA testing**—Testing for a change or changes in a gene or genes.

**Gene**—A building block of inheritance, made up of a compound called DNA (deoxyribonucleic acid) and containing the instructions for the production of a particular protein. Each gene is found on a specific location on a chromosome.

**Magnetic resonance imaging (MRI)**—A test which

uses an external magnetic field instead of x rays to visualize different tissues of the body.

**Myelin sheath**—The cover that surrounds many nerve cells and helps to increase the speed by which information travels along the nerve.

**Neurofibromatosis type 2 (NF2)**—A hereditary condition associated with an increased risk of bilateral acoustic neuromas, other nerve cell tumors and cataracts.

**Protein**—A substance produced by a gene that is involved in creating the traits of the human body such as hair and eye color or is involved in controlling the basic functions of the human body.

**Schwannoma**—A tumor derived from the cells of the myelin sheath that surrounds many nerve cells.

**Tinnitus**—A ringing sound or other noise in the ear.

**Vertigo**—A feeling of spinning or whirling.

**Vestibulocochlear nerve (Eighth cranial nerve)**—Nerve that transmits information, about hearing and balance from the ear to the brain.

**paralysis** of the facial muscles. Double vision is a rare symptom but can result when the 6th cranial nerve is affected. Swallowing and/or speaking difficulties can occur if the tumor presses against the 9th, 10th, or 12th cranial nerves.

If left untreated, the tumor can become large enough to press against and affect the functioning of the brain stem. The brain stem is the stalk like portion of the brain that joins the spinal cord to the cerebrum, the thinking and reasoning part of the brain. Different parts of the brainstem have different functions such as the control of breathing and muscle coordination. Large tumors that impact the brain stem can result in headaches, walking difficulties (gait ataxia) and involuntary shaking movements of the muscles (**tremors**). In rare cases when an acoustic neuroma remains undiagnosed and untreated it can cause nausea, vomiting, lethargy and eventually **coma**, respiratory difficulties and **death**. In the vast majority of cases, however, the tumor is discovered and treated long before it is large enough to cause such serious manifestations.

### Diagnosis

Anyone with symptoms of hearing loss should undergo hearing evaluations. Pure tone and speech **audiometry**

are two screening tests that are often used to evaluate hearing. Pure tone audiometry tests to see how well someone can hear tones of different volume and pitch and speech audiometry tests to see how well someone can hear and recognize speech. An acoustic neuroma is suspected in someone with unilateral hearing loss or hearing loss that is less severe in one ear than the other ear (asymmetrical).

Sometimes an auditory brainstem response (ABR, BAER) test is performed to help establish whether someone is likely to have an acoustic neuroma. During the ABR examination, a harmless electrical impulse is passed from the inner ear to the brainstem. An acoustic neuroma can interfere with the passage of this electrical impulse and this interference can, sometimes be identified through the ABR evaluation. A normal ABR examination does not rule out the possibility of an acoustic neuroma. An abnormal ABR examination increases the likelihood that an acoustic neuroma is present but other tests are necessary to confirm the presence of a tumor.

If an acoustic neuroma is strongly suspected then **magnetic resonance imaging (MRI)** is usually performed. The MRI is a very accurate evaluation that is

able to detect nearly 100% of acoustic neuromas. Computerized tomography (CT scan, CAT scan) is unable to identify smaller tumors; but it can be used when an acoustic neuroma is suspected and an MRI evaluation cannot be performed.

Once an acoustic neuroma is diagnosed, an evaluation by genetic specialists such as a geneticist and genetic counselor may be recommended. The purpose of this evaluation is to obtain a detailed family history and check for signs of NF2. If NF2 is strongly suspected then DNA testing may be recommended. DNA testing involves checking the blood cells obtained from a routine blood draw for the common gene changes associated with NF2.

## Treatment

The three treatment options for acoustic neuroma are surgery, radiation, and observation. The physician and patient should discuss the pros and cons of the different options prior to making a decision about treatment. The patient's, physical health, age, symptoms, tumor size, and tumor location should be considered.

### Microsurgery

The surgical removal of the tumor or tumors is the most common treatment for acoustic neuroma. In most cases the entire tumor is removed during the surgery. If the tumor is large and causing significant symptoms, yet there is a need to preserve hearing in that ear, then only part of the tumor may be removed. During the procedure the tumor is removed under microscopic guidance and general anesthetic. Monitoring of the neighboring cranial nerves is done during the procedure so that damage to these nerves can be prevented. If preservation of hearing is a possibility, then monitoring of hearing will also take place during the surgery.

Most people stay in the hospital four to seven days following the surgery. Total recovery usually takes four to six weeks. Most people experience **fatigue** and head discomfort following the surgery. Problems with balance and head and neck stiffness are also common. The mortality rate of this type of surgery is less than 2% at most major centers. Approximately 20% of patients experience some degree of post-surgical complications. In most cases these complications can be managed successfully and do not result in long term medical problems. Surgery brings with it a risk of **stroke**, damage to the brain stem, infection, leakage of spinal fluid and damage to the cranial nerves. Hearing loss and/or tinnitus often result from the surgery. A follow-up MRI is recommended one to five years following the surgery because of possible regrowth of the tumor.

### Stereotactic Radiation therapy

During stereotactic **radiation therapy**, also called radiosurgery or radiotherapy, many small beams of radiation are aimed directly at the acoustic neuroma. The radiation is administered in a single large dose, under local anesthetic and is performed on an outpatient basis. This results in a high dose of radiation to the tumor but little radiation exposure to the surrounding area. This treatment approach is limited to small or medium tumors. The goal of the surgery is to cause tumor shrinkage or at least limit the growth of the tumor. The long term efficacy and risks of this treatment approach are not known. Periodic MRI monitoring throughout the life of the patient is therefore recommended.

Radiation therapy can cause hearing loss which can sometimes occur even years later. Radiation therapy can also cause damage to neighboring cranial nerves, which can result in symptoms such as numbness, pain or paralysis of the facial muscles. In many cases these symptoms are temporary. Radiation treatment can also induce the formation of other benign or malignant schwannomas. This type of treatment may therefore be contraindicated in the treatment of acoustic neuromas in those with NF2 who are predisposed to developing schwannomas and other tumors.

### Observation

Acoustic neuromas are usually slow growing and in some cases they will stop growing and even become smaller or disappear entirely. It may therefore be appropriate in some cases to hold off on treatment and to periodically monitor the tumor through MRI evaluations. Long-term observation may be appropriate for example in an elderly person with a small acoustic neuroma and few symptoms. Periodic observation may also be indicated for someone with a small and asymptomatic acoustic neuroma that was detected through an evaluation for another medical problem. Observation may also be suggested for someone with an acoustic neuroma in the only hearing ear or in the ear that has better hearing. The danger of an observational approach is that as the tumor grows larger it can become more difficult to treat.

## Prognosis

The prognosis for someone with a unilateral acoustic neuroma is usually quite good provided the tumor is diagnosed early and appropriate treatment is instituted. Long term hearing loss and tinnitus in the affected ear are common, even if appropriate treatment is provided. Regrowth of the tumor is also a possibility following surgery or radiation therapy and repeat treatment may be necessary. The prognosis can be poorer for those with NF2 who have an increased risk of bilateral acoustic neuromas and other tumors.

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- Acoustic Neuroma Association of Canada Box 369, Edmonton, AB T5J 2J6. 1-800-561-ANAC(2622). (780)428-3384. [anac@compusmart.ab.ca](mailto:anac@compusmart.ab.ca). <<http://www.anac.ca>>. 28 June 2001.
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Lisa Andres, M.S., CGC

Acquired hypogammaglobulinemia see  
**Common variable immunodeficiency**

Acquired immunodeficiency syndrome see  
**AIDS**

## Acrocyanosis

### Definition

Acrocyanosis is a decrease in the amount of oxygen delivered to the extremities. The hands and feet turn blue because of the lack of oxygen. Decreased blood supply to the affected areas is caused by constriction or spasm of small blood vessels.

### Description

Acrocyanosis is a painless disorder caused by constriction or narrowing of small blood vessels in the skin of affected patients. The spasm of the blood vessels decreases the amount of blood that passes through them, resulting in less blood being delivered to the hands and feet. The hands may be the main area affected. The affected areas turn blue and become cold and sweaty. Localized swelling may also occur. Emotion and cold temperatures can worsen the symptoms, while warmth can decrease symptoms. The disease is seen mainly in women and the effect of the disorder is mainly cosmetic. People with the disease tend to be uncomfortable, with sweaty, cold, bluish colored hands and feet.

### Causes and symptoms

The sympathetic nerves cause constriction or spasms in the peripheral blood vessels that supply blood to the extremities. The spasms are a contraction of the muscles in the walls of the blood vessels. The contraction decreases the internal diameter of the blood vessels, thereby decreasing the amount of blood flow through the affected area. The spasms occur on a persistent basis, resulting in long term reduction of blood supply to the hands and feet. Sufficient blood still passes through the blood vessels so that the tissue in the affected areas does not starve for oxygen or die. Mainly, blood vessels near the surface of the skin are affected.

### Diagnosis

Diagnosis is made by observation of the main clinical symptoms, including persistently blue and sweaty hands and/or feet and a lack of **pain**. Cooling the hands increases the blueness, while warming the hands decreases

## KEY TERMS

**Sympathetic nerve**—A nerve of the autonomic nervous system that regulates involuntary and automatic reactions, especially to stress.

es the blue color. The acrocyanosis patient's pulse is normal, which rules out obstructive diseases. **Raynaud's disease** differs from acrocyanosis in that it causes white and red skin coloration phases, not just bluish discoloration.

### Treatment

Acrocyanosis usually isn't treated. Drugs that block the uptake of calcium (**calcium channel blockers**) and alpha-one antagonists reduce the symptoms in most cases. Drugs that dilate blood vessels are only effective some of the time. Sweating from the affected areas can be profuse and require treatment. Surgery to cut the sympathetic nerves is performed rarely.

### Prognosis

Acrocyanosis is a benign and persistent disease. The main concern of patients is cosmetic. Left untreated, the disease does not worsen.

### Resources

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John T. Lohr, PhD

## Acromegaly and gigantism

### Definition

Acromegaly is a disorder in which the abnormal release of a particular chemical from the pituitary gland in the brain causes increased growth in bone and soft tissue, as well as a variety of other disturbances throughout the body. This chemical released from the pituitary gland is called growth hormone (GH). The body's ability to

process and use nutrients like fats and sugars is also altered. In children whose bony growth plates have not closed, the chemical changes of acromegaly result in exceptional growth of long bones. This variant is called gigantism, with the additional bone growth causing unusual height. When the abnormality occurs after bone growth stops, the disorder is called acromegaly.

### Description

Acromegaly is a relatively rare disorder, occurring in approximately 50 out of every one million people (50/1,000,000). Both men and women are affected. Because the symptoms of acromegaly occur so gradually, diagnosis is often delayed. The majority of patients are not identified until they are middle aged.

### Causes and symptoms

The pituitary is a small gland located at the base of the brain. A gland is a collection of cells that releases certain chemicals, or hormones, which are important to the functioning of other organs or body systems. The pituitary hormones travel throughout the body and are involved in a large number of activities, including the regulation of growth and reproductive functions. The cause of acromegaly can be traced to the pituitary's production of GH.

Under normal conditions, the pituitary receives input from another brain structure, the hypothalamus, located at the base of the brain. This input from the hypothalamus regulates the pituitary's release of hormones. For example, the hypothalamus produces growth hormone-releasing hormone (GHRH), which directs the pituitary to release GH. Input from the hypothalamus should also direct the pituitary to stop releasing hormones.

In acromegaly, the pituitary continues to release GH and ignores signals from the hypothalamus. In the liver, GH causes production of a hormone called insulin-like growth factor 1 (IGF-1), which is responsible for growth throughout the body. When the pituitary refuses to stop producing GH, the levels of IGF-1 also reach abnormal peaks. Bones, soft tissue, and organs throughout the body begin to enlarge, and the body changes its ability to process and use nutrients like sugars and fats.

In acromegaly, an individual's hands and feet begin to grow, becoming thick and doughy. The jaw line, nose, and forehead also grow, and facial features are described as "coarsening". The tongue grows larger, and because the jaw is larger, the teeth become more widely spaced. Due to swelling within the structures of the throat and sinuses, the voice becomes deeper and sounds more hollow, and patients may develop loud **snoring**. Various hormonal changes cause symptoms such as:

- heavy sweating
- oily skin
- increased coarse body hair
- improper processing of sugars in the diet (and sometimes actual diabetes)
- high blood pressure
- increased calcium in the urine (sometimes leading to kidney stones)
- increased risk of **gallstones**; and
- swelling of the thyroid gland

People with acromegaly have more skin tags, or outgrowths of tissue, than normal. This increase in skin tags is also associated with the development of growths, called polyps, within the large intestine that may eventually become cancerous. Patients with acromegaly often suffer from headaches and arthritis. The various swellings and enlargements throughout the body may press on nerves, causing sensations of local tingling or burning, and sometimes result in muscle weakness.

The most common cause of this disorder (in 90% of patients) is the development of a noncancerous tumor within the pituitary, called a pituitary adenoma. These tumors are the source of the abnormal release of GH. As these tumors grow, they may press on nearby structures within the brain, causing headaches and changes in vision. As the adenoma grows, it may disrupt other pituitary tissue, interfering with the release of other hormones. These disruptions may be responsible for changes in the menstrual cycle of women, decreases in the sexual drive in men and women, and the abnormal production of breast milk in women. In rare cases, acromegaly is caused by the abnormal production of GHRH, which leads to the increased production of GH. Certain tumors in the pancreas, lungs, adrenal glands, thyroid, and intestine produce GHRH, which in turn triggers production of an abnormal quantity of GH.

## Diagnosis

Because acromegaly produces slow changes over time, diagnosis is often significantly delayed. In fact, the characteristic coarsening of the facial features is often not recognized by family members, friends, or long-time family physicians. Often, the diagnosis is suspected by a new physician who sees the patient for the first time and is struck by the patient's characteristic facial appearance. Comparing old photographs from a number of different time periods will often increase suspicion of the disease.

Because the quantity of GH produced varies widely under normal conditions, demonstrating high levels of GH in the blood is not sufficient to merit a diagnosis of acromegaly. Instead, laboratory tests measuring an



**Enlarged feet is one deformity caused by acromegaly.** (*Custom Medical Stock Photo. Reproduced by permission.*)

increase of IGF-1 (3-10 times above the normal level) are useful. These results, however, must be carefully interpreted because normal laboratory values for IGF-1 vary when the patient is pregnant, undergoing **puberty**, elderly, or severely malnourished. Normal patients will show a decrease in GH production when given a large dose of sugar (glucose). Patients with acromegaly will not show this decrease, and will often show an increase in GH production. **Magnetic resonance imaging** (MRI) is useful for viewing the pituitary, and for identifying and locating an adenoma. When no adenoma can be located, the search for a GHRH-producing tumor in another location begins.

## Treatment

The first step in treatment of acromegaly is removal of all or part of the pituitary adenoma. Removal requires surgery, usually performed by entering the skull through the nose. While this surgery can cause rapid improvement of many acromegaly symptoms, most patients will also





**A comparison of the right hand of a person afflicted with acromegaly (left) and the hand of a normal sized person.**  
(Custom Medical Stock Photo. Reproduced by permission.)

require additional treatment with medication. Bromocriptine (Parlodel) is a medication that can be taken by mouth, while octreotide (Sandostatin) must be injected every eight hours. Both of these medications are helpful in reducing GH production, but must often be taken for life and produce their own unique side effects. Some patients who cannot undergo surgery are treated with **radiation therapy** to the pituitary in an attempt to shrink the adenoma. Radiating the pituitary may take up to 10 years, however, and may also injure/destroy other normal parts of the pituitary.

### Prognosis

Without treatment, patients with acromegaly will most likely die early because of the disease's effects on the heart, lungs, brain, or due to the development of **cancer** in the large intestine. With treatment, however, a patient with acromegaly may be able to live a normal lifespan.

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## KEY TERMS

**Adenoma**—A type of noncancerous (benign) tumor that often involves the overgrowth of certain cells found in glands.

**Gland**—A collection of cells that releases certain chemicals, or hormones, that are important to the functioning of other organs or body systems.

**Hormone**—A chemical produced in one part of the body that travels to another part of the body in order to exert an effect.

**Hypothalamus**—A structure within the brain responsible for a large number of normal functions throughout the body, including regulating sleep, temperature, eating, and sexual development. The hypothalamus also regulates the functions of the pituitary gland by directing the pituitary to stop or start production of its hormones.

**Pituitary**—A gland located at the base of the brain that produces a number of hormones, including those that regulate growth and reproductive functions. Overproduction of the pituitary hormone called growth hormone (GH) is responsible for the condition known as acromegaly.

### ORGANIZATIONS

Pituitary Tumor Network Association. 16350 Ventura Blvd., #231, Encino, CA 91436. (805) 499-9973.

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ACT see **Alanine aminotransferase test**

ACTH test see **Adrenocorticotrophic hormone test**

*Actinomyces israelii* infection see **Actinomycosis**

## Actinomycosis

### Definition

Actinomycosis is an infection primarily caused by the bacterium *Actinomyces israelii*. Infection most often occurs in the face and neck region and is characterized by the presence of a slowly enlarging, hard, red lump.

## Description

Actinomycosis is a relatively rare infection occurring in one out of 300,000(1/300,000) people per year. It is characterized by the presence of a lump or mass that often forms, draining sinus tracts to the skin surface. Fifty percent of actinomycosis cases are of the head and neck region (also called “lumpy jaw” and “cervicofacial actinomycosis”), 15% are in the chest, 20% are in the abdomen, and the rest are in the pelvis, heart, and brain. Men are three times more likely to develop actinomycosis than women.

## Causes and symptoms

Actinomycosis is usually caused by the bacterium *Actinomyces israelii*. This bacterium is normally present in the mouth but can cause disease if it enters tissues following an injury. *Actinomyces israelii* is an anaerobic bacterium which means it dislikes oxygen but grows very well in deep tissues where oxygen levels are low. **Tooth extraction**, tooth disease, **root canal treatment**, jaw surgery, or poor dental hygiene can allow *Actinomyces israelii* to cause an infection in the head and neck region.

The main symptom of cervicofacial actinomycosis is the presence of a hard lump on the face or neck. The lump may or may not be red. **Fever** occurs in some cases.

## Diagnosis

Cervicofacial actinomycosis can be diagnosed by a family doctor or dentist and the patient may be referred to an oral surgeon or infectious disease specialist. The diagnosis of actinomycosis is based upon several things. The presence of a red lump with draining sinuses on the head or neck is strongly suggestive of cervicofacial actinomycosis. A recent history of tooth extraction or signs of **tooth decay** or poor dental hygiene aid in the diagnosis. Microscopic examination of the fluid draining from the sinuses shows the characteristic “sulfur granules” (small yellow colored material in the fluid) produced by *Actinomyces israelii*. A biopsy may be performed to remove a sample of the infected tissue. This procedure can be performed under local anesthesia in the doctor’s office. Occasionally the bacteria can be cultured from the sinus tract fluid or from samples of the infected tissue.

Actinomycosis in the lungs, abdomen, pelvis, or brain can be very hard to diagnose since the symptoms often mimic those of other diseases. Actinomycosis of the lungs or abdomen can resemble **tuberculosis** or **cancer**. x-ray results, the presence of draining sinus tracts, and microscopic analysis and culturing of infected tissue assist in the diagnosis.

## Treatment

Actinomycosis is difficult to treat because of its dense tissue location. Surgery is often required to drain

## KEY TERMS

**Biopsy**—The process which removes a sample of tissue for microscopic examination to aid in the diagnosis of a disease.

**Sinus tract**—A narrow, elongated channel in the body which allows the escape of fluid.

the lesion and/or to remove the site of infection. To kill the bacteria, large doses of penicillin are given through a vein daily for two to six weeks followed by six to twelve months of penicillin taken by mouth. Tetracycline, clindamycin, or erythromycin may be used instead of penicillin. The antibiotic therapy must be completed to insure that the infection does not return. Hyperbaric oxygen (oxygen under high pressure) therapy in combination with the antibiotic therapy has been successful.

## Prognosis

Complete recovery is achieved following treatment. If left untreated, the infection may cause localized bone destruction.

## Prevention

The best prevention is to maintain good dental hygiene.

## Resources

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Belinda Rowland, PhD

Activated charcoal see **Charcoal, activated**

Activated partial thromboplastin time see **Partial thromboplastin time**

## Acupressure

### Definition

Acupressure is a form of touch therapy that utilizes the principles of **acupuncture** and Chinese medicine. In acupressure, the same points on the body are used as in acupuncture, but are stimulated with finger pressure