- Nitrous oxide (laughing gas) is a weak anesthetic and is used with other agents, such as thiopental, to produce surgical anesthesia. It has the fastest induction and recovery and is the safest because it does not slow breathing or blood flow to the brain. However, it diffuses rapidly into air-containing cavities and can result in a collapsed lung (**pneumothorax**) or lower the oxygen contents of tissues (hypoxia).

Commonly administered intravenous anesthetic agents include ketamine, thiopental, opioids, and propofol.

- Ketamine (Ketalar) affects the senses, and produces a dissociative anesthesia (**catatonia**, amnesia, analgesia) in which the patient may appear awake and reactive, but cannot respond to sensory stimuli. These properties make it especially useful for use in developing countries and during warfare medical treatment. Ketamine is frequently used in pediatric patients because anesthesia and analgesia can be achieved with an intramuscular injection. It is also used in high-risk geriatric patients and in **shock** cases, because it also provides cardiac stimulation.
- Thiopental (Pentothal) is a barbiturate that induces a rapid hypnotic state of short duration. Because thiopental is slowly metabolized by the liver, toxic accumulation can occur; therefore, it should not be continuously infused. Side effects include **nausea and vomiting** upon awakening.
- Opioids include fentanyl, sufentanil, and alfentanil, and are frequently used prior to anesthesia and surgery as a sedative and analgesic, as well as a continuous infusion for primary anesthesia. Because opioids rarely affect the cardiovascular system, they are particularly useful for cardiac surgery and other high-risk cases. Opioids act directly on spinal cord receptors, and are freqently used in epidurals for spinal anesthesia. Side effects may include nausea and vomiting, **itching**, and respiratory depression.
- Propofol (Diprivan) is a nonbarbiturate hypnotic agent and the most recently developed intravenous anesthetic. Its rapid induction and short duration of action are identical to thiopental, but recovery occurs more quickly and with much less nausea and vomiting. Also, propofol is rapidly metabolized in the liver and excreted in the urine, so it can be used for long durations of anesthesia, unlike thiopental. Hence, propofol is rapidly replacing thiopental as an intravenous induction agent. It is used for **general surgery**, cardiac surgery, neurosurgery, and pediatric surgery.

General anesthetics are given only by anesthesiologists, the medical professionals trained to use them. These specialists consider many factors, including a patient's age, weight, medication **allergies**, medical history, and general health, when deciding which anesthetic or combination of anesthetics to use. General anesthetics are usually inhaled through a mask or a breathing tube or injected into a vein, but are also sometimes given rectally.

General anesthesia is much safer today than it was in the past. This progress is due to faster-acting anesthetics, improved safety standards in the equipment used to deliver the drugs, and better devices to monitor breathing, heart rate, blood pressure, and brain activity during surgery. Unpleasant side effects are also less common.

Recommended dosage

The dosage depends on the type of anesthetic, the patient's age and physical condition, the type of surgery or medical procedure being done, and other medication the patient takes before, during, or after surgery.

Precautions

Although the risks of serious complications from general anesthesia are very low, they can include **heart attack**, **stroke**, brain damage, and death. Anyone scheduled to undergo general anesthesia should thoroughly discuss the benefits and risks with a physician. The risks of complications depend, in part, on a patient's age, sex, weight, allergies, general health, and history of **smoking**, drinking alcohol, or drug use. Some of these risks can be minimized by ensuring that the physician and anesthesiologist are fully informed of the detailed health condition of the patient, including any drugs that he or she may be using. Older people are especially sensitive to the effects of certain anesthetics and may be more likely to experience side effects from these drugs.

Patients who have had general anesthesia should not drink alcoholic beverages or take medication that slow down the central nervous system (such as **antihistamines**, sedatives, tranquilizers, sleep aids, certain pain relievers, **muscle relaxants**, and anti-seizure medication) for at least 24 hours, except under a doctor's care.

Special conditions

People with certain medical conditions are at greater risk of developing problems with anesthetics. Before undergoing general anesthesia, anyone with the following conditions should absolutely inform their doctor.

ALLERGIES. Anyone who has had allergic or other unusual reactions to **barbiturates** or general anesthetics in the past should notify the doctor before having general anesthesia. In particular, people who have had malignant hyperthermia or whose family members have had malignant hyperthermia during or after being given an anes-

Anesthetics: How They Work

Type	Name(s)	Administered	Affect
General	Halothane, Enflurane Isoflurane, Ketamine, Nitrous Oxide, Thiopental	Intravenously, Inhalation	Produces total unconsciousness affecting the entire body
Regional	Mepivacaine, Chloroprocaine, Lidocaine	Intravenously	Temporarily interrupts transmission of nerve impulses (temperature, touch, pain) and motor functions in a large area to be treated; does not produce unconsciousness
Local	Procaine, Lidocaine, Tetracaine, Bupivacaine	Intravenously	Temporarily blocks transmission of nerve impulses and motor functions in a specific area; does not produce unconsciousness
Topical	Benzocaine, Lidocaine Dibucaine, Pramoxine, Butamben, Tetracaine	Demal (Sprays, Drope, Ointments, Creams, Gels)	Temporarily blocks nerve endings in skin and mucous membranes; does not produce unconsciousness

thetic should inform the physician. Signs of malignant hyperthermia include rapid, irregular heartbeat, breathing problems, very high **fever**, and muscle tightness or spasms. These symptoms can occur following the administration of general anesthesia using inhaled agents, especially halothane. In addition, the doctor should also be told about any allergies to foods, dyes, preservatives, or other substances.

PREGNANCY. The effects of anesthetics on pregnant women and fetuses vary, depending on the type of drug. In general, giving large amounts of general anesthetics to the mother during labor and delivery may make the baby sluggish after delivery. Pregnant women should discuss the use of anesthetics during labor and delivery with their doctors. Pregnant women who may be given general anesthesia for other medical procedures should ensure that the treating physician is informed about the **pregnancy**.

BREASTFEEDING. Some general anesthetics pass into breast milk, but they have not been reported to cause problems in nursing babies whose mothers were given the drugs.

OTHER MEDICAL CONDITIONS. Before being given a general anesthetic, a patient who has any of the following conditions should inform his or her doctor:

- neurological conditions, such as epilepsy or stroke
- problems with the stomach or esophagus, such as ulcers or **heartburn**
- eating disorders
- loose teeth, dentures, bridgework
- heart disease or family history of heart problems
- lung diseases, such as **emphysema** or **asthma**
- history of smoking
- immune system diseases
- arthritis or any other conditions that affect movement
- diseases of the endocrine system, such as diabetes or thyroid problems

Side effects

Because general anesthetics affect the central nervous system, patients may feel drowsy, weak, or tired for as long as a few days after having general anesthesia. Fuzzy thinking, blurred vision, and coordination problems are also possible. For these reasons, anyone who has had general anesthesia should not drive, operate machinery, or perform other activities that could endanger themselves or others for at least 24 hours, or longer if necessary.

Most side effects usually disappear as the anesthetic wears off. A nurse or doctor should be notified if these or other side effects persist or cause problems, such as:

- **Headache**
- vision problems, including blurred or double vision
- shivering or trembling
- muscle pain
- dizziness, lightheadedness, or faintness
- drowsiness
- mood or mental changes
- nausea or vomiting
- sore throat
- nightmares or unusual dreams

A doctor should be notified as soon as possible if any of the following side effects occur within two weeks of having general anesthesia:

- severe headache
- pain in the stomach or abdomen
- back or leg pain
- severe nausea
- black or bloody vomit
- unusual tiredness or weakness
- weakness in the wrist and fingers
- weight loss or loss of appetite

KEY TERMS

Amnesia—The loss of memory.

Analgesia—A state of insensitivity to pain even though the person remains fully conscious.

Anesthesiologist—A medical specialist who administers an anesthetic to a patient before he is treated.

Anesthetic—A drug that causes unconsciousness or a loss of general sensation.

Arrhythmia—Abnormal heart beat.

Barbiturate—A drug with hypnotic and sedative effects.

Catatonia—Psychomotor disturbance characterized by muscular rigidity, excitement or stupor.

Hypnotic agent—A drug capable of inducing a hypnotic state.

Hypnotic state—A state of heightened awareness that can be used to modulate the perception of pain.

Hypoxia—Reduction of oxygen supply to the tissues.

Malignant hyperthermia—A type of reaction (probably with a genetic origin) that can occur during general anesthesia and in which the patient experiences a high fever, muscle rigidity, and irregular heart rate and blood pressure.

Medulla oblongata—The lowest section of the brainstem, located next to the spinal cord. The medulla is the site of important cardiac and respiratory regulatory centers.

Opioid—Any morphine-like synthetic narcotic that produces the same effects as drugs derived from the opium poppy (opiates), such as pain relief, sedation, constipation and respiratory depression.

Pneumothorax—A collapse of the lung.

Stenosis—A narrowing or constriction of the diameter of a passage or orifice, such as a blood vessel.

- increase or decrease in amount of urine
- pale skin
- yellow eyes or skin

Interactions

General anesthetics may interact with other medicines. When this happens, the effects of one or both of the drugs may be altered or the risk of side effects may be greater. Anyone scheduled to undergo general anesthesia should inform the doctor about all other medication that he or she is taking. This includes prescription drugs, nonprescription medicines, and street drugs. Serious and possibly life-threatening reactions may occur when general anesthetics are given to people who use street drugs, such as **cocaine**, marijuana, phencyclidine (PCP or angel dust), amphetamines (uppers), barbiturates (downers), heroin, or other narcotics. Anyone who uses these drugs should make sure their doctor or dentist knows what they have taken.

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Anesthesia, local

Definition

Local or regional anesthesia involves the injection or application of an anesthetic drug to a specific area of the body, as opposed to the entire body and brain as occurs during general anesthesia.

Purpose

Local anesthetics are used to prevent patients from feeling **pain** during medical, surgical, or dental procedures. Over-the-counter local anesthetics are also available to provide temporary relief from pain, irritation, and **itching** caused by various conditions, such as cold sores, **canker sores**, sore throats, **sunburn**, insect bites, poison ivy, and minor cuts and scratches.

Types of surgery or medical procedures that regularly make use of local or regional anesthesia include the following:

- biopsies in which skin or tissue samples are taken for diagnostic procedures
- childbirth
- surgeries on the arms, hands, legs, or feet
- eye surgery
- surgeries involving the urinary tract or sexual organs

Surgeries involving the chest and abdomen are usually performed under general anesthesia.

Local and regional anesthesia have advantages over general anesthesia in that patients can avoid some unpleasant side effects, can receive longer lasting pain relief, have reduced blood loss, and maintain a sense of psychological comfort by not losing consciousness.

Description

Regional anesthesia typically affects a larger area than local anesthesia, for example, everything below the waist. As a result, regional anesthesia may be used for more involved or complicated surgical or medical procedures. Regional anesthetics are injected. Local anesthesia involves the injection into the skin or muscle or application to the skin of an anesthetic directly where pain will occur. Local anesthesia can be divided into four groups: injectable, topical, dental (non-injectable), and ophthalmic.

Local and regional anesthesia work by altering the flow of sodium molecules into nerve cells or neurons through the cell membrane. Exactly how the anesthetic does this is not understood, since the drug apparently does not bind to any receptor on the cell surface and does not seem to affect the release of chemicals that transmit nerve impulses (neurotransmitters) from the nerve cells. It is known, however, that when the sodium molecules do not get into the neurons, nerve impulses are not generated and pain impulses are not transmitted to the brain. The duration of action of an anesthetic depends on the type and amount of anesthetic administered.

Regional anesthesia

Types of regional anesthesia include:

- Spinal anesthesia. Spinal anesthesia involves the injection of a small amount of local anesthetic directly into the cerebrospinal fluid surrounding the spinal cord (the subarachnoid space). Blood pressure drops are common but are easily treated.
- Epidural anesthesia. Epidural anesthesia involves the injection of a large volume of local anesthetic directly into the space surrounding the spinal fluid sac (the epidural space), not into the spinal fluid. Pain relief occurs more slowly but is less likely to produce blood pressure drops. Also, the block can be maintained for long periods, even days.
- Nerve blocks. Nerve blocks involve the injection of an anesthetic into the area around a nerve that supplies a particular region of the body, preventing the nerve from carrying nerve impulses to the brain.

Anesthetics may be administered with another drug, such as epinephrine (adrenaline), which decreases bleeding, and sodium bicarbonate to decrease the acidity of a drug so that it will work faster. In addition, drugs may be administered to help a patient remain calm and more comfortable or to make them sleepy.

Local anesthesia

INJECTABLE LOCAL ANESTHETICS. These medicines are given by injection to numb and provide pain relief to some part of the body during surgery, dental procedures, or other medical procedures. They are given only by a trained health care professional and only in a doctor's office or a hospital. Some commonly used injectable local anesthetics are procaine (Novocain), lidocaine (Dalcaine, Dilocaine, L-Caine, Nervocaine, Xylocaine, and other brands), and tetracaine (Pontocaine).

TOPICAL ANESTHETICS. Topical anesthetics, such as benzocaine, lidocaine, dibucaine, pramoxine, butamben, and tetracaine, relieve pain and itching by deadening the nerve endings in the skin. They are ingredients in a variety of nonprescription products that are applied to the skin to relieve the discomfort of sunburn, insect bites or stings, poison ivy, and minor cuts, scratches, and **burns**. These products are sold as creams, ointments, sprays, lotions, and gels.

DENTAL ANESTHETICS (NON-INJECTABLE). Some local anesthetics are intended for pain relief in the mouth or throat. They may be used to relieve throat pain, teething pain, painful canker sores, toothaches, or discomfort from dentures, braces, or bridgework. Some dental anesthetics are available only with a doctor's prescription. Others may be purchased without a prescription, including products such as Num-Zit, Orajel, Chloraseptic lozenges, and Xylocaine.

OPHTHALMIC ANESTHETICS. Other local anesthetics are designed for use in the eye. The ophthalmic anesthetics proparacaine and tetracaine are used to numb the eye before certain eye examinations. Eye doctors may also use these medicines before measuring eye pressure or removing stitches or **foreign objects** from the eye. These drugs are to be given only by a trained health care professional.

Recommended dosage

The recommended dosage depends on the type of local anesthetic and the purpose for which it is being used. When using a nonprescription local anesthetic, follow the directions on the package. Questions concerning how to use a product should be referred to a medical doctor, dentist, or pharmacist.

Precautions

People who strongly feel that they cannot psychologically cope with being awake and alert during certain procedures may not be good candidates for local or regional anesthesia. Other medications may be given in conjunction with the anesthetic, however, to relieve **anxiety** and help the patient relax.

Local anesthetics should be used only for the conditions for which they are intended. For example, a topical anesthetic meant to relieve sunburn pain should not be used on cold sores. Anyone who has had an unusual reaction to any local anesthetic in the past should check with a doctor before using any type of local anesthetic again. The doctor should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

Older people may be more sensitive to the effects of local anesthetics, especially lidocaine. This increased sensitivity may increase the risk of side effects. Older people who use nonprescription local anesthetics should be especially careful not to use more than the recommended amount. Children also may be especially sensitive to the effects of some local anesthetics, which may increase the chance of side effects. Anyone using these medicines on a child should be careful not to use more than the amount that is recommended for children. Certain types of local anesthetics should not be used at all young children. Follow package directions carefully and check with a doctor of pharmacist if there are any questions.

Regional anesthetics

Serious, possibly life-threatening, side effects may occur when anesthetics are given to people who use street drugs. Anyone who uses **cocaine**, **marijuana**, amphetamines, **barbiturates**, phencyclidine (PCP, or angel dust), heroin, or other street drugs should make sure their doctor or dentist knows what they have used.

Patients who have had a particular kind of reaction called malignant hyperthermia (or who have one or more family members who have had this problem) during or just after receiving a general anesthetic should inform their doctors before receiving any kind of anesthetic. Signs of malignant hyperthermia include fast and irregular heartbeat, very high **fever**, breathing problems, and muscle spasms or tightness.

Although problems are rare, some unwanted side effects may occur when regional anesthetics are used during labor and delivery. These anesthetics can prolong labor and increase the risk of **Cesarean section**. Pregnant women should discuss with their doctors the risks and benefits of being given these drugs.

Patients should not drive or operate other machinery immediately following a procedure involving regional anesthesia, due to numbness and weakness, or if local anesthesia also included drugs to make the patient sleep or strong pain medications. Injection sites should be kept clean, dry, and uncovered to prevent infection.

Injectable local anesthetics

Until the anesthetic wears off, patients should be careful not to injure the numbed area. If the anesthetic was used in the mouth, do not eat or chew gum until feeling returns.

Topical anesthetics

Unless advised by a doctor, topical anesthetics should not be used on or near any part of the body with large sores, broken or scraped skin, severe injury, or infection. They should also not be used on large areas of skin. Some topical anesthetics contain alcohol and should not be used near an open flame, or while **smoking**.

Anyone using a topical anesthetic should be careful not to get this medication in the eyes, nose, or mouth. When using a spray form of this medication, do not spray it directly on the face, but apply it to the face with a cotton swab or sterile gauze pad. After using a topical anesthetic on a child, make sure the child does not get the medicine in his or her mouth.

Topical anesthetics are intended for the temporary relief of pain and itching. They should not be used for more than a few days at a time. Check with a doctor if:

- the discomfort continues for more than seven days
- the problem gets worse
- the treated area becomes infected
- new signs of irritation, such as skin rash, burning, stinging, or swelling appear

Dental anesthetics (non-injectable)

Dental anesthetics should not be used if certain kinds of infections are present. Check package directions or check with a dentist or medical doctor if uncertain. Dental anesthetics should be used only for temporary pain relief. If problems such as **toothache**, mouth sores, or pain from dentures or braces continue, check with a dentist. Check with a doctor if **sore throat** pain is severe, lasts more than two days, or is accompanied by other symptoms such as fever, **headache**, skin rash, swelling, nausea, or vomiting.

Patients should not eat or chew gum while the mouth is numb from a dental anesthetic. There is a risk of accidently biting the tongue or the inside of the mouth. Also nothing should be eaten or drunk for one hour after applying a dental anesthetic to the back of the mouth or throat, since the medicine may interfere with swallowing and may cause **choking**. If normal feeling does not return to the mouth within a few hours after receiving a dental anesthetic or if it is difficult to open the mouth, check with a dentist.

Ophthalmic anesthetics

When anesthetics are used in the eye, it is important not to rub or wipe the eye until the effect of the anesthetic has worn off and feeling has returned. Rubbing the eye while it is numb could cause injury.

Side effects

Side effects of regional or local anesthetics vary depending on the type of anesthetic used and the way it is administered. Anyone who has unusual symptoms following the use of an anesthetic should get in touch with his or her doctor immediately.

Paralysis after regional anesthesia, for example an epidural or spinal block, is extremely rare, but can occur. Paralysis reportedly occurs even less frequently than deaths due to general anesthesia.

There is a small risk of developing a severe headache called a spinal headache following a spinal or epidural block. This headache is severe when the patient is upright and hardly felt when the patient lies down. Though rare, it can occur and can be treated by performing a blood patch, in which a small amount of the patient's own blood is injected into the area in the back where the anesthetic was injected. The blood clots and closes up any area that may have been leaking spinal fluid. Relief is almost immediate. Finally, blood clots or **abscess** can form in the back, but these are also readily treatable and so pose little risk.

KEY TERMS

Canker sore—A painful sore inside the mouth.

Cold sore—A small blister on the lips or face, caused by a virus. Also called a fever blister.

Epidural space—The space surrounding the spinal fluid sac.

Malignant hyperthermia—A type of reaction (probably with a genetic basis) that can occur during general anesthesia in which the patient experiences a high fever, the muscles become rigid, and the heart rate and blood pressure fluctuate.

Subarachnoid space—The space surrounding the spinal cord that is filled with cerebrospinal fluid.

Topical—Not ingested; applied to the outside of the body, for example to the skin, eye, or mouth.

A physician should be notified immediately if any of these symptoms occur:

- large swellings that look like **hives** on the skin, in the mouth, or in the throat
- severe headache
- blurred or double vision
- dizziness or lightheadedness
- drowsiness
- confusion
- anxiety, excitement, nervousness, or restlessness
- convulsions (seizures)
- feeling hot, cold, or numb
- ringing or buzzing in the ears
- shivering or trembling
- sweating
- pale skin
- slow or irregular heartbeat
- breathing problems
- unusual weakness or tiredness

Interactions

Some anesthetic drugs may interact with other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Anyone who receives a regional or local anesthetic should let the doctor know all other drugs he or she is tak-

ing including prescription drugs, nonprescription drugs, and street drugs (such as cocaine, marijuana, and heroin).

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Aneurysmectomy

Definition

Aneurysmectomy is a surgical procedure performed to repair a weak area in the aorta. The aorta is the largest artery in the body and the main blood vessel leading away from the heart.

Purpose

The purpose of aneurysmectomy is to repair an **aortic aneurysm** that is likely to rupture if left in place. Aneurysmectomy is indicated for an aortic aneurysm that grows to at least 2 in (5 cm) or for an aortic aneurysm of any size that is symptomatic, tender, or enlarging rapidly.

Precautions

Aneurysmectomy may not be appropriate for patients with severely debilitating diseases such as **cancer**, **emphysema**, and **heart failure**.

Description

An aortic aneurysm is a bulge in the wall of the aorta that is usually due to arteriosclerosis or **atherosclerosis**. People who are 50-80 years old are most likely to develop an aortic aneurysm, with men four times more likely to develop one than women.

An aortic aneurysm develops and grows slowly. It rarely produces symptoms and is usually only diagnosed by accident during a routine physical exam or on an x ray or ultrasound done for another reason. As the aneurysm grows larger, the risk of bursting with no warning, which causes catastrophic bleeding, rises. A ruptured aortic aneurysm can cause sudden loss of a fatal amount of blood within minutes or it can leak in a series of small bleeds that lead within hours or days to massive bleeding. A leaking aortic aneurysm that is not treated is always fatal.

Aneurysmectomy is performed to repair the two most common types of aortic aneurysms: abdominal aortic aneurysms that occur in the abdomen below the kidneys, and thoracic aortic aneurysms that occur in the chest. It is major surgery performed in a hospital under general anesthesia and involves removing debris and then implanting a flexible tube (graft) to replace the enlarged artery. Aneurysmectomy for an aneurysm of the ascending aorta (the first part of the aorta that travels upward from the heart) requires the use of a heart-lung machine that temporarily stops the heart while the aneurysm is repaired. Aneurysmectomy requires a one-week hospital stay; the recovery period is five weeks.

During surgery, the site of the aneurysm (either the abdomen or the chest) is opened with an incision to expose the aneurysm. The aorta is clamped above and below the aneurysm to stop the flow of blood. Then, an incision is made in the aneurysm. An artificial Dacron tube is sewn in place above and below the opened aneurysm, but the aneurysm is not removed. Plaque or clotted blood are cleaned from the diseased tissue. The clamps are removed and blood flow is re-established through the graft. The wall of the aneurysm is wrapped around the graft to protect it and the skin of the abdomen or chest is sewn up.

Aneurysmectomy can be performed as elective or emergency surgery. Elective aneurysmectomy takes about an hour and is far safer than emergency aneurysmectomy, with a mortality rate of 3-5% for elective abdominal aneurysmectomy and 5-10% for elective thoracic aneurysmectomy. When an aneurysm ruptures, 62% of patients die before they reach the hospital. Of those who make it into emergency aneurysmectromy, 50% die. After a successful aneurysmectomy, the patient has nearly the same life expectancy as other people of the same age.

Preparation

Before elective aneurysmectomy, blood studies, a **chest x ray**, cardiac catherization, electrocardiogram (ECG), and ultrasound are performed.

Aftercare

After aneurysmectomy, the patient is monitored in an Intensive Care Unit for the first 24–48 hours. Follow-up tests include ECG, chest x ray, and ultrasound.

Risks

Elective aneurysmectomy has a 5-10% rate of complications, such as bleeding, kidney failure, respiratory complications, **heart attack**, **stroke**, infection, limb loss, bowel **ischemia**, and **impotence**. These complications are many times more common in emergency aneurysmectomy.

KEY TERMS

Aneurysm—A weakening in the muscular walls of a part of the artery which causes the damaged section to enlarge or sag, giving it a balloon-like appearance.

Aorta—The main blood vessel that leads away from the heart and the body's largest artery. The aorta carries blood from the heart through the chest and abdomen, providing major branches to all of the organs in the body.

Arteriosclerosis—Hardening of the arteries that occurs as part of the aging process.

Artery—A blood vessel that carries blood from the heart to the body's tissues.

Atherosclerosis—A form of arteriosclerosis in which cholesterol-containing fatty deposits accumulate in the inner most walls of the heart's arteries.

Thoracic—Relating to the chest.

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Aneurysms *see* **Aneurysmectomy; Cerebral aneurysm; Ventricular aneurysm**

Angina

Definition

Angina is **pain**, "discomfort," or pressure localized in the chest that is caused by an insufficient supply of blood (**ischemia**) to the heart muscle. It is also sometimes characterized by a feeling of **choking**, suffocation, or crushing heaviness. This condition is also called angina pectoris.

Description

Often described as a muscle spasm and choking sensation, the term "angina" is used primarily to describe chest (thoracic) pain originating from insufficient oxygen to the heart muscle. An episode of angina is not an actual **heart attack**, but rather pain that results from the heart muscle temporarily receiving too little blood. This temporary condition may be the result of demanding activities such as **exercise** and does not necessarily indicate that the heart muscle is experiencing permanent damage. In fact, episodes of angina seldom cause permanent damage to heart muscle.

Angina can be subdivided further into two categories: angina of effort and variant angina.

Angina of effort

Angina of effort is a common disorder caused by the narrowing of the arteries (**atherosclerosis**) that supply oxygen-rich blood to the heart muscle. In the case of angina of effort, the heart (coronary) arteries can provide the heart muscle (myocardium) adequate blood during rest but not during periods of exercise, **stress**, or excitement—any of which may precipitate pain. The pain is relieved by resting or by administering nitroglycerin, a medication that reduces ischemia of the heart. Patients with angina of effort have an increased risk of heart attack (myocardial infarction).

Variant angina

Variant angina is uncommon and occurs independently of atherosclerosis which may, however, be present as an incidental finding. Variant angina occurs at rest and is not related to excessive work by the heart muscle. Research indicates that variant angina is caused by coro-

nary artery muscle spasm of insufficient duration or intensity to cause an actual heart attack.

Causes and symptoms

Angina causes a pressing pain or sensation of heaviness, usually in the chest area under the breast bone (sternum). It occasionally is experienced in the shoulder, arm, neck, or jaw regions. Because episodes of angina occur when the heart's need for oxygen increases beyond the oxygen available from the blood nourishing the heart, the condition is often precipitated by physical exertion. In most cases, the symptoms are relieved within a few minutes by resting or by taking prescribed angina medications. Emotional stress, extreme temperatures, heavy meals, cigarette **smoking**, and alcohol can also cause or contribute to an episode of angina.

Diagnosis

Physicians can usually diagnose angina based on the patient's symptoms and the precipitating factors. However, other diagnostic testing is often required to confirm or rule out angina, or to determine the severity of the underlying heart disease.

Electrocardiogram (ECG)

An electrocardiogram is a test that records electrical impulses from the heart. The resulting graph of electrical activity can show if the heart muscle isn't functioning properly as a result of a lack of oxygen. Electrocardiograms are also useful in investigating other possible abnormal features of the heart.

Stress test

For many individuals with angina, the results of an electrocardiogram while at rest will not show any abnormalities. Because the symptoms of angina occur during stress, the functioning of the heart may need to be evaluated under the physical stress of exercise. The **stress test** records information from the electrocardiogram before, during, and after exercise in search of stress-related abnormalities. Blood pressure is also measured during the stress test and symptoms are noted. A more involved and complex stress test (for example, thallium scanning) may be used in some cases to picture the blood flow in the heart muscle during the most intense time of exercise and after rest.

Angiogram

The angiogram, which is basically an x ray of the coronary artery, has been noted to be the most accurate diagnostic test to indicate the presence and extent of coronary disease. In this procedure, a long, thin, flexible tube (catheter) is maneuvered into an artery located in the forearm or groin. This catheter is passed further through the artery into one of the two major coronary arteries. A dye is injected at that time to help the x rays "see" the heart and arteries more clearly. Many brief x rays are made to create a "movie" of blood flowing through the coronary arteries, which will reveal any possible narrowing that causes a decrease in blood flow to the heart muscle and associated symptoms of angina.

Treatment

Conservative treatment

Artery disease causing angina is addressed initially by controlling existing factors placing the individual at risk. These risk factors include cigarette smoking, high blood pressure, **high cholesterol** levels, and **obesity**. Angina is often controlled by medication, most commonly with nitroglycerin. This drug relieves symptoms of angina by increasing the diameter of the blood vessels carrying blood to the heart muscle. Nitroglycerin is taken whenever discomfort occurs or is expected. It may be taken by mouth by placing the tablet under the tongue or transdermally by placing a medicated patch directly on the skin. In addition, **beta blockers** or **calcium channel blockers** may be prescribed to also decrease the demand on the heart by decreasing the rate and workload of the heart.

Surgical treatment

When conservative treatments are not effective in the reduction of angina pain and the risk of heart attack remains high, physicians may recommend **angioplasty** or surgery. Coronary artery bypass surgery is an operation in which a blood vessel (often a long vein surgically removed from the leg) is grafted onto the blocked artery to bypass the blocked portion. This newly formed pathway allows blood to flow adequately to the heart muscle.

Another procedure used to improve blood flow to the heart is balloon angioplasty. In this procedure, the physician inserts a catheter with a tiny balloon at the end into a forearm or groin artery. The catheter is then threaded up into the coronary arteries and the balloon is inflated to open the vessel in narrowed sections. Other techniques using laser and mechanical devices are being developed and applied, also by means of catheters.

Alternative treatment

During an angina episode, relief has been noted by applying massage or kinesiological methods, but these techniques are not standard recommendations by physi-

cians. For example, one technique places the palm and fingers of either hand on the forehead while simultaneously firmly massaging the sternum (breast bone) up and down its entire length using the other hand. This is followed by additional massaging by the fingertip and thumb next to the sternum, on each side.

Once the angina has subsided, the cause should be determined and treated. Atherosclerosis, a major associated cause, requires diet and lifestyle adjustments, primarily including regular exercise, reduction of dietary sugar and saturated fats, and increase of dietary fiber. Both conventional and alternative medicine agree that increasing exercise and improving diet are important steps to reduce high cholesterol levels. Alternative medicine has proposed specific cholesterol-lowering treatments, with several gaining the attention and interest of the public. One of the most recent popular treatments is garlic (*Allium sativum*). Some studies have shown that adequate dosages of garlic can reduce total cholesterol by about 10%, LDL (bad) cholesterol by 15%, and raise HDL (good) cholesterol by 10%. Other studies have not shown significant benefit. Although its effect on cholesterol is not as great as that achieved by medications, garlic may possibly be of benefit in relatively mild cases of high cholesterol, without causing the side effects associated with **cholesterol-reducing drugs**. Other herbal remedies that may help lower cholesterol include alfalfa (*Medicago sativa*), fenugreek (*Trigonella foenum-graecum*), Asian ginseng (*Panax ginseng*), and tumeric (*Curcuma longa*).

Antioxidants, including vitamin A (beta carotene), vitamin C, vitamin E, and selenium, can limit the oxidative damage to the walls of blood vessels that may be a precursor of atherosclerotic plaque formation.

Prognosis

The prognosis for a patient with angina depends on its origin, type, severity, and the general health of the individual. A person who has angina has the best prognosis if he or she seeks prompt medical attention and learns the pattern of his or her angina, such as what causes the attacks, what they feel like, how long episodes usually last, and whether medication relieves the attacks. If patterns of the symptoms change significantly, or if symptoms resemble those of a heart attack, medical help should be sought immediately.

Prevention

In most cases, the best prevention involves changing one's habits to avoid bringing on attacks of angina. If blood pressure medication has been prescribed, compliance is a necessity and should be a priority as well. Many healthcare professionals—including physicians, dietitians, and nurses—can provide valuable advice on proper diet, weight control, blood cholesterol levels, and blood pressure. These professionals also offer suggestions about current treatments and information to help stop smoking. In general, the majority of those with angina adjust their lives to minimize episodes of angina, by taking necessary precautions and using medications if recommended and necessary. **Coronary artery disease** is the underlying problem that should be addressed.

KEY TERMS

Ischemia—Decreased blood supply to an organ or body part, often resulting in pain.

Myocardial infarction—A blockage of a coronary artery that cuts off the blood supply to part of the heart. In most cases, the blockage is caused by fatty deposits.

Myocardium—The thick middle layer of the heart that forms the bulk of the heart wall and contracts as the organ beats.

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Angioedema *see* **Hives**

Angiogram *see* **Angiography**

Angiography

Definition

Angiography is the x-ray study of the blood vessels. An angiogram uses a radiopaque substance, or dye, to

make the blood vessels visible under x ray. Arteriography is a type of angiography that involves the study of the arteries.

Purpose

Angiography is used to detect abnormalities or blockages in the blood vessels (called occlusions) throughout the circulatory system and in some organs. The procedure is commonly used to identify **atherosclerosis**; to diagnose heart disease; to evaluate kidney function and detect kidney cysts or tumors; to detect an aneurysm (an abnormal bulge of an artery that can rupture leading to hemorrhage), tumor, blood clot, or **arteriovenous malformations** (abnormals tangles of arteries and veins) in the brain; and to diagnose problems with the retina of the eye. It is also used to give surgeons an accurate "map" of the heart prior to open-heart surgery, or of the brain prior to neurosurgery.

Precautions

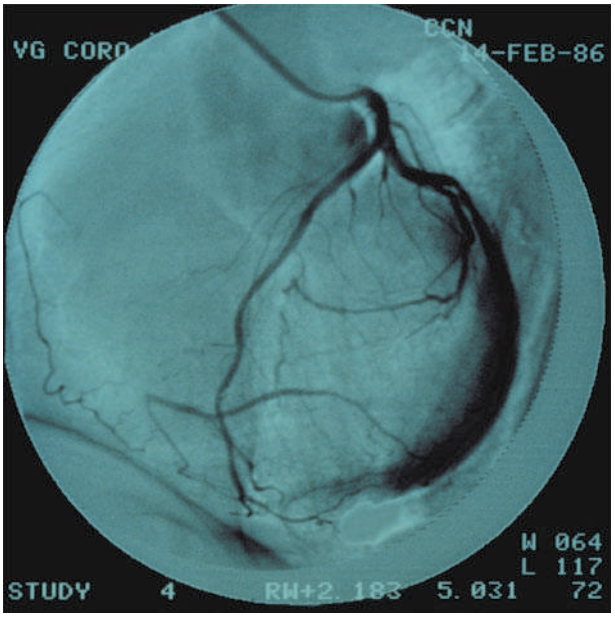
Patients with kidney disease or injury may suffer further kidney damage from the contrast mediums used for angiography. Patients who have blood clotting problems, have a known allergy to contrast mediums, or are allergic to iodine, a component of some contrast mediums, may also not be suitable candidates for an angiography procedure. Because x rays carry risks of ionizing radiation exposure to the fetus, pregnant women are also advised to avoid this procedure.

Description

Angiography is usually performed at a hospital by a trained radiologist and assisting technician or nurse. It takes place in an x-ray or fluoroscopy suite, and for most types of angiograms, the patient's vital signs will be monitored throughout the procedure.

Angiography requires the injection of a contrast dye that makes the blood vessels visible to x ray. The dye is injected through a procedure known as *arterial puncture*. The puncture is usually made in the groin area, armpit, inside elbow, or neck. The site is cleaned with an antiseptic agent and injected with a local anesthetic. First, a small incision is made in the skin to help the needle pass. A needle containing an inner wire called a stylet is inserted through the skin into the artery. When the radiologist has punctured the artery with the needle, the stylet is removed and replaced with another long wire called a guide wire. It is normal for blood to spout out of the needle before the guide wire is inserted.

The guide wire is fed through the outer needle into the artery and to the area that requires angiographic



An angiogram of a coronary artery. *(Phototake NYC. Reproduced by permission.)*

study. A fluoroscopic screen that displays a view of the patient's vascular system is used to pilot the wire to the correct location. Once it is in position, the needle is removed and a catheter is slid over the length of the guide wire until it to reaches the area of study. The guide wire is removed and the catheter is left in place in preparation for the injection of the contrast medium, or dye.

Depending on the type of angiography procedure being performed, the contrast medium is either injected by hand with a syringe or is mechanically injected with an automatic injector connected to the catheter. An automatic injector is used frequently because it is able to propel a large volume of dye very quickly to the angiogram site. The patient is warned that the injection will start, and instructed to remain very still. The injection causes some mild to moderate discomfort. Possible side effects or reactions include **headache**, **dizziness**, irregular heartbeat, nausea, warmth, burning sensation, and chest **pain**, but they usually last only momentarily. To view the area of study from different angles or perspectives, the patient may be asked to change positions several times, and subsequent dye injections may be administered. During any injection, the patient or the camera may move.

Throughout the dye injection procedure, x-ray pictures and/or fluoroscopic pictures (or moving x rays) will be taken. Because of the high pressure of arterial blood flow, the dye will dissipate through the patient's system quickly, so pictures must be taken in rapid succession.

An automatic film changer is used because the manual changing of x-ray plates can eat up valuable time.

Once the x rays are complete, the catheter is slowly and carefully removed from the patient. Pressure is applied to the site with a sandbag or other weight for 10-20 minutes in order for clotting to take place and the arterial puncture to reseal itself. A pressure bandage is then applied.

Most angiograms follow the general procedures outlined above, but vary slightly depending on the area of the vascular system being studied. A variety of common angiography procedures are outlined below:

Cerebral angiography

Cerebral angiography is used to detect aneurysms, blood clots, and other vascular irregularities in the brain. The catheter is inserted into the femoral or carotid artery and the injected contrast medium travels through the blood vessels on the brain. Patients frequently experience headache, warmth, or a burning sensation in the head or neck during the injection portion of the procedure. A cerebral angiogram takes two to four hours to complete.

Coronary angiography

Coronary angiography is administered by a cardiologist with training in radiology or, occasionally, by a radiologist. The arterial puncture is typically given in the femoral artery, and the cardiologist uses a guide wire and catheter to perform a contrast injection and x-ray series on the coronary arteries. The catheter may also be placed in the left ventricle to examine the mitral and aortic valves of the heart. If the cardiologist requires a view of the right ventricle of the heart or of the tricuspid or pulmonic valves, the catheter will be inserted through a large vein and guided into the right ventricle. The catheter also serves the purpose of monitoring blood pressures in these different locations inside the heart. The angiogram procedure takes several hours, depending on the complexity of the procedure.

Pulmonary angiography

Pulmonary, or lung, angiography is performed to evaluate blood circulation to the lungs. It is also considered the most accurate diagnostic test for detecting a **pulmonary embolism**. The procedure differs from cerebral and coronary angiograms in that the guide wire and catheter are inserted into a vein instead of an artery, and are guided up through the chambers of the heart and into the pulmonary artery. Throughout the procedure, the patient's vital signs are monitored to ensure that the catheter doesn't cause **arrhythmias**, or irregular heartbeats. The contrast medium is then injected into the pulmonary artery where it circulates through the lung capillaries. The test typically takes up to 90 minutes.

Kidney angiography

Patients with chronic renal disease or injury can suffer further damage to their kidneys from the contrast medium used in a kidney angiogram, yet they often require the test to evaluate kidney function. These patients should be well-hydrated with a intravenous saline drip before the procedure, and may benefit from available medications (e.g., dopamine) that help to protect the kidney from further injury due to contrast agents. During a kidney angiogram, the guide wire and catheter are inserted into the femoral artery in the groin area and advanced through the abdominal aorta, the main artery in the abdomen, and into the renal arteries. The procedure will take approximately one hour.

Fluorescein angiography

Fluorescein angiography is used to diagnose retinal problems and circulatory disorders. It is typically conducted as an outpatient procedure. The patient's pupils are dilated with eye drops and he rests his chin and forehead against a bracing apparatus to keep it still. Sodium fluorescein dye is then injected with a syringe into a vein in the patient's arm. The dye will travel through the patient's body and into the blood vessels of the eye. The procedure does not require x rays. Instead, a rapid series of close-up photographs of the patient's eyes are taken, one set immediately after the dye is injected, and a second set approximately 20 minutes later once the dye has moved through the patient's vascular system. The entire procedure takes up to one hour.

Celiac and mesenteric angiography

Celiac and mesenteric angiography involves x-ray exploration of the celiac and mesenteric arteries, arterial branches of the abdominal aorta that supply blood to the abdomen and digestive system. The test is commonly used to detect aneurysm, thrombosis, and signs of **ischemia** in the celiac and mesenteric arteries, and to locate the source of gastrointestinal bleeding. It is also used in the diagnosis of a number of conditions, including portal **hypertension**, and **cirrhosis**. The procedure can take up to three hours, depending on the number of blood vessels studied.

Splenoportography

A splenoportograph is a variation of an angiogram that involves the injection of contrast medium directly into the spleen to view the splenic and portal veins. It is used to diagnose blockages in the splenic vein and portal

KEY TERMS

Arteriosclerosis—A chronic condition characterized by thickening and hardening of the arteries and the build-up of plaque on the arterial walls. Arteriosclerosis can slow or impair blood circulation.

Carotid artery—An artery located in the neck.

Catheter—A long, thin, flexible tube used in angiography to inject contrast material into the arteries.

Cirrhosis—A condition characterized by the destruction of healthy liver tissue. A cirrhotic liver is scarred and cannot break down the proteins in the bloodstream. Cirrhosis is associated with portal hypertension.

Embolism—A blood clot, air bubble, or clot of foreign material that travels and blocks the flow of blood in an artery. When blood supply to a tissue or organ is blocked by an embolism, infarction, or death of the tissue the artery feeds, occurs. Without immediate and appropriate treatment, an embolism can be fatal.

Femoral artery—An artery located in the groin area that is the most frequently accessed site for arterial puncture in angiography.

Fluorescein dye—An orange dye used to illuminate the blood vessels of the retina in fluorescein angiography.

Fluoroscopic screen—A fluorescent screen which displays "moving x-rays" of the body. Fluoroscopy allows the radiologist to visualize the guide wire and catheter he is moving through the patient's artery.

Guide wire—A wire that is inserted into an artery to guides a catheter to a certain location in the body.

Iscehmia—A lack of normal blood supply to a organ or body part because of blockages or constriction of the blood vessels.

Necrosis—Cellular or tissue death; skin necrosis may be caused by multiple, consecutive doses of radiation from fluoroscopic or x-ray procedures.

Plaque—Fatty material that is deposited on the inside of the arterial wall.

Portal hypertension—A condition caused by cirrhosis of the liver. It is characterized by impaired or reversed blood flow from the portal vein to the liver, an enlarged spleen, and dilated veins in the esophagus and stomach.

Portal vein thrombosis—The development of a blood clot in the vein that brings blood into the liver. Untreated portal vein thrombosis causes portal hypertension.

vein thrombosis and to assess the strength and location of the vascular system prior to **liver transplantation**.

Most angiography procedures are typically paid for by major medical insurance. Patients should check with their individual insurance plans to determine their coverage.

Preparation

Patients undergoing an angiogram are advised to stop eating and drinking eight hours prior to the procedure. They must remove all jewelry before the procedure and change into a hospital gown. If the arterial puncture is to be made in the armpit or groin area, shaving may be required. A sedative may be administered to relax the patient for the procedure. An IV line will also be inserted into a vein in the patient's arm before the procedure begins in case medication or blood products are required during the angiogram.

Prior to the angiography procedure, patients will be briefed on the details of the test, the benefits and risks, and the possible complications involved, and asked to sign an informed consent form.

Aftercare

Because life-threatening internal bleeding is a possible complication of an arterial puncture, an overnight stay in the hospital is sometimes recommended following an angiography procedure, particularly with cerebral and coronary angiograms. If the procedure is performed on an outpatient basis, the patient is typically kept under close observation for a period of at six to 12 hours before being released. If the arterial puncture was performed in the femoral artery, the patient will be instructed to keep his leg straight and relatively immobile during the observation period. The patient's blood pressure and vital signs will be monitored and the puncture site observed closely. Pain medication may be prescribed if the patient is experiencing discomfort from the puncture, and a cold pack is applied to the site to reduce swelling. It is normal for the puncture site to be sore and bruised for several weeks.

The patient may also develop a hematoma, a hard mass created by the blood vessels broken during the procedure. Hematomas should be watched carefully, as they may indicate continued bleeding of the arterial puncture site.

Angiography patients are also advised to enjoy two to three days of rest and relaxation after the procedure in order to avoid placing any undue **stress** on the arterial puncture. Patients who experience continued bleeding or abnormal swelling of the puncture site, sudden dizziness, or chest pains in the days following an angiography procedure should seek medical attention immediately.

Patients undergoing a fluorescein angiography should not drive or expose their eyes to direct sunlight for 12 hours following the procedure.

Risks

Because angiography involves puncturing an artery, internal bleeding or hemorrhage are possible complications of the test. As with any invasive procedure, infection of the puncture site or bloodstream is also a risk, but this is rare.

A **stroke** or **heart attack** may be triggered by an angiogram if blood clots or plaque on the inside of the arterial wall are dislodged by the catheter and form a blockage in the blood vessels or artery. The heart may also become irritated by the movement of the catheter through its chambers during pulmonary and coronary angiography procedures, and arrhythmias may develop.

Patients who develop an allergic reaction to the contrast medium used in angiography may experience a variety of symptoms, including swelling, difficulty breathing, **heart failure**, or a sudden drop in blood pressure. If the patient is aware of the allergy before the test is administered, certain medications can be administered at that time to counteract the reaction.

Angiography involves minor exposure to radiation through the x rays and fluoroscopic guidance used in the procedure. Unless the patient is pregnant, or multiple radiological or fluoroscopic studies are required, the small dose of radiation incurred during a single procedure poses little risk. However, multiple studies requiring fluoroscopic exposure that are conducted in a short time period have been known to cause skin necrosis in some individuals. This risk can be minimized by careful monitoring and documentation of cumulative radiation doses administered to these patients.

Normal results

The results of an angiogram or arteriogram depend on the artery or organ system being examined. Generally, test results should display a normal and unimpeded flow of blood through the vascular system. Fluorescein angiography should result in no leakage of fluorescein dye through the retinal blood vessels.

Abnormal results

Abnormal results of an angiography may display a restricted blood vessel or arterial blood flow (ischemia) or an irregular placement or location of blood vessels. The results of an angiography vary widely by the type of procedure performed, and should be interpreted and explained to the patient by a trained radiologist.

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Paula Anne Ford-Martin

Angiomas *see* **Birthmarks**

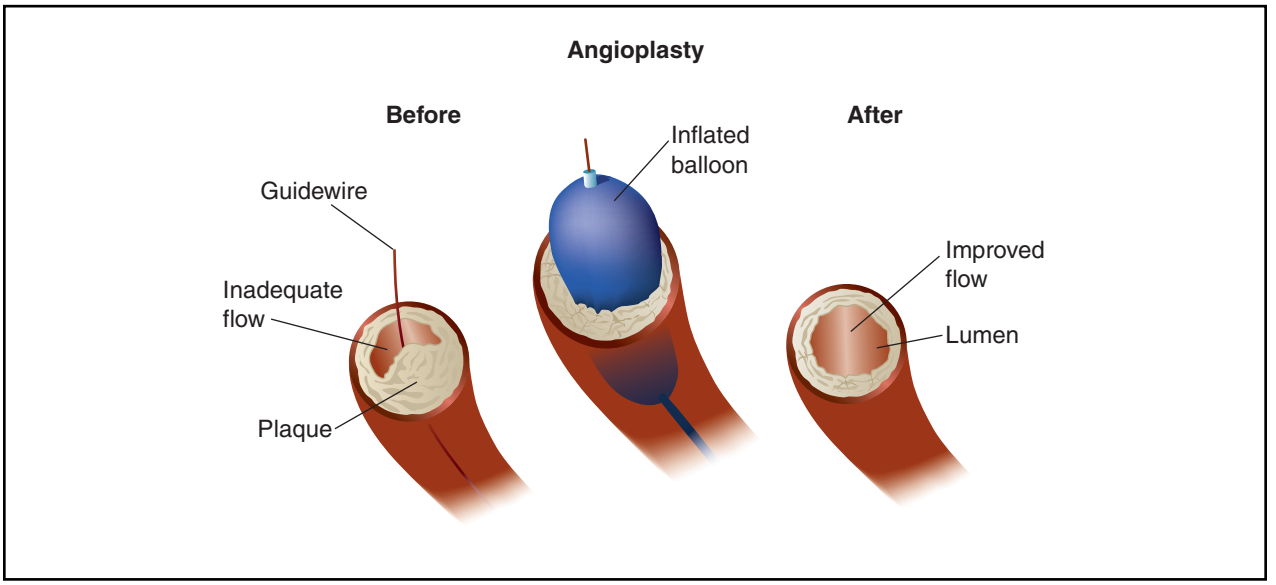
Angioplasty

Definition

Angioplasty is a term describing a procedure used to widen vessels narrowed by stenoses or occlusions. There are various types of these procedures and their names are associated with the type of vessel entry and equipment used. For example, percutaneous transluminal angioplasty (PTA) describes entry through the skin (percutaneous) and navigates to the area of the vessel of interest through the same vessel or one that communicates with it (transluminal). In the case of a procedure involving the coronary arteries, the point of entry could be the femoral artery in the groin and the catheter/guidewire system is passed through the aorta to the heart and the origin of the coronary arteries at the base of the aorta just outside the aortic valve.

Purpose

In individuals with an occulsive vascular disease such as **atherosclerosis**, blood flow is impaired to an organ (such as the heart) or to a distal body part (such as the lower leg) by the narrowing of the vessel's lumen due to fatty deposits or calcium accumulation. This narrowing may occur in any vessel but may occur anywhere. Once the vessel has been widened, adequate blood flow is returned. The vessel may narrow again over time at the same location and the procedure could be repeated.



In balloon angioplasty, plaque is pushed out of the clogged artery by the inflation of the balloon device. *(Illustration by Argosy Inc.)*

Precautions

Angioplasty procedures are performed on hospital inpatients in facilities for proper monitoring and recovery. If the procedure is to be performed in a coronary artery, the patient's care is likely to be provided by specially trained physicians, nurses, and vascular specialists. Typically, patients are given anticoagulants prior to the procedure to assist in the prevention of thromboses (blood clots). Administration of anticoagulants, however, may impede the sealing of the vascular entry point. The procedure will be performed using fluoroscopic guidance and contrast media. Since the decision to perform angioplasty may have been made following a diagnostic angiogram, the patient's sensitivity to iodinated contrast media is likely to known. The procedure may then require the use of non-ionic contrast agents.

Description

Angioplasty was originally performed by dilating the vessel with the introduction of larger and larger stiff catheters through the narrowed space. Complications of this procedure caused researchers to develop means of widening the vessel using a minimally sized device. Today, catheters contain balloons that are inflated to widen the vessel and stents to provide structural support for the vessel. Lasers may be used to assist in the break up of the fat or calcium plaque. Catheters may also be equipped with spinning wires or drill tips to clean out the plaque.

Angioplasty may be performed while the patient is sedated or anesthetized, depending on the vessels involved. If a percutaneous transluminal coronary angioplasty (PTCA) is to be performed, the patient will be kept awake to report on discomfort and **cough** if required. PTCA procedures are performed in **cardiac catheterization** labs with sophisticated monitoring devices. If angioplasty is performed in the radiology department's angiographic suite, the patient may be sedated for the procedure and a nurse will monitor the patient's vital signs during the procedure. If performed by a vascular surgeon, the angioplasty procedure will be performed in an operating room or specially designed vascular procedure suite.

The site of the introduction of the angioplasty equipment is prepared as a sterile surgical site. Although many procedures are performed by puncturing the vessel through skin, many procedures are also performed by surgically exposing the site of entry. Direct view of the vessel's puncture site aids in monitoring damage to the vessel or excessive bleeding at the site. Once the vessel is punctured and the guidewire is introduced, fluoroscopy is used to monitor small injections of contrast media used to visualize the path through the vessel. If the fluoroscopy system has a feature called 'roadmap', the amount of contrast media injected will be greater in order to define the full route the guidewire will take. The fluoroscopy system will then superimpose subsequent images over the roadmap while the vessel is traversed, that is, the physician moves the guidewire along the map to the destination.

Having reached the area of stenosis, the physician will inflate the balloon on the catheter that has been

passed along the guidewire. Balloons are inflated in size and duration depending on the size and location of the vessel. In some cases, the use of a stent (a mesh of wire that resembles a Chinese finger puzzle) may also be used. The vessel may be widened before, during, or after the deployment of the stent. Procedures for deploying stents are dependent on the type of stent used. In cases where the vessel is tortuous or at intersections of vessels, the use of a graph may be necessary to provide structural strength to the vessel. Stents, graphs, and balloon dilation may all be used together or separately.

The procedure is verified using fluoroscopy and contrast media to produce an angiogram or by using intravascular ultrasound or both. All equipment is withdrawn from the vessel and the puncture site repaired.

Risks

During the procedure there is a danger of puncturing the vessel with the guidewire. This is a very small risk. Patients must be monitored for hematoma or hemorrhage at the puncture site. There is also a small risk of **heart attack**, emboli, and although unlikely **death**. Hospitalization will vary in length by the patient's overall condition, any complications, and availability of home care.

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KEY TERMS

Plaque—In atherosclerosis, a swollen area in the lining of an artery formed by fatty deposits.

Cardiac catheterization—A procedure to pass a catheter to the heart and its vessels for the purpose of diagnosing coronary artery disease, assessing injury or disease of the aorta, or evaluating cardiac function.

EKG—Electrocardiogram, used to study and record the electrical activity of the heart.

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Angiotensin-converting enzyme inhibitors

Definition

Angiotensin-converting enzyme inhibitors (also called ACE inhibitors) are medicines that block the conversion of the chemical angiotensin I to a substance that increases salt and water retention in the body.

Purpose

ACE inhibitors are used in the treatment of high blood pressure. They may be used alone or in combination with other medicines for high blood pressure. They work by preventing a chemical in the blood, angiotensin I, from being converted into a substance that increases salt and water retention in the body. Increased salt and water retention lead to high blood pressure. ACE inhibitors also make blood vessels relax, which helps lower blood pressure and allows more oxygen-rich blood to reach the heart.

Treating high blood pressure is important because the condition puts a burden on the heart and the arteries, which can lead to permanent damage over time. If untreated, high blood pressure increases the risk of heart attacks, **heart failure**, **stroke**, or kidney failure.

ACE inhibitors may also be prescribed for other conditions. For example, captopril (Capoten) is used to treat kidney problems in people who take insulin to control diabetes. Captopril and lisinopril are also given to some patients after a **heart attack**. Heart attacks damage and weaken the heart muscle, and the damage continues even after a person recovers from the attack. This medicine helps slow down further damage to the heart. ACE inhibitors also may be used to treat congestive heart failure.

Description

ACE inhibitors are available only with a physician's prescription and come in tablet, capsule, and injectable forms. Some commonly used ACE inhibitors are benazepril (Lotensin), captopril (Capoten), enalapril (Vasotec), fosinopril (Monopril), lisinopril (Prinivil, Zestril), moexipril (Univasc), perindopril (Aceon), quinapril (Accupril), ramipril (Altace) and trandolapril (Mavik).

Recommended dosage

The recommended dosage depends on the type of ACE inhibitor and the medical condition for which it is being taken. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

This medicine may take weeks to noticeably lower blood pressure. Take it exactly as directed.

Do not stop taking this medicine without checking with the physician who prescribed it.

Precautions

A person taking an ACE inhibitor should see a physician regularly. The physician will check the blood pressure to make sure the medicine is working as it should and will note any unwanted side effects. People who have high blood pressure often feel perfectly fine. However, they should continue to see their physicians even when they feel well so that the physician can keep a close watch on their condition. It is also important for patients to keep taking their medicine even when they feel fine.

ACE inhibitors will not cure high blood pressure, but will help control the condition. To avoid the serious health problems that high blood pressure can cause, patients may have to take medicine for the rest of their lives. Furthermore, medicine alone may not be enough. Patients with high blood pressure may also need to avoid certain foods, such as salty snacks, and keep their weight under control. The health care professional who is treating the condition can offer advice on what measures may be necessary. Patients being treated for high blood pressure should not change their **diets** without consulting their physicians.

Anyone taking this medicine for high blood pressure should not take any other prescription or over-the-counter (OTC) medicine without first checking with his or her physician. Some medicines, such as certain cold remedies, may increase blood pressure.

Some people feel dizzy or lightheaded after taking the first dose of an ACE inhibitor, especially if they have been taking a water pill (diuretic). Anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them. Such symptoms should be reported to the physician or pharmacist if they do not subside within a day or so. For the first one or two days of taking an ACE inhibitor, patients may become lightheaded when arising from bed in the morning. Patienst should rise slowly to a sitting position before standing up.

While a goal of treatment with an ACE inhibitor is to lower the blood pressure, patients must be careful not to let their blood pressure get too low. Low blood pressure can lead to **dizziness**, lightheadedness and **fainting**. To prevent the blood pressure from getting too low, observe these precautions:

- Do not drink alcohol without checking with the physician who prescribed this medicine.
- Captopril and moexipril should be taken one hour before meals. Other ACE inhinbitors may be taken with or without meals.
- Avoid overheating when exercising or in hot weather. The loss of water from the body through heavy sweating can cause low blood pressure.
- Check with a physician right away if illness occurs while taking an ACE inhibitor. This is especially true if the illness involves severe nausea, vomiting, or **diarrhea**. Vomiting and diarrhea can cause the loss of too much water from the body, which can lead to low blood pressure.

Anyone who is taking ACE inhibitors should be sure to tell the health care professional in charge before having any surgical or dental procedures or receiving emergency treatment.

Some ACE inhibitors may change the results of certain medical tests, such as blood or urine tests. Before having medical tests, anyone taking this medicine should alert the health care professional in charge.

Do not use a potassium supplement or a salt substitute that contains potassium without first checking with the physician who prescribed the ACE inhibitor.

Patients who are being treated with bee or wasp venom to prevent allergic reactions to stings may have a severe allergic reaction to certain ACE inhibitors.

Special conditions

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

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

PREGNANCY. The use of ACE inhibitors in **pregnancy** can cause serious problems and even **death** in the fetus or newborn. Women who are pregnant or who may become pregnant should check with their physicians before using this medicine. Women who become pregnant while taking this medicine should check with their physicians immediately.

BREASTFEEDING. Some ACE inhibitors pass into breast milk. Women who are breastfeeding should check with their physicians before using ACE inhibitors.

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

- diabetes
- heart or blood vessel disease
- recent heart attack or stroke
- liver disease
- kidney disease
- kidney transplant
- scleroderma
- systemic lupus erythematosus (SLE)

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

Side effects

The most common side effect is a dry, continuing **cough**. This usually does not subside unless the medication is stopped. Ask the physician if the cough can be treated. Less common side effects, such as **headache**, loss of taste, unusual tiredness, and nausea or diarrhea also may occur and do not need medical attention unless they are severe or they interfere with normal activities.

More serious side effects are rare, but may occur. If any of the following side effects occur, check with a physician immediately:

- swelling of the face, lips, tongue, throat, arms, legs, hands, or feet
- itchy skin
- sudden breathing or swallowing problems
- chest pain
- hoarseness
- sore throat
- fever and chills
- stomach pain
- yellow eyes or skin

In addition, anyone who has any of the following symptoms while taking an ACE inhibitor should check with his or her physician as soon as possible:

- dizziness, lightheadedness, fainting
- confusion
- nervousness
- fever
- joint pain
- numbness or tingling in hands, feet, or lips
- weak or heavy feeling in the legs
- skin rash
- irregular heartbeat
- shortness of breath or other breathing problems

Other side effects may occur. Anyone who has unusual symptoms after taking an ACE inhibitor should get in touch with his or her physician.

Interactions

ACE inhibitors may interact with certain foods and other medicines. For example, captopril (Capoten) interacts with food and should be taken one hour before meals. Anyone who takes ACE inhibitors should let the physician know all other medicines he or she is taking and should ask about foods that should be avoided.

KEY TERMS

Arteries—Blood vessels that carry blood away from the heart to the cells, tissues, and organs of the body.

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

Enzyme—A type of protein, produced in the body, that brings about or speeds up chemical reactions.

Fetus—A developing baby inside the womb.

Scleroderma—A disease that first affects the skin and later affects certain internal organs. The first symptoms are the hardening, thickening, and shrinking of the skin.

Systemic lupus erythematosus (SLE)—A chronic disease that affects the skin, joints, and certain internal organs.

Venom—A poisonous substance secreted by an animal, usually delivered through a bite or a sting.

Among the foods and drugs that may interact with ACE inhibitors are:

- water pills (diuretics)
- lithium, used to treat bipolar disorder
- tetracycline, an antibiotic
- medicines or supplements that contain potassium
- salt substitutes that contain potassium

The list above may not include everything that interacts with ACE inhibitors. Be sure to check with a physician or pharmacist before combining ACE inhibitors with any other prescription or nonprescription (over-the-counter) medicine.

Nancy Ross-Flanigan

Angiotensin-converting enzyme test

Definition

This test measures blood levels of angiotensin-converting enzyme (ACE), also known as Serum Angiotensin-Converting Enzyme (SASE). The primary function of ACE is to help regulate arterial pressure by converting angiotensin I to angiotensin II.

Purpose

The ACE test is used primarily to detect and monitor the clinical course of **sarcoidosis** (a disease that affects many organs, especially the lungs), to differentiate between sarcoidosis and similar diseases, and to delineate between active and inactive sarcoid disease. Elevated ACE levels are also found in a number of other conditions, including Gaucher's disease (a rare familial disorder of fat metabolism) and **leprosy**.

Precautions

It should be noted that people under 20 years of age normally have very high ACE levels. Decreased levels may be seen in the condition of excess fat in the blood (hyperlipidemia). Drugs that may cause decreased ACE levels include ACE inhibitor antihypertensives and steroids.

Description

ACE plays an important role in the renin/aldosterone mechanism which controls blood pressure by converting angiotensin I to angiotensin II, two proteins involved in regulating blood pressure. Angiotensin I by itself is inactive, but when converted by ACE to the active form, angiotensin II, it causes narrowing of the small blood vessels in tissues, resulting in an increase in blood pressure. Angiotensin II also stimulates the hormone aldosterone, which causes an increase in blood pressure. Certain kidney disorders increase the production of angiotensin II, another cause of **hypertension**. Despite the action of ACE on blood pressure regulation, determination of this enzyme is not very helpful in the evaluation of hypertension (high blood pressure).

Preparation

Determination of ACE levels requires a blood sample. The patient need not be **fasting**.

Risks

Risks for this test are minimal, but may include slight bleeding from the puncture site, **fainting** or feeling lightheaded after venipuncture, or hematoma (blood accumulating under the puncture site).

Normal results

Normal ranges for this test are laboratory-specific but can range from 8-57 U/ml for patients over 20 years of age.

KEY TERMS

Sarcoidosis—Sarcoidosis is a rare disease of unknown cause in which inflammation occurs in lymph nodes and other tissues throughout the body, usually the lungs, skin, liver, and eyes.

Abnormal results

Serum ACE levels are elevated in approximately 80-90% of patients with active sarcoidosis. Thyroid hormone may have an effect on ACE activity, as hypothyroid (low thyroid) patients, as well as patients with **anorexia nervosa** with associated findings of **hypothyroidism**, may have low serum ACE activity. ACE can also be decreased in lung **cancer** (bronchogenic carcinoma).

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Janis O. Flores

Animal bite infections

Definition

The most common problem following an animal bite is simple infection. The saliva of dogs and cats is known to contain a wide variety of bacteria. According to one recent study, bacteria or other pathogens show up in about 85 percent of bites. When an animal bites, it can then transmit pathogens into the wound. These microorganisms may grow within the wound and cause an infection. The consequences of infection range from mild discomfort to life-threatening complications.

Description

Two to 4.5 million animal bites occur each year in the United States and about 1% of bites require hospitalization. Animal bites result in 334,000 emergency room visits per year, which represents approximately 1% of all emergency hospital visits, at an annual cost of $100 million dollars in health care expenses and lost income. Children are the most frequent victims of dog bites, with 5-9 year-old boys having the highest incidence. Men are more often bitten by dogs than are women (3:1), whereas women are more often bitten by cats (3:1).

Dog bites make up 80-85% of all reported incidents. Cats account for about 10% of reported bites, and other animals (including rodents, rabbits, horses, raccoons, bats, skunks, and monkeys) make up the remaining 5-10%. Cat bites become infected more frequently than dog bites. A dog's mouth is rich in bacteria, but only 15-20% of dog bites become infected. In contrast, approximately 30-50% of cat bites become infected.

Many factors contribute to the infection rates, such as, for example, the type of wound inflicted, the location of the wound, pre-existing health conditions in the bitten person, the extent of delay before treatment, patient compliance and the presence of a foreign body in the wound. Dogs usually inflict crush injuries because they have rounded teeth and strong jaws; thus, the bite of an adult dog can exert up to 200 pounds per square inch of pressure. This pressure usually results in a crushing injury, causing damage to deep structures such as bones, blood vessels, tendons, muscles, and nerves. Dog canine teeth are also sharp and strong and also inflict lacerations. Cats, with their needle-like fangs, typically cause puncture **wounds**. Puncture wounds appear innocuous on the surface, but the underlying injury goes deep. Cat teeth essentially inject bacteria into the bite, and the deep, narrow wound is difficult to clean. Persons with impaired immunocompetence—for example, individuals with HIV infection—are especially vulnerable to infection.

The bacterial species most commonly found in bite wounds include *Pasteurella multocida*, *Staphylococcus aureus*, *Pseudomonas sp*, and *Streptococcus sp*. *P. multocida*, the root cause of pasteurellosis, is especially prominent in cat bite infections. Other infectious diseases from animal bites include **cat-scratch disease**, **tetanus** and **rabies**.

Causes and symptoms

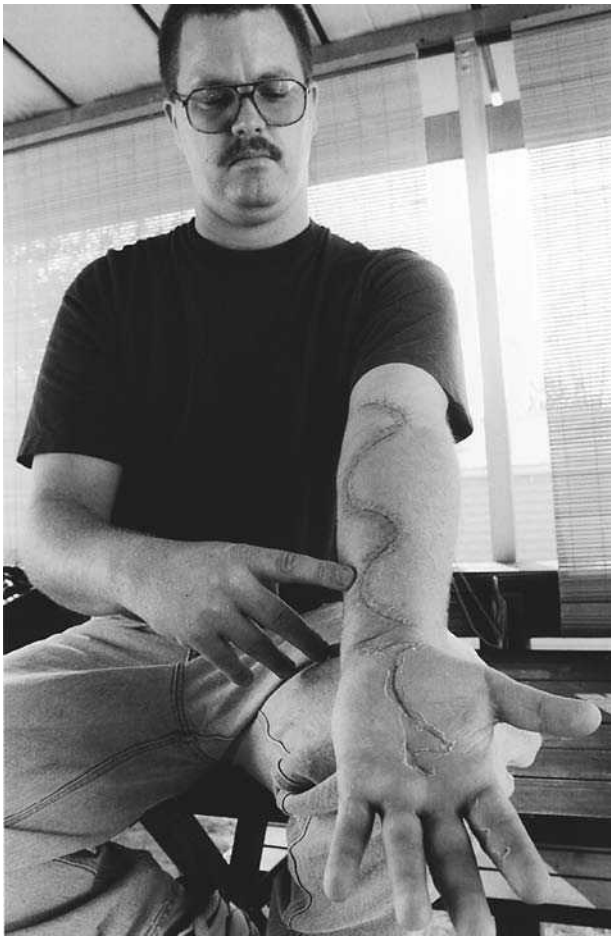
The most common sign of infection from an animal bite is inflammation. The skin around the wound is red and feels warm, and the wound may exude pus. Nearby lymph glands may be swollen. Complications can arise if the infection is not treated and spreads into deeper structures or into the bloodstream. If the bite is deep or occurs on the hand or at a joint, complications are more likely.

Live, disease-causing bacteria within the bloodstream and tissues cause complications far from the wound site. Such complications include **meningitis**, brain abscesses, **pneumonia** and lung abscesses, and heart infections, among others. These complications can be fatal. Deep bites or bites near joints can damage joints

and bones, causing inflammation of the bone and bone marrow or septic arthritis.

Cat-scratch disease is caused by *Bartonella henselae*, a bacterium that is carried in cat saliva; infection may be transmitted by a bite or scratch. Approximately 22,000 cases are reported each year in the United States; worldwide, nine out of every 100,000 individuals become infected. More than 80% of reported cases occur in persons under the age of 21. The disease is not normally severe in individuals with healthy immune systems. Symptoms may become serious, however, in immunocompromised individuals, such as those with acquired immune deficiency syndrome (**AIDS**) or those undergoing **chemotherapy**. Common symptoms include an inflamed sore in the area of the bite or scratch, swollen lymph nodes, **fever**, **fatigue**, and rash.

Rabies is caused by a virus that is transmitted through the bite of an animal that is already infected. More than 90% of animal rabies cases occur in wild animals such as skunks, bats, and raccoons, with domestic animals such as dogs and cats accounting for less than 10%. The World Health Organization (WHO) estimates that between 35,000 and 50,000 individuals worldwide die each year as a result of rabies. The highest incidence of rabies occurs in Asia where, in 1997, over 33,000 deaths were noted, most occurring in India. Rabies is nowadays rare in the U.S. due to good animal control practice. The delay of onset is usually weeks to months after being bitten. Early symptoms of rabies include fever, **headache**, and flu-like symptoms. These progress to **anxiety**, **hallucinations**, muscle spasms, partial **paralysis**, fear of water (hydrophobia), and other neurological symptoms as the virus spreads to the central nervous system. Medical treatment must be sought soon after exposure because **death** invariably follows once the infection becomes established.



This snake breeder shows the scar from his surgery after he was bitten by a venomous West African Gabon viper. His arm was cut open in order to relieve swelling from the snake bite in his middle finger. *(Photograph by Joe Crocetta, AP/Wide World Photo. Reproduced by permission.)*

Diagnosis

A medical examination involves taking the history of the injury and assessing the wound type and damage. Tetanus immunization and general health status are checked. An x ray may be ordered to assess bone damage and to check for **foreign objects** in the wound. Wound cultures are done for infected bites if the victim is at high risk for complications or if the infection does not respond to treatment. Evaluation of possible exposure to rabies is also important. A biting animal suspected of having rabies is usually apprehended, tested, and observed for a period of time for evidence of pre-existing infection.

Treatment

Treatment depends on the wound type, its site, and risk factors for infection. All wounds are cleaned and disinfected as thoroughly as possible. Bites to the head and face usually receive sutures, as do severe lacerations elsewhere. Puncture wounds are left open. If **abscess** formation occurs, the physician may perform an incision so as to drain the abscess.

If infection occurs, **antibiotics** are prescribed. Antibiotics may also be used for infection prevention. Since a single bite wound may contain many different types of bacteria, no single antibiotic is always effective. Commonly prescribed antibiotics are penicillin or a combination of amoxicillin and clavulanate potassium.

Because rabies is caused by a virus, antibiotics are not effective. In addition, as of 2001, there is no known cure for the disease once symptoms become apparent. It is therefore recommended that individuals with a high risk of contracting the disease (veterinarians, animal handlers, some laboratory workers) receive preexposure **vac-**

KEY TERMS

Canines—The two sharp teeth located next to the front incisor teeth in mammals that are used to grip and tear.

Culture—A laboratory procedure in which a sample from a wound, the blood or other body fluid is taken from an infected person. The sample is placed in conditions under which bacteria can grow. If bacteria grow, identification tests are done to determine the bacteria species causing the infection.

Immunocompetence—An individual's ability to fight off infection.

Microorganisms—Microscopic organisms, such as bacteria, viruses, algae and fungi.

Pasteurellosis—A bacterial infection caused by *Pasteurella multocida*. Pasteurellosis is characterized by inflammation around the wound site and may be accompanied by bacteria in the bloodstream and infection in tissues and organs.

Pathogen—Any disease producing microorganism.

Postexposure prophylaxis (PEP)—Any treatment given after exposure to a disease to try to prevent the disease from occurring. In the case of rabies, PEP involves a series of vaccines given to an individual who has been bitten by an unknown animal or one that is potentially infected with the rabies virus.

cination. Individuals bitten by an unknown or potentially rapid animal should receive postexposure vaccination, also called postexposure **prophylaxis** (PEP). The PEP regimen consists of one vaccine given at the initial visit as well as one dose of human immune globulin. Additional vaccines given on days 3, 7, 14, and 28.

Prognosis

Once a bacterial infection is halted, the bite victim usually recovers fully. There is no known cure for rabies once symptoms become evident and death is almost certain. WHO reports that 114 rabies deaths occurred in the Americas in 1997, with only four deaths occurring that year in the United States, thus emphasizing the importance of good animal control practice and postexposure prophylaxis.

Prevention

Preventing bites obviously prevents subsequent infections. Children under 12 years of age are at a higher risk for bites due to their small size and their inexperience with animals; therefore, they should be supervised with animals and taught to act appropriately around them. An animal that is unusually aggressive or behaving strangely (e.g. a raccoon that is active during the daytime) should be avoided and reported to the local animal control authorities; it may be infected with the rabies virus. All pets should be vaccinated against rabies and wild animals should not be taken in as pets. People should also avoid trying to break up fights between animals and should as a rule approach unknown cats and dogs very cautiously, especially on their territory. Finally, animals should not be trained to fight.

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Julia Barrett

Ankylosing spondylitis

Definition

Ankylosing spondylitis (AS) refers to inflammation of the joints in the spine. AS is also known as rheumatoid spondylitis or Marie-Strümpell disease (among other names).

Description

A form of arthritis, AS is characterized by chronic inflammation, causing **pain** and stiffness of the back,

progressing to the chest and neck. Eventually, the whole back may become curved and inflexible if the bones fuse (this is known as "bamboo spine"). AS is a systemic disorder that may involve multiple organs, such as the:

- eye (causing an inflammation of the iris, or iritis)
- heart (causing aortic valve disease)
- lungs
- skin (causing a scaly skin condition, or psoriasis)
- gastrointestinal tract (causing inflammation within the small intestine, called ileitis, or inflammation of the large intestine, called colitis)

Less than 1% of the population has AS; however, 20% of AS sufferers have a relative with the disorder.

Causes and symptoms

Genetics play an important role in the disease, but the cause of AS is still unknown. More than 90% of patients have a gene called HLA-B27, but only 10-15% of those who inherit the gene develop the disease. Symptoms of AS include:

- low back and hip pain and stiffness
- difficulty expanding the chest
- pain in the neck, shoulders, knees, and ankles
- low-grade fever
- fatigue
- weight loss

AS is seen most commonly in males 30 years old and older. Initial symptoms are uncommon after the age of 30, although the diagnosis may not be established until after that age. The incidence of AS in Afro-Americans is about 25% of the incidence in Caucasians.

Diagnosis

Doctors usually diagnose the disease simply by the patient's report of pain and stiffness. Doctors also review spinal and pelvic x rays since involvement of the hip and pelvic joints is common and may be the first abnormality seen on the x ray. The doctor may also order a blood test to determine the presence of HLA-B27 antigen. When a diagnosis is made, patients may be referred to a rheumatologist, a doctor who specializes in treating arthritis. Patients may also be referred to an orthopedic surgeon, a doctor who can surgically correct joint or bone disorders.

Treatment

Nonsteroidal anti-inflammatory drugs (NSAIDs), like naproxen (Naprosyn) or indomethacin (Indocin) are used to relieve pain and stiffness. In severe cases, sulfasalazine (Azulfidine), another drug to reduce inflammation, or methotrexate (Rheumatrex), an immune-suppressing drug, is recommended. In cases where chronic therapy is needed, potential drug side effects must be taken into consideration. Corticosteroid drugs are effective in relieving symptoms, but are usually reserved for severe cases that do not improve when NSAIDs are used. To avoid potential side effects, treatment with **corticosteroids** is usually limited to a short amount of time with a gradual weaning from the drug.

Physical therapists prescribe exercises to prevent a stooped posture and breathing problems when the spine starts to fuse and ribs are affected. Back braces may be used to prevent continued deformity of the spine and ribs. Only in severe cases of deformity is surgery performed to straighten and realign the spine, or to replace knee, shoulder, or hip joints.

Alternative treatment

To reduce inflammation various herbal remedies, including white willow (*Salix alba*), yarrow (*Achillea millefolium*), and lobelia (*Lobelia inflata*), may be helpful. **Acupuncture**, performed by a trained professional, has helped some patients manage their pain. Homeopathic practitioners may prescribe such remedies as *Bryonia* and *Rhus toxicodendron* for pain relief.

Prognosis

There is no cure for AS, and the course of the disease is unpredictable. Generally, AS progresses for about 10 years and then its progression levels off. Most patients can lead normal lives with treatment to control symptoms.

Prevention

There is no known way to prevent AS.

Resources

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ORGANIZATIONS

Arthritis Foundation.1300 W. Peachtree St., Atlanta, GA 30309. (800) 283-7800. <http://www.arthritis.org>.

KEY TERMS

Ankylosing—When bones of a joint are fused, stiff, or rigid.

HLA-B27—An antigen or protein marker on cells that may indicate ankylosing spondylitis.

Immune suppressing—Anything that reduces the activity of the immune system.

Inflammation—A reaction of tissues to disease or injury, often associated with pain and swelling.

Spondylitis—An inflammation of the spine.

National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse. 1 AMS Circle, Bethesda, MD 29892-3675. (301) 495-4484.

Spondylitis Association of America. P.O. Box 5872, Sherman Oaks, CA 91413. (800) 777-8189.

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Jeanine Barone, Physiologist

Anorectal abscess *see* **Anorectal disorders**

Anorectal disorders

Definition

Anorectal disorders are a group of medical disorders that occur at the junction of the anal canal and the rectum.

Description

The anal canal, also called the anus, is the opening at the bottom end of the digestive tract and is a combination of external skin and tissue from the digestive tract. It has many sensory nerves and is sensitive to **pain**. The rectum is the last section of the digestive tract and has a mucus layer as its inside surface. It has very few sensory nerves and is, therefore, relatively insensitive to pain. The anal canal has a ring of muscle, called the anal sphincter, which keeps the anus closed. There are a number of different anorectal disorders.

Causes and symptoms

Hemorrhoids are swollen or **varicose veins** in the anal canal and rectum. They may become inflamed, enlarged, or protrude from the anorectal area. Hemorrhoids may bleed when passing a bowel movement. The amount of bleeding is typically small. Frequently, hemorrhoids develop because of straining during bowel movements, especially if the person has **constipation**.

An anal fissure is a tear in the lining of the anus that is usually caused by a hard bowel movement. Fissures are painful and bleed when the tissue is stressed during bowel movements.

Anorectal abscesses are characterized by pus-forming infections in the anorectal region. Painful abscesses form under the skin.

An anorectal fistula is an abnormal opening or channel from the anorectal area to another part of the body. Typically, the channel leads to pockets of skin near the anus. When seen in infants, anorectal fistulas are considered **birth defects**. These are seen more frequently in boys than in girls. Fistulas are also seen more frequently in people who have other diseases, including **Crohn's disease**, **tuberculosis**, **cancer**, and diverticulitis. Anorectal fistulas also occur following anorectal abscesses or other injury to the anal area. Fistulas are usually painful and discharge pus.

Proctitis is an inflammation of the internal mucosal lining of the rectum. Ulcers of the lining may form and develop into **ulcerative colitis**. There are many causes of proctitis, including the **sexually transmitted diseases** chlamydia and herpes simplex infections. Proctitis is frequently seen in homosexual males as a consequence of anorectal infection. Proctitis itself is not painful, but pain may be caused by the infectious agent.

Diagnosis

Diagnosis is made by visual inspection of the skin around the anus. Also, the doctor may probe the rectum with a gloved finger. An anoscope is a short instrument that allows the physician to view the inside of the anus. A proctoscope is a longer, rigid viewing tube of approximately six to ten inches in length, which may be used to look for anorectal disorders. A sigmoidoscope is a longer, flexible tube, that allows the physician to view up to about two feet of the inside of the large intestine. Tissue samples and material for microbial culture may be obtained during the examination.

Treatment

Treatment usually isn't required for hemorrhoids. Most hemorrhoids will heal if the patient takes stool soft-

eners to relieve the constipation. Enlarged blood vessels can be eliminated by surgery if they are considered a severe problem. In the case of fissures, treatment involves stool softeners that eliminate **stress** on the fissure during bowel movements, which allows the fissure to heal. If the fissure doesn't heal, surgery is required. Treatment for anorectal abscesses consists of cutting the **abscess** and draining the pus. Fistulas are treated by surgery.The usual treatment for proctitis is **antibiotics**.

Resources

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John T. Lohr, PhD

Anorectal fistula *see* **Anorectal disorders**

Anorexia nervosa

Definition

Anorexia nervosa is an eating disorder characterized by unrealistic fear of weight gain, self-starvation, and conspicuous distortion of body image. The name comes from two Latin words that mean nervous inability to eat. In females who have begun to menstruate, anorexia nervosa is usually marked by **amenorrhea**, or skipping at least three menstrual periods in a row. The fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*, or *DSM-IV* (1994), defines two subtypes of anorexia nervosa—a restricting type, characterized by strict dieting and **exercise** without binge eating; and a binge-eating/purging type, marked by episodes of compulsive eating with or without self-induced vomiting and the use of **laxatives** or **enemas**. *DSM-IV* defines a binge as a time-limited (usually under two hours) episode of compulsive eating in which the individual consumes a significantly larger amount of food than most people would eat in similar circumstances.

Description

Anorexia nervosa was not officially classified as a psychiatric disorder until the third edition of *DSM* in 1980. It is, however, a growing problem among adolescent females. Its incidence in the United States has doubled since 1970. The rise in the number of reported cases reflects a genuine increase in the number of persons affected by the disorder, and not simply earlier or more accurate diagnosis. Estimates of the incidence of anorexia range between 0.5–1% of caucasian female adolescents. Over 90% of patients diagnosed with the disorder as of 1998 are female. It was originally thought that only 5% of anorexics are male, but that estimate is being revised upward. The peak age range for onset of the disorder is 14-18 years, although there are patients who develop anorexia as late as their 40s. In the 1970s and 1980s, anorexia was regarded as a disorder of upper- and middle-class women, but that generalization is also changing. More recent studies indicate that anorexia is increasingly common among women of all races and social classes in the United States.

Anorexia nervosa is a serious public health problem not only because of its rising incidence, but also because it has one of the highest mortality rates of any psychiatric disorder. Moreover, the disorder may cause serious long-term health complications, including congestive **heart failure**, sudden **death**, growth retardation, dental problems, **constipation**, stomach rupture, swelling of the salivary glands, anemia and other abnormalities of the blood, loss of kidney function, and **osteoporosis**.

Causes and symptoms

Anorexia is a disorder that results from the interaction of cultural and interpersonal as well as biological factors. While the precise cause of the disease is not known, it has been linked to the following:

Social influences

The rising incidence of anorexia is thought to reflect the present idealization of thinness as a badge of upper-class status as well as of female beauty. In addition, the increase in cases of anorexia includes "copycat" behavior, with some patients developing the disorder from imitating other girls.

The onset of anorexia in adolescence is attributed to a developmental crisis caused by girls' changing bodies coupled with society's overemphasis on women's looks. The increasing influence of the mass media in spreading and reinforcing gender stereotypes has also been noted.

Occupational goals

The risk of developing anorexia is higher among adolescents preparing for careers that require attention to weight and/or appearance. These high-risk groups

include dancers, fashion models, professional athletes (including gymnasts, skaters, long-distance runners, and jockeys), and actresses.

Genetic and biological influences

Women whose biological mothers or sisters have the disorder appear to be at increased risk.

Psychological factors

A number of theories have been advanced to explain the psychological aspects of the disorder. No single explanation covers all cases. Anorexia nervosa has been interpreted as:

- A rejection of female sexual maturity. This rejection is variously interpreted as a desire to remain a child, or as a desire to resemble men as closely as possible.
- A reaction to sexual **abuse** or assault.
- A desire to appear as fragile and nonthreatening as possible. This hypothesis reflects the idea that female passivity and weakness are attractive to men.
- Overemphasis on control, autonomy, and independence. Some anorexics come from achievement-oriented families that **stress** physical fitness and dieting. Many anorexics are perfectionistic and "driven" about schoolwork and other matters in addition to weight control.
- Evidence of family dysfunction. In some families, a daughter's eating disorder serves as a distraction from marital discord or other family tensions.
- Inability to interpret the body's hunger signals accurately due to early experiences of inappropriate feeding.

Male anorexics

Although anorexia nervosa is still considered a disorder that largely affects women, its incidence in the male population is rising. Less is known about the causes of anorexia in males, but some risk factors are the same as for females. These include certain occupational goals and increasing media emphasis on external appearance in men. Moreover, homosexual males are under pressure to conform to an ideal body weight that is about 20 pounds lighter than the standard "attractive" weight for heterosexual males.

Diagnosis

Diagnosis of anorexia nervosa is complicated by a number of factors. One is that the disorder varies somewhat in severity from patient to patient. A second factor is denial, which is regarded as an early sign of the disorder. Most anorexics deny that they are ill and are usually brought to treatment by a family member.

Most anorexics are diagnosed by pediatricians or family practitioners. Anorexics develop emaciated bodies, dry or yellowish skin, and abnormally low blood pressure. There is usually a history of amenorrhea (failure to menstruate) in females, and sometimes of abdominal **pain**, constipation, or lack of energy. The patient may feel chilly or have developed lanugo, a growth of downy body hair. If the patient has been vomiting, she may have eroded tooth enamel or Russell's sign (scars on the back of the hand). The second step in diagnosis is measurement of the patient's weight loss. *DSM-IV* specifies a weight loss leading to a body weight 15% below normal, with some allowance for body build and weight history.

The doctor will need to rule out other physical conditions that can cause weight loss or vomiting after eating, including metabolic disorders, brain tumors (especially hypothalamus and pituitary gland lesions), diseases of the digestive tract, and a condition called superior mesenteric artery syndrome. Persons with this condition sometimes vomit after meals because the blood supply to the intestine is blocked. The doctor will usually order blood tests, an electrocardiogram, **urinalysis**, and bone densitometry (**bone density test**) in order to exclude other diseases and to assess the patient's nutritional status.

The doctor will also need to distinguish between anorexia and other psychiatric disorders, including depression, **schizophrenia**, social phobia, **obsessive-compulsive disorder**, and body dysmorphic disorder. Two diagnostic tests that are often used are the Eating Attitudes Test (EAT) and the Eating Disorder Inventory (EDI).

Treatment

Treatment of anorexia nervosa includes both short- and long-term measures, and requires assessment by dietitians and psychiatrists as well as medical specialists. Therapy is often complicated by the patient's resistance or failure to carry out treatment plan.

Hospital treatment

Hospitalization is recommended for anorexics with any of the following characteristics:

- weight of 40% or more below normal; or weight loss over a three-month period of more than 30 pounds
- severely disturbed metabolism
- severe binging and purging
- signs of **psychosis**
- severe depression or risk of suicide
- family in crisis

Hospital treatment includes individual and **group therapy** as well as refeeding and monitoring of the patient's physical condition. Treatment usually requires two to four months in the hospital. In extreme cases, hospitalized patients may be force-fed through a tube inserted in the nose (nasogastric tube) or by over-feeding (hyperalimentation techniques).

Outpatient treatment

Anorexics who are not severely malnourished can be treated by outpatient psychotherapy. The types of treatment recommended are supportive rather than insight-oriented, and include behavioral approaches as well as individual or group therapy. **Family therapy** is often recommended when the patient's eating disorder is closely tied to family dysfunction. Self-help groups are often useful in helping anorexics find social support and encouragement. Psychotherapy with anorexics is a slow and difficult process; about 50% of patients continue to have serious psychiatric problems after their weight has stabilized.

Medications

Anorexics have been treated with a variety of medications, including antidepressants, **antianxiety drugs**, **selective serotonin reuptake inhibitors**, and lithium carbonate. The effectiveness of medications in treatment regimens is still debated. However, at least one study of Prozac showed it helped the patient maintain weight gained while in the hospital.

Prognosis

Figures for long-term recovery vary from study to study, but the most reliable estimates are that 40-60% of anorexics will make a good physical and social recovery, and 75% will gain weight. The long-term mortality rate for anorexia is estimated at around 10%, although some studies give a lower figure of 3-4%. The most frequent causes of death associated with anorexia are **starvation**, electrolyte imbalance, heart failure, and suicide.

Prevention

Short of major long-term changes in the larger society, the best strategy for prevention of anorexia is the cultivation of healthy attitudes toward food, weight control, and beauty (or body image) within families.

KEY TERMS

Amenorrhea—Absence of the menses in a female who has begun to have menstrual periods.

Binge eating—A pattern of eating marked by episodes of rapid consumption of large amounts of food; usually food that is high in calories.

Body dysmorphic disorder—A psychiatric disorder marked by preoccupation with an imagined physical defect.

Hyperalimentation—A method of refeeding anorexics by infusing liquid nutrients and electrolytes directly into central veins through a catheter.

Lanugo—A soft, downy body hair that develops on the chest and arms of anorexic women.

Purging—The use of vomiting, diuretics, or laxatives to clear the stomach and intestines after a binge.

Russell's sign—Scraped or raw areas on the patient's knuckles, caused by self-induced vomiting.

Superior mesenteric artery syndrome—A condition in which a person vomits after meals due to blockage of the blood supply to the intestine.

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American Anorexia/Bulimia Association. 418 East 76th St., New York, NY 10021. (212) 734-1114.

National Institute of Mental Health Eating Disorders Program, Building 10, Room 3S231. 9000 Rockville Pike, Bethesda, MD 20892. (301) 496-1891.

Rebecca J. Frey

Anoscopy

Definition

An anoscopy is an examination of the rectum in which a small tube is inserted into the anus to screen, diagnose, and evaluate problems of the anus and anal canal.

KEY TERMS

Anal fissure—An ulcer on the margin of the anus.

Digital rectal examination—An examination where a gloved, lubricated index finger is inserted into the rectum to check for any abnormalities.

Polyps—A tumor with a small flap that attaches itself to the wall of various vascular organs such as the nose, uterus and rectum. Polyps bleed easily, and if they are suspected to be cancerous they should be surgically removed.

Vasovagal reaction—Regarding the action of stimuli from the vagus nerve on blood vessels.

Purpose

This test may be ordered for the evaluation of perianal or anal **pain**, **hemorrhoids**, **rectal prolapse**, digital **rectal examination** that shows a mass, perianal **abscess** and condyloma (a wart-like growth). An anascopy may be performed to check for abnormal openings between the anus and the skin, or anal fissures. The test is also used to diagnose **rectal cancer**.

Precautions

Anoscopy should not be performed on patients with acute cardiovascular problems due to the vasovagal reaction it may cause. This test is also not recommended for patients with acute abdominal problems and those with a constricted or narrowed anal canal.

Description

Anoscopy views the anus and anal canal by using an anoscope. An anoscope is a plastic, tube-shaped speculum that is a smaller version of a sigmoidscope. Before the anoscope is used, the doctor completes a digital rectal examination with a lubricated, gloved index finger. The anoscope is then lubricated and gently inserted a few inches into the rectum. This procedure enlarges the rectum to allow the doctor to view the entire anal canal with a light. If any suspicious areas are noticed, a piece of tissue can be biopsied.

During the anoscopy procedure there may be a feeling of pressure or the need to go to the bathroom. If a biopsy is taken, the patient may feel a slight pinch. The procedure is performed on an out-patient basis, and takes approximately an hour to complete.

Preparation

The patient will be instructed to clear their rectum of stool before the procedure. This may be done by taking a laxative, enema, or other preparation that may help with the evacuation.

Aftercare

If a biopsy is needed during an anoscopy, there may be slight anal bleeding for less than two days following the procedure. The patient may be instructed to sit in a bathtub of warm water for 10 to 15 minutes, three times a day, to help decrease the pain and swelling.

Risks

A simple anoscopy procedure offers minimal risks. There is a limited risk of bleeding and mild pain is a biopsy is performed.

Normal results

Normal values to look for during an anoscopy include an anal canal that appears healthy in size, color, and shape. The test also looks for no evidence of bleeding, polyps, hemorrhoids or other abnormalities.

Abnormal results

While an anoscopy is typically performed to determine is hemorrhoids are present, other abnormal finding could include polyps, abscesses, inflammation, fissures, colorectal polyps, or **cancer**.

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Beth A. Kapes

Anosmia

Definition

The term anosmia means lack of the sense of smell. It may also refer to a decreased sense of smell. Ageusia, a companion word, refers to a lack of taste sensation. Patients who actually have anosmia may complain wrongly of ageusia, although they retain the ability to distinguish salt, sweet, sour, and bitter—humans' only taste sensations.

Description

Of the five senses, smell ranks fourth in importance for humans, although it is much more pronounced in other animals. Bloodhounds, for example, can smell an odor a thousand times weaker than humans. Taste, considered the fifth sense, is mostly the smell of food in the mouth. The sense of smell originates from the first cranial nerves (the olfactory nerves), which sit at the base of the brain's frontal lobes, right behind the eyes and above the nose. Inhaled airborne chemicals stimulate these nerves.

There are other aberrations of smell beside a decrease. Smells can be distorted, intensified, or hallucinated. These changes usually indicate a malfunction of the brain.

Causes and symptoms

The most common cause of anosmia is nasal occlusion caused by **rhinitis** (inflammation of the nasal membranes). If no air gets to the olfactory nerves, smell will not happen. In turn, rhinitis and **nasal polyps** (growths on nasal membranes) are caused by irritants such as allergens, infections, cigarette smoke, and other air pollutants. Tumors such as nasal polyps can also block the nasal passages and the olfactory nerves and cause anosmia. **Head injury** or, rarely, certain viral infections can damage or destroy the olfactory nerves.

Diagnosis

It is difficult to measure a loss of smell, and no one complains of loss of smell in just one nostril. So a physician usually begins by testing each nostril separately with a common, non-irritating odor such as perfume, lemon, vanilla, or coffee. Polyps and rhinitis are obvious causal agents a physician looks for. Imaging studies of the head may be necessary in order to detect brain injury, sinus infection, or tumor.

Treatment

Cessation of **smoking** is the first step. Many smokers who quit discover new tastes so enthusiastically that they immediately gain weight. Attention to reducing exposure to other nasal irritants and treatment of respiratory **allergies** or chronic upper respiratory infections will be beneficial. **Corticosteroids** are particularly helpful.

Alternative treatment

Finding and treating the cause of the loss of smell is the first approach in **naturopathic medicine**. If rhinitis is the cause, treating acute rhinitis with herbal mast cell stabilizers and herbal **decongestants** can offer some relief as the body heals. If chronic rhinitis is present, this is often related to an environmental irritant or to food allergies. Removal of the causative factors is the first step to healing. Nasal steams with essential oils offer relief of the blockage and tonification of the membranes. Blockages can sometimes be resolved through naso-specific therapy—a way of realigning the nasal cavities. Polyp blockage can be addressed through botanical medicine treatment as well as **hydrotherapy**. Olfactory nerve damage may not be regenerable. Some olfactory aberrations, like intensified sense of smell, can be resolved using homeopathic medicine.

Prognosis

If nasal inflammation is the cause of anosmia, the chances of recovery are excellent. However, if nerve damage is the cause of the problem, the recovery of smell is much more difficult.

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KEY TERMS

Allergen—Any substance that irritates only those who are sensitive (allergic) to it.

Corticosteroids—Cortisone, prednisone, and related drugs that reduce inflammation.

Rhinitis—Inflammation and swelling of the nasal membranes.

Nasal polyps—Drop-shaped overgrowths of the nasal membranes.

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J. Ricker Polsdorfer, MD

Anoxemia *see* **Anoxia**

Anoxia

Definition

Anoxia is a condition characterized by an absence of oxygen supply to an organ or a tissue.

Description

Anoxia results when oxygen is not being delivered to a part of the body. If the condition does not involve total oxygen deprivation, it is often called hypoxia, although the two terms have been used interchangeably. A related condition, anoxemia, occurs when the blood circulates but contains a below normal amount of oxygen.

The five types of anoxia or hypoxia include hypoxemic, anemic, affinity, stagnant, and histotoxic. Hypoxemic anoxia happens when the oxygen pressure outside the body is so low that the hemoglobin, the chemical which carries oxygen in the red blood cells (RBCs), is unable to become fully loaded with the gas. This results in too little oxygen reaching the tissues and can occur in suffocation when a person is at high altitude, where the pressure of oxygen in the air is much less than at sea level.

Anemic anoxia results from a decrease in the amount of hemoglobin or RBCs in the blood, which reduces the ability to get oxygen to the tissues. Anemia may result from lack of production of red blood cells (iron deficiency), blood loss (hemorrhage), or shortened lifespan of red blood cells (autoimmune disease).

Affinity anoxia involves a defect in the chemistry of the blood such that the hemoglobin can no longer pick up as much oxygen from the air, even though the quantities are normal, reducing how much is delivered to the tissues.

Stagnant anoxia occurs when there is interference with the blood flow, although the blood and its oxygen-carrying abilities are normal. A common cause of general stagnant anoxia is heart disease or interference with the return of blood flow through the veins. Examples of local stagnant anoxia include exposure to cold, diseases that restrict circulation to the extremities, and ergot **poisoning**. When the tissue or organ itself has a reduced ability to accept and use the oxygen, it is called histotoxic anoxia. The classic example is cyanide poisoning, where the chemical inactivates a cellular enzyme necessary for the cell to use oxygen. Thus, tissue exposed to cyanide cannot use the oxygen even though it is in normal amounts in the bloodstream. Histotoxic anoxia can also be caused by exposure to narcotics, alcohol, formaldehyde, acetone, toluene, and certain anesthetic agents.

Causes and symptoms

Anoxia and hypoxia can be caused by any number of disease states of the blood, lungs, heart and circulation including **heart attack**, severe **asthma**, or **emphysema**. It can also result from smoke or carbon monoxide inhalation, improper exposure to anesthesia, poisoning, strangulation, **near-drowning**, or high altitude exposure through mountain climbing or travel in an insufficiently pressurized airplane. Anoxia, and the resultant brain damage, is a particular problem with newborns during difficult births.

No matter what the cause of anoxia, the symptoms are similar. In severe cases, the patient is often confused and commonly stuperous or comatose (in a state of unconsciousness). Depending on the severity of the injury to the brain, the organ most sensitive to reduced oxygen intake, this condition can persist for hours, days, weeks, or even months or years. Seizures, myoclonic jerks (involuntary muscle spasms or twitches), and neck stiffness are some other symptoms of the anoxic condition.

Symptoms of more localized or less complete oxygen deprivation (hypoxia) include increased breathing rate, lightheadedness, **dizziness**, tingling or warm sensation, sweating, reduced field of vision, sleepiness, a bluish tint to skin, particularly the fingertips and lips, and behavior changes, often an inappropriate sense of euphoria.

Diagnosis

Diagnosis of anoxia and hypoxia is commonly made through the appearance of clinical symptoms. However,

suspected reduction in oxygen reaching the tissues can be confirmed using laboratory tests. The exact test that is performed is dependent on the suspected cause of the anoxia. One systemic measure of tissue anoxia is the serum lactate (lactic acid) test. When cells are forced to produce energy without oxygen, as would happen during anoxia, lactic acid is one of the byproducts. Thus, an increase in lactic acid in the blood would indicate that tissues were starved for oxygen and are using non-oxygen pathways to produce energy. Normally, the blood contains less than 2mmol/L of lactic acid. However, some forms of anoxia do not increase lactic acid concentrations in the blood and some increases in lactic acid levels are not associated with anoxia, so an elevated value for this test is only suggestive of an anoxic or hypoxic condition.

Treatment

The exact treatment for anoxia is dependent on the cause of the reduced oxygen reaching the tissues. However, immediate restoration of tissue oxygen levels through supplementing the patient's air supply with 100% oxygen is a common first step. Secondary steps often include support of the cardiovascular system through drugs or other treatment, treatment of lung disease, transfusions, or administration of anecdotes for poisoning, as appropriate.

Prognosis

A good prognosis is dependent on the ability to treat the underlying cause of the low oxygen levels. If cardiovascular and respiratory systems can be supported adequately, recovery from the injury to the tissue is possible, although extent of injury to the brain can be difficult to assess. The exact amount of recovery varies with the amount of injury sustained, where significant injury brings a poorer prognosis. As recovery occurs, both psychological and neurological abnormalities may appear, persist, and can improve. Some problems seen after anoxia include mental confusion, personality changes, **amnesia** or other types of memory loss, **hallucinations**, and persistent myoclonus (involuntary contractions of the muscles).

Prevention

Hypoxemic anoxia can be avoided by utilizing supplemental oxygen when in high altitudes and being aware of the early symptoms of **altitude sickness** and reducing altitude once recognized. Iron supplements can avoid anemic hypoxia, although more severe anemic states are usually caused by disease or bleeding. Maintaining good cardiovascular health through proper diet and **exercise** is a good first step to avoiding the most common cause of stagnant anoxia. Avoiding exposure to the toxic chemicals that cause the condition can prevent histotoxic anoxia.

KEY TERMS

Amnesia—Loss of memory often traceable to brain tissue damage.

Anoxemia—An extreme lack of oxygen in the blood.

Hemoglobin—A chemical found in red blood cells that transports oxygen.

Myoclonus—Involuntary contractions of a muscle or group of muscles.

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Michelle Johnson, MS, JD

Antacids

Definition

Antacids are medicines that neutralize stomach acid.

Purpose

Antacids are used to relieve acid **indigestion**, upset stomach, sour stomach, and **heartburn**. Additional components of some formulations include dimethicone, to

reduce gas pains (flatulence) and alginic acid, which, in combination with antacids, may help manage GERD (gastro-esophageal reflux disease). Antacids should not be confused with gastric acid inhibitors, such as the H-2 receptor blockers (cimetidine, ranitide and others) or the proton pump inhibitors (lansoprazole, omeprazole and others). Although all three classes of drugs act to reduce the levels of gastric acid, their mechanisms are different, and this affects the appropriate use of the drug. Antacids have a rapid onset and short duration of action, and are most appropriate for rapid relief of gastric discomfort for a short period of time.

Antacids may be divided into two classes, those that work by chemical neutralization of gastric acid, most notably sodium bicarbonate; and those that act by adsorption of the acid (non-absorbable antacids), such as calcium and magnesium salts.

The chemical antacids show the most rapid onset of action, but may cause "acid rebound," a condition in which the gastric acid returns in greater concentration after the drug effect has stopped. Also, since these antacids may contain high concentrations of sodium, they may be inappropriate in patients with **hypertension**.

Calcium and magnesium salts act by adsorption of the acid, and are less prone to the rebound effect, but may have other significant disadvantages. These antacids are particularly prone to drug interactions, and patients taking other medications must often avoid simultaneous administration of the medications. These antacids are more effective in liquid formulations than in tablet or capsule form, and so may be inconvenient for routine dosing.

The non-absorbable antacids may have additional uses beyond control of hyperacidity. Calcium salts may be used as diet supplements in prevention of **osteoporosis**. Aluminum carbonate is useful for binding phosphate, and has been effective in treatment and control of hyperphosphatemia or for use with a low phosphate diet to prevent formation of phosphate urinary stones. This application is particularly valuable in patients with chronic renal failure. Antacids with aluminum and magnesium hydroxides or aluminum hydroxide alone effectively prevent significant **stress** ulcer bleeding in post-operative patients or those with severe **burns**.

Recommended dosage

The dose depends on the type of antacid. Consult specific references.

When using antacids in chewable tablet form, chew the tablet well before swallowing. Drink a glass of water after taking chewable aluminum hydroxide. Lozenges should be allowed to dissolve completely in the mouth. Liquid antacids should be shaken well before using.

Precautions

Antacids should be avoided if any signs of **appendicitis** or inflamed bowel are present. These include cramping, **pain**, and soreness in the lower abdomen, bloating, and **nausea and vomiting**.

Antacids may affect the results of some medical tests, such as those that measure how much acid the stomach produces. Health care providers and patients should keep this in mind when scheduling a medical test.

Antacids that contain magnesium may cause **diarrhea**. Other types of antacids may cause **constipation**.

Avoid taking antacids containing sodium bicarbonate when the stomach is uncomfortably full from eating or drinking.

Antacids should not be given to children under six years of age.

Antacids that contain calcium or sodium bicarbonate may cause side effects, such as **dizziness**, nausea, and vomiting, in people who consume large amounts of calcium (from dairy products or calcium supplements). In some cases, this can lead to permanent kidney damage. Before combining antacids with extra calcium, check with a physician.

Some antacids contain large amounts of sodium, particularly sodium bicarbonate (baking soda). Anyone who is on a low-sodium diet should check the list of ingredients or check with a physician or pharmacist before taking an antacid product.

Excessive use of antacids may cause or increase the severity or kidney problems. Calcium based antacids may lead to renal stone formation.

ALLERGIES. **Allergies** to antacids are extremely rare, however the inactive ingredients in some formulations may include dyes or other products with allergic potential.

PREGNANCY. Antacids are not classified under the **pregnancy** safety categories A, B, C, D and X. Occasional use of antacids in small amounts during pregnancy is considered safe. However, pregnant women should check with their physicians before using antacids or any other medicines. Pregnant women who are consuming extra calcium should be aware that using antacids that contain sodium bicarbonate or calcium can lead to serious side effects.

BREASTFEEDING. Some antacids may pass into breast milk. However, no evidence exists that the inges-

KEY TERMS

Acid indigestion—Indigestion that results from too much acid in the stomach.

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

Heartburn—A burning sensation, usually in the center of the chest, near the breastbone.

Indigestion—A feeling of discomfort or illness that results from the inability to properly digest food.

Inflamed bowel—Irritation of the intestinal tract.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Pregnancy safety categories—A system for reporting the known safety issues of drugs for use during pregnancy, The ratings range from A, proven safe by well controlled studies, to X, proven harmful.

tion of antacids through breast milk causes problems for nursing babies whose mothers use antacids occasionally.

Side effects

Side effects are very rare when antacids are taken as directed. They are more likely when the medicine is taken in large doses or over a long time. Minor side effects include a chalky taste, mild constipation or diarrhea, thirst, stomach cramps, and whitish or speckled stools. These symptoms do not need medical attention unless they do not go away or they interfere with normal activities.

Other uncommon side effects may occur. Anyone who has unusual symptoms after taking antacids should get in touch with his or her health care provider.

Interactions

Antacids have multiple drug interactions, usually due to inhibition of absorption of other medications. In rare cases, the absorbable antacids may alter the pH of the stomach contents or urine sufficiently to alter drug absoprtion or excretion. Consult specific references.

Samuel Uretsky, PharmD

Antegrade pyelography *see* **Intravenous urography**

Antenatal testing

Definition

Antenatal testing includes any diagnostic procedures performed before the birth of a baby.

Purpose

These tests and exams are essential for protecting the health of a pregnant woman and her developing child.

Precautions

Some tests, such as amniocentisis, carry a small risk of a **miscarriage** or other complications that could harm the mother or baby.

Description

Women who become pregnant undergo a wide variety of tests throughout the nine months before delivery. In the early stages, physicians order blood tests to screen for possible disorders or infections, such as human **immunodeficiency** virus (HIV), which can pass from the mother to the fetus. Later, the focus shifts to checking on fetal well-being with a variety of technological tools such as ultrasound scans. Descriptions of the most common tests and procedures used during **pregnancy** are listed below.

When a woman first learns she is pregnant, her physician will run a series of routine urine and blood tests to determine her blood type, check for anemia and **gestational diabetes**, make sure she is immune to **rubella** (German **measles**) and check for infectious diseases like HIV, hepatitis, chlamydia or **syphilis**. Physicians also usually do **pelvic exam** to screen for **cervical cancer** and check the patient's blood pressure. As the pregnancy progresses, more tests will follow.

Ultrasound

Ultrasound is a device that records sound waves as they bounce off the developing fetus to create an image, which is projected onto a large computer screen. Physicians order an ultrasound scan to listen for a fetal heartbeat, determine a woman's precise due date and check for twins, among other uses. An ultrasound scan also is known as a sonogram. The procedure takes a few minutes, is painless and usually is covered by health insurance.

The ultrasound technician will ask the pregnant woman to remove her clothes and change into a gown. The technician may rub some gel on the woman's stomach, which helps the hand-held device pick up sound

waves better. In certain cases, the technician may insert a plastic probe into the woman's vaginal canal to get a clearer picture of the fetus. Early in pregnancy, the test may need to be done with a full bladder.

Unlike x rays, ultrasound is safe to use during pregnancy. It does not cause any known side-effects that would harm the mother or baby.

Pregnant women usually will have their first ultrasound anytime between 8 and 12 weeks of gestation. In normal cases, the technician is able to identify a fetal heartbeat, which appears as a flashing light on the screen. Closer to the due date, physicians use ultrasound to make sure the fetus is in the correct position to exit the birth canal head first.

Sometimes an ultrasound will show that a fetus has stopped growing, or a gestational sac has formed without a fetus, and a miscarriage has occurred. Later in pregnancy, it also may show that the child is in a breech position, oriented feet first, which can cause a difficult labor.

Tests for birth defects

Most obstetricians offer parents a variety of ways to find out if their developing child might have **birth defects** such as **spina bifida** and **Down Syndrome**. An alpha fetoprotein screen can be done through a simple blood test in the doctor's office between the 16th and 18th week of gestation. It tells the odds that their child will have a severe congenital anomaly. The test works by measuring the level of alpha fetoprotein, a substance produced by a fetus with birth defects. Low levels of alpha fetoprotein in the mother's blood may indicate Down's Syndrome. In that case, the next step for most couples is **amniocentesis** because the alpha fetoprotein test can give false-positive results. Amniocentesis is a more accurate test, but it also has higher risks of complications.

This procedure typically is used to diagnose Down syndrome while a developing child is still in the womb, at 15-28 weeks.

During amniocentesis, a doctor inserts a needle through a woman's vaginal canal and inside her cervix. Using ultrasound as a guide, the doctor pierces the uterus to withdraw a sample of fluid from the amniotic sac. Afterwards, tiny cells shed by the fetus can be studied in the laboratory. Scientists can analyze DNA samples to determine if the fetus has Down syndrome or other genetic conditions. Amniocentesis also can determine the sex of the fetus.

Women who have a history of recurring miscarriages may not want to have this procedure.

Amniocentesis is usually performed in a doctor's office on an outpatient basis.

Common side effects include cramping and bleeding.

In about one out of every 1,000 cases, amniocentesis causes a needle to puncture the uterine wall, which could result in miscarriage.

In most cases, couples find out their baby does not have a birth defect.

If the results come back positive for Down's Syndrome or other serious conditions, the couple must decide if they want to end the pregnancy. Others use the knowledge to plan and prepare any special care needed for their future child.

Group B Strep

This test is for Group B streptococci (GBS) infection.

By testing for GBS, physicians can determine if a woman is at risk of passing this infection along to her child.

Women who have had a prior child with GBS, or who have a **fever** or prolonged or premature rupture of the amniotic sac may be at higher risk for this type of infection.

GBS is a type of bacteria commonly found in the vagina and rectum. Unlike regular **strep throat**, GBS can be present in a person's body without causing any symptoms, so many women do not realize they are infected with it.

To test for the presence of GBS, doctors may take a urine sample. They also may collect samples from the vagina or rectum, which are then analyzed in a lab. This test is usually performed late in pregnancy, at 35-37 weeks of gestation.

This is a routine urine test or pelvic exam with no side effects.

In many cases, doctors do not find any evidence of this type of infection.

If a woman is found to be infected with Group B strep, physicians usually wait to treat it until just before labor begins. At that time, they may give the mother **antibiotics** so the baby is not born with the infection. Newborns who are exposed to Group B strep can have inflammation of the brain, spinal cord, blood or lungs. In some cases, this serious complication can result in infant **death**.

Resources

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KEY TERMS

Ultrasound—A device that records sound waves as they bounce off a developing fetus to create an image, which is projected onto a large computer screen

Breech position—When a child is oriented feet first in the mother's uterus just before delivery.

Alpha fetoprotein screen—A test that measures the level of alpha fetoprotein, a substance produced by a fetus with birth defects, in the mother's blood.

Amniocentesis—An invasive procedure that allows physicians to check for birth defects by collecting a sample of fetal cells from inside the amniotic sac.

GBS—Group B streptococci are a type of bacteria that, if passed to a can cause inflammation of the brain, spinal cord, blood or lungs. In some cases, it can result in infant death

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ORGANIZATIONS

American College of Obstetricians and Gynecologists.409 12th Street SW, Washington, DC 20024-2188. (202) 638-5577. <http://www.acog.org>.

March of Dimes Birth Defects Foundation. P.O. Box 1657, Wilkes-Barre, PA 18703. 1-800-367-6630. <http://www.modimes.org>.

Melissa Knopper

Antepartum testing

Definition

Antepartum testing consists of a variety of tests performed late in **pregnancy** to verify fetal well-being, as judged by the baby's heart rate and other characteristics. Antepartum tests include the nonstress test (NST), biophysical profile, and contraction **stress test** (CST).

Purpose

Antepartum testing is performed after 32 weeks of pregnancy so that the couple and the doctor can be warned of any problems that may necessitate further testing or immediate delivery. The results reflect the adequacy of blood flow (and oxygen delivery) to the fetus from the placenta.

Antepartum tests are usually done in pregnancies at high risk for fetal complications. Various reasons include:

- any chronic illness in the mother, such as high blood pressure or diabetes
- problems with previous pregnancies, such as **stillbirth**
- fetal complications, such as **intrauterine growth retardation** (a slowing of growth of the fetus) or **birth defects**
- problems in the current pregnancy, including preeclampsia (serious pregnancy-induced high blood pressure), gestational (pregnancy-related) diabetes, premature rupture of the membranes, excessive amniotic fluid (the liquid that surrounds the fetus), vaginal bleeding, or **placenta previa** (a condition in which the placenta is positioned over the cervix instead of near the top of the uterus)
- twins or other multiple fetuses

One of the most common indications for antepartum testing is post-term pregnancy. A pregnancy should not be allowed to continue past 42 weeks. (The usual pregnancy is 40 weeks in duration). Babies should be monitored with antepartum testing starting at 41 weeks. After 41 weeks, there is an increasing risk that the placenta cannot meet the growing baby's needs for oxygen and **nutrition**. This may be reflected in decreased movements of the baby, decreased amniotic fluid, and changes in the heart rate pattern of the baby.

Description

Technology

The NST and CST use a technique called **electronic fetal monitoring** to evaluate the heartbeat of the fetus. The biophysical profile is an ultrasound examination.

NST

The NST is usually the first antepartum test used to verify fetal well-being. It is based on the principle that when the fetus moves, its heartbeat normally speeds up. The NST assesses fetal health through monitoring accelerations of the heart rate in response to the baby's own movements, i.e., in the absence of **stress**.

The mother lays down or sits, and an electronic fetal monitor is placed on her abdomen to monitor the fetal heart rate. The doctor records the baby's heartbeat on a graph or "tracing" to determine whether it demonstrates

correct reactivity, or acceleration of the heart rate. To record fetal movements on the tracing, the mother presses a button every time she feels the baby move. If the baby is inactive, the mother may be asked to rub her abdomen to "awaken" it. Sometimes an instrument is used to produce a loud noise to arouse the fetus (vibroacoustic stimulation). The test usually takes between 20–45 minutes.

A baby who is receiving enough oxygen should move at least twice in a 20 minute period. The baby's heart rate should increase at least 20 beats per minute for at least 20 seconds during these movements. The NST is the simplest and cheapest antepartum test.

Biophysical profile

The biophysical profile is an ultrasound exam that can add additional information to the NST. During the biophysical profile, the examiner checks for various characteristics of the baby to evaluate its overall health. These include: fetal movement, fetal tone, breathing movements, and the amniotic fluid volume. Amniotic fluid volume is important because a decreased amount raises the possibility that the baby may be under stress. The five components of the test (NST is also included) are each given a score of 2 for normal (or present), 1 if decreased, and 0 for abnormal. The highest possible score is 10. The "modified" biophysical profile is another option; this includes only the NST and amniotic fluid volume.

CST

The CST is like the NST, except that the fetus is evaluated in response to contractions of the mother's uterus. Because it is a more complicated test, it is often used after an abnormal NST to confirm the results. Uterine contractions produce "stress" in the fetus because they temporarily stop the flow of blood and oxygen. The CST is used to confirm that the fetus does not respond to this stress by a decrease in the heart rate.

The CST is performed with the same equipment as the NST. Maternal blood pressure and fetal heart rate are recorded along with the onset, relative intensity, and duration of any spontaneous contractions. For an accurate test, the contractions should be of sufficient duration and frequency. If uterine activity does not occur naturally, a drug called oxytocin may be given to the mother intravenously (hence the test's alternate name, the oxytocin challenge test) to provoke contractions. Another option is self-stimulation of the mother's nipples, because this releases natural oxytocin. The fetal heart rate is observed until, ideally, three moderate contractions occur within 10 minutes.

Preparation

The mother should eat just before the antepartum tests to help stimulate fetal activity.

Risks

There are no appreciable risks from the NST or the biophysical profile. Ultrasound used for the biophysical profile is painless and safe because it uses no harmful radiation, and no evidence has been found that sound waves cause any adverse effects on the mother or fetus.

The frequency of antepartum testing depends on the reason for its use. All of the tests occasionally give incorrect results, which may prompt an unnecessary early delivery or cesarean. Repeat testing is important to double-check any abnormal findings.

Normal results

In general, "negative" or normal results on antepartum testing provide reassurance that the baby is healthy and should remain so for perhaps a week, with no need for immediate delivery. Unfortunately, the tests cannot guarantee that there are no problems, because falsely normal results can occur, though this is unusual. Even if all test results are normal, it is important to realize that this does not guarantee a "perfect" baby.

The NST is normal ("reactive") if two or more distinct fetal movements occur in association with appropriate accelerations of the fetal heart rate within 20 minutes. A biophysical profile score of 8-10 is considered reassuring. The CST is normal if the fetus shows no decelerations in heart rate in response to three uterine contractions within 10 minutes.

Abnormal results

A "positive" result suggests that the baby is not receiving enough oxygen for some reason. However, it is quite possible that the test result was falsely abnormal. To confirm or monitor a suspected disorder, follow-up testing with the same or an alternate test will probably be performed at least weekly.

The NST is abnormal ("nonreactive") if the fetal heart rate fails to speed up by at least 20 beats per minute at least two times during a 20-minute period. Abnormal decreases in the heart rate (decelerations) are also a cause for concern.

A biophysical profile score of 6 is considered a cause for concern and should be followed by further testing. Scores of 4 or less may require immediate delivery of the fetus.

KEY TERMS

Amniotic fluid—The liquid that surrounds the baby within the amniotic sac. Because it is composed mostly of fetal urine, a low amount of fluid can indicate inadequate placental blood flow to the fetus.

Deceleration—A decrease in the fetal heart rate that can indicate inadequate blood flow through the placenta.

Oxytocin—A natural hormone that produces uterine contractions.

Ultrasound—A procedure in which high-frequency sound waves are used to create a picture of the baby, used alone or with antepartum tests.

Vibroacoustic stimulation—In the biophysical profile, use of an artificial larynx to produce a loud noise to "awaken" the fetus.

Abnormal results on the CST include late decelerations, or abnormal slowing of the fetal heart rate after the uterine contractions. This can suggest that the baby is not receiving enough oxygen and may have difficulty withstanding the stress of labor and vaginal delivery. **Cesarean section** might be necessary so the baby can be spared the stress of labor. With either NST or CST, a severe deceleration (a period of very slow heartbeat) can also suggest fetal distress.

The ultimate outcome will depend on the woman's individual situation. In some cases, delivery can be postponed while medication is given to the mother (e.g., for high blood pressure) or the fetus (e.g., to speed up lung maturity before delivery). Depending upon the readiness of the mother's cervix, the doctor may decide to induce labor. The extra-large fetus of a diabetic woman may require cesarean delivery; severe preeclampsia also may necessitate **induction of labor** or cesarean section. The doctor will determine the most prudent course of action.

Resources

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American College of Obstetricians and Gynecologists. 409 12th Street, S.W., P.O. Box 96920, Washington, DC 20090-6920. (202) 638-5577. <http://www.acog.com>.

National Institute of Child Health and Human Development. Bldg 31, Room 2A32, MSC 2425, 31 Center Drive, Bethesda, MD 20892-2425. (800) 505-2742. <http://www.nichd.nih.gov/sids/sids.htm>.

Laura J. Ninger

Anthrax

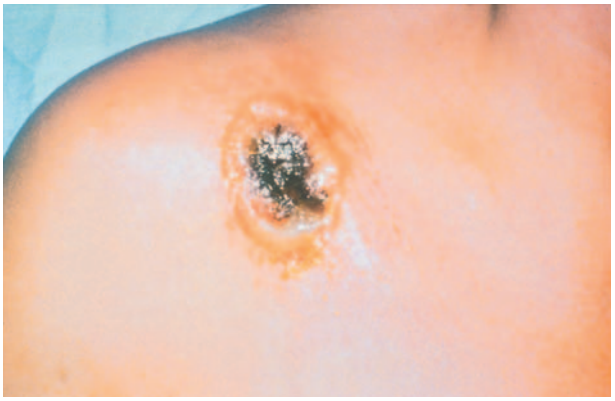
Definition

Anthrax is a bacterial infection caused by *Bacillus anthracis* that primarily affects livestock but that can occasionally spread to humans, affecting either the skin, intestines, or lungs. In humans, the infection can often be treated, but it is almost always fatal in animals.

Description

Anthrax is most often found in the agricultural areas of South and Central America, southern and eastern Europe, Asia, Africa, the Caribbean, and the Middle East. In the United States, anthrax is rarely reported, however, cases of animal infection with anthrax are most often reported in Texas, Louisiana, Mississippi, Oklahoma, and South Dakota. The bacterium and its associated disease get their name from the Greek word meaning "coal" because of the characteristic coal-black sore that is the hallmark of the most common form of the disease.

During the 1800s, in England and Germany, anthrax was known either as "wool-sorter's" or "ragpicker's" disease because workers contracted the disease from bacterial spores present on hides and in wool or fabric fibers. Spores are the small, thick-walled dormant stage of some bacteria that enable them to survive for long periods of time under adverse conditions. The first anthrax vaccine was perfected in 1881 by Louis Pasteur.



Humans suffering from anthrax often develop ulcerating nodules on the body. *Custom Medical Stock Photo. Reproduced by permission.)*

The largest outbreak ever recorded in the United States occurred in 1957 when nine employees of a goat hair processing plant became ill after handling a contaminated shipment from Pakistan. Four of the five patients with the pulmonary form of the disease died. Other cases appeared in the 1970s when contaminated goatskin drumheads from Haiti were brought into this country as souvenirs. Today, anthrax is rare, even among cattle, largely because of widespread animal **vaccination**. However, some serious epidemics continue to occur among animal herds and in human settlements in developing countries due to ineffective control programs.

There has been a great deal of recent concern that the bacteria that causes anthrax may be used by some countries as a type of biological warfare, since it is possible to become infected simply by breathing in the spores. The largest-ever documented outbreak of human anthrax contracted through spore inhalation occurred in Russia in 1979, when anthrax spores were released from a military laboratory, causing a regional epidemic that killed 69 of its 77 victims. Because the United States government considers anthrax to be of potential risk to soldiers, the Department of Defense has begun systematic vaccination of all military personnel against anthrax, and other nations, such as Britain, are rapidly following suit.

Causes and symptoms

Anthrax is caused by the bacterium *Bacillus anthracis*, which produces spores that can remain dormant for years in soil and on animal products, such as hides, wool, hair, or bones. The disease is often fatal to cattle, sheep, and goats, and their hides, wool, and bones are often heavily contaminated.

Today, in humans, the disease is almost always an occupational hazard, contracted by those who handle animal hides (farmers, butchers, and veterinarians) or sort wool. It is also possible to become infected with anthrax by eating meat from contaminated animals. There are no reports of the disease spreading from one person to another.

Symptoms vary depending on how the disease was contracted, but the symptoms usually appear within one week of exposure.

Cutaneous anthrax

In humans, anthrax usually occurs when the bacteria enter a cut or abrasion, causing a skin (cutaneous) infection at the site. Cutaneous anthrax, as this infection is called, is the mildest form of the disease. At first, the bacteria cause an itchy, raised area like an insect bite. Within one to two days, inflammation occurs around the raised area, and a blister forms around an area of dying tissue that becomes black in the center. Other symptoms may include shivering and chills. In most cases the bacteria remain within the sore. If, however, they spread to the nearest lymph node (or, in rare cases, escape into the bloodstream), the bacteria can cause a form of blood **poisoning** that rapidly proves fatal.

Inhalation anthrax

Inhaling the bacteria or bacterial spores can lead to a rare, fatal form of anthrax known as pulmonary or inhalation anthrax that attacks the lungs and sometimes spreads to the brain. Inhalation anthrax begins with flu-like symptoms, namely **fever**, **fatigue**, **headache**, and **shortness of breath**, but progresses to **bronchitis**, during which time it becomes difficult to breathe, and finally, the patient enters a state of **shock**. This rare form of anthrax is usually fatal, even if treated within one or two days after the symptoms appear.

Intestinal anthrax

Intestinal anthrax is a rare, often-fatal form of the disease, caused by eating meat from an animal that died of anthrax. Intestinal anthrax causes stomach and intestinal inflammation and sores or lesions (ulcers), much like the sores that appear on the skin in the cutaneous form of anthrax. The first signs of the disease are **nausea and vomiting**, loss of appetite, and fever, followed by abdominal **pain**, vomiting of blood, and severe bloody **diarrhea**.

Diagnosis

Anthrax is diagnosed by detecting *B. anthracis* in samples taken from blood, **skin lesions**, or respiratory secretions. The bacteria may be positively identified using biochemical methods or using a technique where-

by, if present in the sample, the anthrax bacterium is made to fluoresce. Blood samples will also indicate elevated antibody levels or increased amounts of a protein produced directly in response to infection with the anthrax bacterium. Additional DNA-based tests are also currently being perfected.

Treatment

In the early stages, anthrax is curable by administering high doses of penicillin, but in the advanced stages, it can be fatal. Other commonly used **antibiotics**, such as erythromycin, tetracycline, or chloramphenicol, are also effective, particularly for those individuals who are allergic to penicillin. Although not proven, it is thought that newer antibiotics, like ciprofloxacin and some **cephalosporins**, may also prove effective. Although cutaneous anthrax may be cured following a single dose of antibiotic, it is important to continue treatment so as to avoid potential serious complications, such as inflammation of the membranes covering the brain and spinal cord (**meningitis**).

Prognosis

Untreated anthrax is often fatal, but **death** is far less likely with appropriate care. Ten to twenty percent of patients will die from anthrax of the skin (cutaneous anthrax) if it is not properly treated. All patients with inhalation (pulmonary) anthrax will die if untreated. Intestinal anthrax is fatal 25-75% of the time.

Prevention

Anthrax is relatively rare in the United States because of widespread animal vaccination and practices used to disinfect hides or other animal products. For those in high-risk professions, an anthrax vaccine is available that is 93% effective in protecting against infection. To provide this immunity, an individual must be given an initial course of three injections, given two weeks apart, followed by booster injections at 6, 12, and 18 months and an annual immunization thereafter.

Approximately 30% of those who have been vaccinated against anthrax may notice mild local reactions, such as a slight tenderness at the injection site. Someone who has already had anthrax might have a more severe local reaction upon vaccination. Infrequently, there may be a severe local reaction with extensive swelling of the forearm, and only a very few vaccine recipients may have a more general flu-like reaction to the shot.

Other means of preventing the spread of infection include carefully handling dead animals suspected of having the disease and providing good ventilation when processing hides, fur, wool, or hair. Whether this vaccine would protect against anthrax used as a biological weapon is, as yet, unclear.

Anyone visiting a country where anthrax is common or where herd animals are not often vaccinated should avoid contact with livestock or animal products and avoid eating meat that has not been properly prepared and cooked.

KEY TERMS

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

Bronchitis—Inflammation of the mucous membrane of the bronchial tubes of the lung that can make it difficult to breathe.

Cutaneous—Pertaining to the skin

Meningitis—Inflammation of the membranes covering the brain and spinal cord called the meninges.

Pulmonary—Having to do with the lungs or respiratory system.

Spore—A dormant form assumed by some bacteria, such as anthrax, that enable the bacterium to survive high temperatures, dryness, and lack of nourishment for long periods of time. Under proper conditions, the spore may revert to the actively multiplying form of the bacteria.

Resources

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ORGANIZATIONS

Centers for Disease Control and Prevention. 1600 Clifton Rd., NE, Atlanta, GA 30333. (800) 311-3435, (404) 639-3311. <http://www.cdc.gov>.

National Institute of Allergies and Infectious Diseases, Division of Microbiology and Infectious Diseases. Building 31, Room. 7A-50, 31 Center Drive MSC 2520, Bethesda, MD 20892. <http://www.niaid.nih.gov>.

World Health Organization, Division of Emerging and Other Communicable Diseases Surveillance and Control. Avenue Appia 20, 1211 Geneva 27, Switzerland. (+00 41 22) 791 21 11. <http://www.who.int>.

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Carol A. Turkington

Antiacne drugs

Definition

Antiacne drugs are medicines that help clear up pimples, blackheads, whiteheads, and more severe forms of **acne**.

Purpose

Different types of antiacne drugs are used for different purposes. For example, lotions, soaps, gels, and creams containing benzoyl peroxide or tretinoin may be used to clear up mild to moderately severe acne. Isotretinoin (Accutane) is prescribed only for very severe, disfiguring acne.

Acne is a skin condition that occurs when pores or hair follicles become blocked. This allows a waxy material, sebum, to collect inside the pores or follicles. Normally, sebum flows out onto the skin and hair to form a protective coating, but when it cannot get out, small swellings develop on the skin surface. Bacteria and dead skin cells can also collect that can cause inflammation. Swellings that are small and not inflamed are whiteheads or blackheads. When they become inflamed, they turn into pimples. Pimples that fill with pus are called pustules.

Acne cannot be cured, but acne drugs can help clear the skin. Benzoyl peroxide and tretinoin work by mildly irritating the skin. This encourages skin cells to slough off, which helps open blocked pores. Benzoyl peroxide also kills bacteria, which helps prevent whiteheads and blackheads from turning into pimples. Isotretinoin shrinks the glands that produce sebum.

Description

Benzoyl peroxide is found in many over-the-counter acne products that are applied to the skin, such as Benoxyl, Clear By Design, Neutrogena Acne, PanOxyl, and some formulations of Clean & Clear, Clearasil, and Oxy. Some benzoyl peroxide products are available without a physician's prescription; others require a prescription. Tretinoin (Retin-A) is available only with a physician's prescription and comes in liquid, cream, and gel forms, which are applied to the skin. Isotretinoin (Accutane), which is taken by mouth in capsule form, is available only with a physician's prescription. Only physicians who have experience in diagnosing and treating severe acne, such as dermatologists, should prescribe isotretinoin.

Recommended dosage

The recommended dosage depends on the type of anti-acne drug. These drugs usually come with written directions for patients and should be used only as directed. Patients who have questions about how to use the medicine should check with a physician or pharmacist.

Patients who use isotretinoin usually take the medicine for a few months, then stop for at least two months. Their acne may continue to improve even after they stop taking the medicine. If the condition is still severe after several months of treatment and a two-month break, the physician may prescribe a second course of treatment.

Precautions

Isotretinoin

Isotretinoin can cause serious **birth defects**, including **mental retardation** and physical deformities. This medicine should not be used during **pregnancy**. Women who are able to bear children should not use isotretinoin unless they have very severe acne that has not cleared up with the use of other anti-acne drugs. In that case, a woman who uses this drug must have a pregnancy test two weeks before beginning treatment and each month they are taking the drug. Another pregnancy test must be done one month after treatment ends. The woman must use an effective birth control method for one month before treatment begins and must continue using it throughout treatment and for one month after treatment ends. Women who are able to bear children and who want to use this medicine should discuss this information with their health care providers. Before using the medicine, they will be asked to sign a consent form stating that they understand the danger of taking isotretinoin during pregnancy and that they agree to use effective birth control.

Do not donate blood to a blood bank while taking isotretinoin or for 30 days after treatment with the drug

Antiacne Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Accutane (isotretinoin)	Dry skin, dry mouth, conjunctivitis
Benzamycin	Dry and itchy skin
Cleocin T (clindamycin phosphate)	Dry skin
Desquam-E (benzoyl peroxide)	Itching, red and peeling skin
Erythromycin topical (A/T/S, erycette, t-stat)	Burning, dry skin, hives, red and peeling skin
Minocin (minocycline hydrochloride)	Headache, hives, diarrhea, peeling skin, vomiting
Retin-A (tretinoin)	Darkening of the skin, blistering, crusted, or puffy skin

ends. This will help reduce the chance of a pregnant woman receiving blood containing isotretinoin, which could cause birth defects.

Isotretinoin may cause a sudden decrease in night vision. If this happens, do not drive or do anything else that could be dangerous until vision returns to normal. Let the physician know about the problem.

This medicine may also make the eyes, nose, and mouth dry. Ask the physician about using special eye drops to relieve eye dryness. To temporarily relieve the **dry mouth**, chew sugarless gum, suck on sugarless candy or ice chips, or use saliva substitutes, which come in liquid and tablet forms and are available without a prescription. If the problem continues for more than two weeks, check with a physician or dentist. Mouth dryness that continues over a long time may contribute to **tooth decay** and other dental problems.

Isotretinoin may increase sensitivity to sunlight. Patients being treated with this medicine should avoid exposure to the sun and should not use tanning beds, tanning booths, or sunlamps until they know how the drug affects them.

In the early stages of treatment with isotretinoin, some people's acne seems to get worse before it starts getting better. If the condition becomes much worse or if the skin is very irritated, check with the physician who prescribed the medicine.

Benzoyl peroxide and tretinoin

When applying antiacne drugs to the skin, be careful not to get the medicine in the eyes, mouth, or inside of the nose. Do not put the medicine on skin that is wind burned, sunburned, or irritated, and do not apply it to open **wounds**.

Because antiacne drugs such as benzoyl peroxide and tretinoin irritate the skin slightly, avoid doing anything that might cause further irritation. Wash the face with mild soap and water only two or three times a day, unless the physician says to wash it more often. Avoid using abrasive soaps or cleansers and products that might dry the skin or make it peel, such as medicated cosmetics, cleansers that contain alcohol, or other acne products that contain resorcinol, sulfur or salicylic acid.

If benzoyl peroxide or tretinoin make the skin too red or too dry or cause too much peeling, check with a physician. Using the medicine less often or using a weaker strength may be necessary.

Tretinoin may increase sensitivity to sunlight. While being treated with this medicine, avoid exposure to the sun and do not use tanning beds, tanning booths, or sunlamps. If it is not possible to avoid being in the sun, use a sunscreen with a skin protection factor (SPF) of at least 15 or wear protective clothing over the treated areas. The skin may also become more sensitive to cold and wind. People who use this medicine should protect their skin from cold and wind until they know how the medicine affects them.

Benzoyl peroxide may discolor hair or colored fabrics.

Special conditions

People who have certain medical conditions or who are taking certain other medicines may have problems if they use antiacne drugs. Before using these products, be sure to let the physician know about any of these conditions:

ALLERGIES. Anyone who has had unusual reactions to etretinate, isotretinoin, tretinoin, vitamin A preparations, or benzoyl peroxide in the past should let his or her physician know before using an antiacne drug. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY. Women who are pregnant or who may become pregnant should check with a physician before using tretinoin or benzoyl peroxide. *Isotretinoin causes birth defects in humans and must not be used during pregnancy.*

BREASTFEEDING. No problems have been reported in nursing babies whose mothers used tretinoin or benzoyl peroxide. Women who are breastfeeding babies should not take isotretinoin, however, as it may cause problems in nursing babies.

OTHER MEDICAL CONDITIONS. Before using anti-acne drugs applied to the skin, people with any of these medical problems should make sure their physicians are aware of their conditions:

- eczema. Anti-acne drugs that are applied to the skin may make this condition worse.
- sunburn or raw skin. Anti-acne drugs that are applied to the skin may increase the **pain** and irritation of these conditions.

In people with certain medical conditions, isotretinoin may increase the amount of triglyceride (a fatty-substance) in the blood. This may lead to heart or blood vessel problems. Before using isotretinoin, people with any of these medical problems should make sure their physicians are aware of their conditions:

- alcoholism or heavy drinking, now or in the past
- diabetes (or family history of diabetes). Isotretinoin may also change blood sugar levels.
- family history of high triglyceride levels in the blood
- severe weight problems

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

KEY TERMS

Acne—A skin condition in which raised bumps, pimples, and cysts form on the face, neck, shoulders and upper back.

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Bowel—The intestine; a tube-like structure that extends from the stomach to the anus. Some digestive processes are carried out in the bowel before food passes out of the body as waste.

Cyst—An abnormal sac or enclosed cavity in the body, filled with liquid or partially solid material.

Eczema—Inflammation of the skin with itching and a rash. The rash may have blisters that ooze and form crusts.

Pimple—A small, red swelling of the skin.

Psoriasis—A skin disease in which people have itchy, scaly, red patches on the skin.

Pus—Thick, whitish or yellowish fluid that forms in infected tissue.

Triglyceride—A substance formed in the body from fat in the diet.

Side effects

Isotretinoin

Minor discomforts such as dry mouth or nose, dry eyes, dry skin, or **itching** usually go away as the body adjusts to the drug and do not require medical attention unless they continue or are bothersome.

Other side effects should be brought to a physicians attention. These include:

- burning, redness, or itching of the eyes
- nosebleeds
- signs of inflammation of the lips, such as peeling, burning, redness or pain

Bowel inflammation is not a common side effect, but it may occur. If any of the following signs of bowel inflammation occur, stop taking isotretinoin immediately and check with a physician:

- pain in the abdomen
- bleeding from the rectum
- severe **diarrhea**

Benzoyl peroxide and tretinoin

The most common side effects of antiacne drugs applied to the skin are slight redness, dryness, peeling, and stinging, and a warm feeling to the skin. These problems usually go away as the body adjusts to the drug and do not require medical treatment.

Other side effects should be brought to a physician's attention. Check with a physician as soon as possible if any of the following side effects occur:

- blistering, crusting or swelling of the skin
- severe burning or redness of the skin
- darkening or lightening of the skin. (This effect will eventually go away after treatment with an anti-acne drug ends.)
- skin rash

Other side effects are possible with any type of anti-acne drug. Anyone who has unusual symptoms while using anti-acne drugs should get in touch with his or her physician.

Interactions

Patients using antiacne drugs on their skin should tell their physicians if they are using any other prescription or nonprescription (over-the-counter) medicine that they apply to the skin in the same area.

KEY TERMS

Acne—A skin condition in which raised bumps, pimples, and cysts form on the face, neck, shoulders and upper back.

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Bowel—The intestine; a tube-like structure that extends from the stomach to the anus. Some digestive processes are carried out in the bowel before food passes out of the body as waste.

Cyst—An abnormal sac or enclosed cavity in the body, filled with liquid or partially solid material.

Eczema—Inflammation of the skin with itching and a rash. The rash may have blisters that ooze and form crusts.

Pimple—A small, red swelling of the skin.

Psoriasis—A skin disease in which people have itchy, scaly, red patches on the skin.

Pus—Thick, whitish or yellowish fluid that forms in infected tissue.

Triglyceride—A substance formed in the body from fat in the diet.

Isotretinoin may interact with other medicines. When this happens, the effects of one or both drugs may change or the risk of side effects may be greater. Anyone who takes isotretinoin should let the physician know about all other medicines he or she is taking and should ask whether the possible interactions can interfere with drug therapy. Among the drugs that may interact with isotretinoin are:

- etretinate (Tegison), used to treat severe **psoriasis**. Using this medicine with isotretinoin increases side effects.
- tretinoin (Retin-A, Renova). Using this medicine with isotretinoin increases side effects.
- vitamin A or any medicine containing vitamin A. Using any vitamin A preparations with isotretinoin increases side effects. Do not take vitamin supplements containing vitamin A while taking isotretinoin.
- tetracyclines (used to treat infections). Using these medicines with isotretinoin increases the chance of swelling of the brain. Make sure the physician knows if tetracycline is being used to treat acne or another infection.

Nancy Ross-Flanigan

Antiangina drugs

Definition

Antiangina drugs are medicines that relieve the symptoms of **angina** pectoris (severe chest **pain**).

Purpose

The dull, tight chest pain of angina occurs when the heart's muscular wall is not getting enough oxygen. By relaxing the blood vessels, antiangina drugs reduce the heart's work load and increase the amount of oxygen-rich blood that reaches the heart. These drugs come in different forms, and are used in three main ways:

- taken regularly over a long period, they reduce the number of angina attacks.
- taken just before some activity that usually brings on an attack, such as climbing stairs, they prevent attacks.
- taken when an attack begins, they relieve the pain and pressure.

Not every form of antiangina drug can be used in every way. Some work too slowly to prevent attacks that are about to begin or to relieve attacks that have already started. These forms can be used only to reduce the number of attacks. Be sure to understand how and when to use the type of antiangina drug that has been prescribed.

Description

Antiangina drugs, also known as nitrates, come in many different forms: tablets and capsules that are swallowed; tablets that are held under the tongue, inside the lip, or in the cheek until they dissolve; stick-on patches; ointment; and in-the-mouth sprays. Commonly used antiangina drugs include isosorbide dinitrate (Isordil, Sorbitrate, and other brands) and nitroglycerin (Nitro-Bid, Nitro-Dur, Nitrolingual Spray, Nitrostat Tablets, Transderm-Nitro, and other brands). These medicines are available only with a physician's prescription.

Recommended dosage

The recommended dosage depends on the type and form of antiangina drug and may be different for different patients. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Always take antiangina drugs exactly as directed. The medicine will not work if it is not taken correctly.

Do not stop taking this medicine suddenly after taking it for several weeks or more, as this could cause angi-

Antiangina Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Calan (calan SR, isoptin, isoptin SR, verelan)	Constipation, dizziness, fatigue, headache, fluid retention, low blood pressure, nausea
Cardene (nicardipine hydrochloride)	Dizziness, headache, indigestion, nausea, rapid heartbeat, sleepiness, swelling of feet, flushing
Cardizem (diltiazem hydrochloride)	Dizziness, fluid retention, headache, nausea, rash
Corgard (nadolol)	Behaviorial changes, dizziness, drowsiness, tiredness
Imdur, Ismo, Monoket (isosorbide mononitrate)	Headache
Isordil (isosorbide dinitrate)	Headache, dizziness, low blood pressure
Lopressor (metroprolol tartrate)	Depression, diarrhea, itching, rash, tiredness
Nitro-Bid, Nitro-Dur, Nitrolingual Spray, Nitrostat Tables, Transderm-Nitro (nitroglycerin)	Dizziness, flushing, headache
Norvasc (amlodipine besylate)	Dizziness, fatigue, fluid retention, headache, palpitations
Procardia, Procardia XL, Adalat (nifedipine)	Constipation, dizziness, hearburn, low blood pressure, moodiness, nausea, swelling
Tenormin (atenolol)	Dizziness, fatigue, nausea, slowed heartbeat

na attacks to return. If it is necessary to stop taking the drug, check with the physician who prescribed it for instructions on how to taper down gradually.

Precautions

Remember that some forms of antiangina drugs work too slowly to relieve attacks that have already started. Check with the physician who prescribed the medicine for instructions on how to use the type that has been prescribed. Patients who are using slower-acting forms to make attacks less frequent may want to ask their physicians to prescribe a fast-acting type to relieve attacks. Another method of treating the frequency of attacks is to increase the dosage of the long-acting antiangina drug. Do this only with the approval of a physician.

These medicines make some people feel lightheaded, dizzy, or faint when they get up after sitting or lying down. To lessen the problem, get up gradually and hold onto something for support if possible. Antiangina drugs may also cause **dizziness**, lightheadedness, or **fainting** in hot weather or when people stand for a long time or **exercise**. Use caution in all these situations. Drinking alcohol while taking antiangina drugs may cause the same problems. Anyone who takes this medicine should limit the amount of alcohol consumed.

Because these drugs may cause dizziness, be careful when driving, using machines, or doing anything else that could be dangerous.

If the person is taking the form of nitroglycerin that is placed under the tongue and symptoms are not relieved within three doses taken about 5 minutes apart, the person should go to the hospital emergency room as soon as possible. A **heart attack** may be in progress.

Some people develop tolerance to antiangina drugs over time. That is, the drug no longer produces the desired effects. Anyone who seems to be developing a tolerance to this medicine should check with his or her physician.

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

Women who are pregnant or breastfeeding or who may become pregnant should check with their physicians before using antiangina drugs.

Older people may be especially sensitive to the effects of antiangina drugs and thus more likely to have side effects such as dizziness and lightheadedness.

Before using antiangina drugs, people with any of these medical problems should make sure their physicians are aware of their conditions:

- recent heart attack or **stroke**
- kidney disease
- liver disease
- severe anemia
- overactive thyroid
- glaucoma
- recent head injury

Side effects

A common side effect is a **headache** just after taking a dose of the medicine. These headaches usually become less noticeable as the body adjusts to the drug. Check with a physician if they are severe or they continue even after taking the medicine for a few weeks. Unless a physician says to do so, do not change the dose to avoid

KEY TERMS

Angina pectoris—A feeling of tightness, heaviness, or pain in the chest, caused by a lack of oxygen in the muscular wall of the heart.

headaches. Other common side effects include dizziness, lightheadedness, fast pulse, flushed face and neck, nausea or vomiting, and restlessness. These problems do not need medical attention unless they do not go away or they interfere with normal activities.

Other side effects may occur. Anyone who has unusual symptoms after taking an antiangina drug should get in touch with his or her physician.

Interactions

Antiangina drugs may interact with other medicines. This may increase the risk of side effects or change the effects of one or both drugs. Anyone who takes antiangina drugs should let the physician know all other medicines he or she is taking. Among the drugs that may interact with antiangina drugs are:

- other heart medicines
- blood pressure medicines
- aspirin
- alcohol
- ergot alkaloids used in migraine headaches

Nancy Ross-Flanigan

Antianxiety drugs

Definition

Antianxiety drugs are medicines that calm and relax people with excessive **anxiety**, nervousness, or tension, or for short term control of social phobia disorder or specific phobia disorder.

Purpose

Antianxiety agents, or anxiolytics, may be used to treat mild transient bouts of anxiety as well as more pronounced episodes of social phobia and specific phobia. Clinically significant anxiety is marked by several symptoms. The patient experiences marked or persistent fear of one or more social or performance situations in which he or she is exposed to unfamiliar people or possible scrutiny by others, and may react in a humiliating or embarrassing way. The exposure to the feared situation produces an anxiety attack. Fear of these episodes of anxiety leads to avoidance behavior, which impairs normal social functioning, including working or attending classes. The patient is aware that these fears are unjustified.

Description

In psychiatric practice, treatment of anxiety has largely turned from traditional antianxiety agents, anxiolytics, to antidepressant therapies. In current use, the **benzodiazepines**, the best known class of anxiolytics, have been largely supplanted by serotonin-specific reuptake inhibitors (SSRIs, citalopram, fluoxetine, fluvoxamine and others) which have a milder side effect profile and less risk of dependency. However, traditional anxiolytics remain useful for patients who need a rapid onset of action, or whose frequency of exposure to anxiety provoking stimuli is low enough to eliminate the need for continued treatment. While SSRIs may require three to five weeks to show any effects, and must be taken continuously, benzodiazepines may produce a response within 30 minutes, and may be dosed on an as-needed basis.

The intermediate action benzodiazepines, alprazolam (Xanax), and lorazepam (Ativan) are the appropriate choice for treatment of mild anxiety and social phobia. Diazepam (Valium) is still widely used for anxiety, but its active metabolite, desmethyldiazepam, which has a long half-life, may make this a poorer choice than other drugs in its class. Note that there is considerable variation between individuals in metabolism of benzodiazepines, so patient response may not be predictable. As a class, benzodiazepines are used not only as anxiolytics, but also as sedatives, **muscle relaxants**, and in treatment of epilepsy and **alcoholism**. The distinctions between these uses are largely determined by onset and duration of action, and route of administration.

Buspirone (BuSpar), which is not chemically related to other classes of central nervous system drugs, is also a traditional anxiolytic, although it is now considered either a third line or adjunctive agent for use after trials of SSRIs and benzodiazepines. It is appropriate for use in patients who have either failed trials of other treatments, or who should not receive benzodiazepines because of a history of substance abuse problems. Buspirone, in common with antidepressants, requires a two to three week period before there is clinical evidence of improvement, and must be continuously dosed to maintain its effects.

Antianxiety Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Atarax (hydroxyzine hydrochloride)	Drowsiness, dry mouth
Ativan (lorazepam)	Dizziness, excessive calm, weakness
BuSpar, Buspirone (buspirone hydrochloride)	Dry mouth, dizziness, headache, fatigue, nausea
Centrax (pazepam)	Decreased coordination, dizziness, drowsiness, fatigue, weakness
Librium, Libritabs (chlordiazepoxide)	Constipation, drowsiness, nausea, swelling
Miltown, Equanil (meprobamate)	Diarrhea, bruising, fever, headache, nausea, rash, slurred speech
Serax (oxazepam)	Dizziness, fainting, headache, liver problems, decreased coordination, nausea, swelling, vertigo
Stelazine (trifluoperazine hydrochloride)	Abnormal glucose in urine, allergic reactions, blurred vision, constipation, eye spasms, fluid retention and swelling
Tranxene, Tranxene-SD (clorazepate dipotassium)	Drowsiness
Valium (diazepam)	Decreased coordination, drowsiness, light-headedness

Benzodiazepines are controlled drugs under federal law. Buspirone is not a controlled substance and has no established abuse potential.

Recommended dosage

Benzodiazepines should be administered 30 to 60 minutes before exposure to the anticipated **stress**. Dosage should be individualized to minimize **sedation**. The normal dose of alprazolam is 0.25–0.5 mg. The usual dose of lorazepam is 2–3 mg. Doses may be repeated if necessary.

Buspirone is initially dosed at 5 mg t.i.d. (3 times a day.) Increase the dosage 5 mg/day, at intervals of two to three days, as needed. Do not exceed 60 mg/day. Two to three weeks may be required before a satisfactory response is seen.

Precautions

Benzodiazepines should not be used in patients with **psychosis**, acute narrow angle **glaucoma**, or liver disease. The drugs can act as respiratory depressants and should be avoided in patients with respiratory conditions. Benzodiazepines are potentially addictive and should not be administered to patients with substance abuse disorders. Because benzodiazepines are sedative, they should be avoided in patients who must remain alert. Their use for periods over four months has not been documented. These drugs should not be used during the second and third trimester of **pregnancy**, although use during the first trimester appears to be safe. They should not be taken while breastfeeding. Consult specialized references for use in children.

Buspirone is metabolized by the liver and excreted by the kidney, and should be used with care in patients with hepatic or renal disease. The drug is classified as schedule B during pregnancy, but should not be taken during breastfeeding. Its use in children under the age of 18 years has not been studied.

Side effects

The most common side effects of benzodiazepines are secondary to their CNS effects and include sedation and sleepiness; depression; lethargy; apathy; **fatigue**; hypoactivity; lightheadedness; memory impairment; disorientation; anterograde **amnesia**; restlessness; confusion; crying or sobbing; **delirium**; **headache**; slurred speech; aphonia; dysarthria; stupor; seizures; **coma**; syncope; rigidity; tremor; dystonia; vertigo; **dizziness**; euphoria; nervousness; irritability; difficulty in concentration; agitation; inability to perform complex mental functions; akathisia; hemiparesis; hypotonia; unsteadiness; ataxia; incoordination; weakness; vivid dreams; psychomotor retardation; "glassy-eyed" appearance; extrapyramidal symptoms; paradoxical reactions. Other reactions include changes in heart rate and blood pressure, changes in bowel function, severe skin rash and changes in genitourinary function. Other adverse effects have been reported.

Buspirone has a low incidence of side effects. Dizziness and drowsiness are the most commonly reported adverse effects. Other CNS effects include dream disturbances; depersonalization, dysphoria, noise intolerance, euphoria, akathisia, fearfulness, loss of interest, disassociative reaction, **hallucinations**, suicidal ideation, seizures; feelings of claustrophobia, cold intolerance, stupor and slurred speech, psychosis. Rarely, heart problems, including congestive **heart failure** and myocardial infarction, have been reported. Other adverse effects have been reported.

Interactions

The metabolism of alprazolam may be increased by: cimetidine, **oral contraceptives**, disulfiram, fluoxetine,

KEY TERMS

Anxiety—Worry or tension in response to real or imagined stress, danger, or dreaded situations. Physical reactions, such as fast pulse, sweating, trembling, fatigue, and weakness may accompany anxiety.

Epilepsy—A brain disorder with symptoms that include seizures.

Panic disorder—An disorder in which people have sudden and intense attacks of anxiety in certain situations. Symptoms such as shortness of breath, sweating, dizziness, chest pain, and extreme fear often accompany the attacks.

Phobia—An intense, abnormal, or illogical fear of something specific, such as heights or open spaces.

Pregnancy category B—Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies.

Pregnancy category C—No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data.

Seizure—A sudden attack, spasm, or convulsion.

isoniazid, ketoconazole, metoprolol, propoxyphene, propranolol and valproic acid. The absorption of all benzodiazepines is inhibited by concomitant use of **antacids**. Benzodiazepines may increase blood devels of digoxin, and reduce the efficacy of levodopa. Other drug interactions have been reported.

Buspirone levels will be increased by concomitant use of erythromycin, itraconazole, and nefazadone. Doses should be adjusted based on clinical response. Use of buspirone at the same time as mono-amine oxidase inhibitors (MAOIs, phenelzine, tranycypromine) may cause severe blood pressure elevations. Use of buspirone with MAOIs should be avoided.

Samuel Uretsky, PharmD

Antiarrhythmic drugs

Definition

Antiarrhythmic drugs are medicines that correct irregular heartbeats and slow down hearts that beat too fast.

Purpose

Normally, the heart beats at a steady, even pace. The pace is controlled by electrical signals that begin in one part of the heart and quickly spread through the whole heart. If something goes wrong with this control system, the result may be an irregular heartbeat, or an arrhythmia. Antiarrhythmic drugs correct irregular heartbeats, restoring the normal rhythm. If the heart is beating too fast, these drugs will slow it down. By correcting these problems, antiarrhythmic drugs help the heart work more efficiently.

Description

Antiarrhythmic drugs are available only with a physician's prescription and are sold in capsule (regular and extended release), tablet (regular and extended-release), and injectable forms. Commonly used antiarrhythmic drugs are disopyramide (Norpace, Norpace CR), procainamide (Procan SR, Pronestyl, Pronestyl-SR), and quinidine (Cardioquin, Duraquin, Quinidex, and other brands). *Do not confuse quinidine with quinine, which is a related medicine with different uses, such as relieving leg cramps.*

Recommended dosage

The recommended dosage depends on the type of antiarrhythmic drug and other factors. Doses may be different for different patients. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Always take antiarrhythmic drugs exactly as directed. Never take larger or more frequent doses.

Do not stop taking this medicine without checking with the physician who prescribed it. Stopping it suddenly could lead to a serious change in heart function.

Antiarrhythmic drugs work best when they are at constant levels in the blood. To help keep levels constant, take the medicine in doses spaced evenly through the day and night. Do not miss any doses. If taking medicine at night interferes with sleep, or if it is difficult to remember to take the medicine during the day, check with a health care professional for suggestions.

Precautions

Persons who take these drugs should see their physician regularly. The physician will check to make sure the medicine is working as it should and will note any unwanted side effects.

Some people feel dizzy, lightheaded, or faint when using these drugs. This medicine may cause blurred

vision or other vision problems. Because of these possible problems, anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them. If the medicine does cause vision problems, wait until vision is clear before driving or engaging in other activities that require normal vision.

Antiarrhythmic drugs make some people feel lightheaded, dizzy, or faint when they get up after sitting or lying down. To lessen the problem, get up gradually and hold onto something for support if possible.

Anyone taking this medicine should not drink alcohol without his or her physician's approval.

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

Anyone who is taking antiarrhythmic drugs should be sure to tell the health care professional in charge before having any surgical or dental procedures or receiving emergency treatment.

Antiarrhythmic drugs may cause low blood sugar in some people. Anyone who experiences symptoms of low blood sugar should eat or drink a food that contains sugar and call a physician immediately. Signs of low blood sugar are:

- anxiety
- confusion
- nervousness
- shakiness
- unsteady walk
- extreme hunger
- headache
- nausea
- drowsiness
- unusual tiredness or weakness
- fast heartbeat
- pale, cool skin
- chills
- cold sweats

Antiarrhythmic drugs may cause **dry mouth**. To temporarily relieve the discomfort, chew sugarless gum, suck on sugarless candy or ice chips, or use saliva substitutes, which come in liquid and tablet forms and are available without a prescription. If the problem continues for more than 2 weeks, check with a physician or dentist. Mouth dryness that continues over a long time may contribute to **tooth decay** and other dental problems.

People taking antiarrhythmic drugs may sweat less, which can cause the body temperature to rise. Anyone who takes this medicine should be careful not to become overheated during **exercise** or hot weather and should avoid hot baths, hot tubs, and saunas. Overheating could lead to heat stroke.

Older people may be especially sensitive to the effects of antiarrhythmic drugs. This may increase the risk of certain side effects, such as dry mouth, difficult urination, and **dizziness** or lightheadedness.

The antiarrhythmic drug procainamide can cause serious blood disorders. Anyone taking this medicine should have regular blood counts and should check with a physician if any of the following symptoms occur:

- joint or muscle **pain**
- muscle weakness
- pain in the chest or abdomen
- tremors
- wheezing
- cough
- palpitations
- rash, sores, or pain in the mouth
- sore throat
- fever and chills
- loss of appetite
- **diarrhea**
- dark urine
- yellow skin or eyes
- unusual bleeding or bruising
- dizziness
- **hallucinations**
- depression

Special conditions

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

ALLERGIES. Anyone who has had unusual reactions to an antiarrhythmic drug in the past should let his or her physician know before taking this type of medicine again. Patients taking procainamide should let their physicians know if they have ever had an unusual or allergic reaction to procaine or any other "caine-type" medicine, such as xylocaine or lidocaine. Patients taking quinidine should mention any previous reactions to qui-

KEY TERMS

Anxiety—Worry or tension in response to real or imagined stress, danger, or dreaded situations. Physical reactions, such as fast pulse, sweating, trembling, fatigue, and weakness may accompany anxiety.

Arrhythmia—Abnormal heart rhythm.

Asthma—A disease in which the air passages of the lungs become inflamed and narrowed.

Emphysema—A lung disease in which breathing becomes difficult.

Glaucoma—A condition in which pressure in the eye is abnormally high. If not treated, glaucoma may lead to blindness.

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

Heat stroke—A severe condition caused by prolonged exposure to high heat. Heat stroke interferes with the body's temperature regulating abilities and can lead to collapse and coma.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Myasthenia gravis—A chronic disease with symptoms that include muscle weakness and sometimes paralysis.

Palpitation—Rapid, forceful, throbbing, or fluttering heartbeat.

Prostate—A donut-shaped gland below the bladder in men that contributes to the production of semen.

Psoriasis—A skin disease in which people have itchy, scaly, red patches on the skin.

Systemic lupus erythematosus (SLE)—A chronic disease that affects the skin, joints, and certain internal organs.

Tourette syndrome—A condition in which a person has tics and other involuntary behavior, such as barking, sniffing, swearing, grunting, and making uncontrollable movements.

Tremor—Shakiness or trembling.

nine. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

CONGESTIVE HEART DISEASE. Antiarrhythmic drugs may cause low blood sugar, which can be a particular problem for people with congestive heart disease. Anyone with congestive heart disease should be familiar with the signs of low blood sugar (listed above) and should check with his or her physician about what to do if such symptoms occur.

DIABETES. Antiarrhythmic drugs may cause low blood sugar, which can be a particular problem for people with diabetes. Anyone with diabetes should be familiar with the signs of low blood sugar (listed above) and should check with his or her physician about what to do if such symptoms occur.

PREGNANCY. The effects of taking antiarrhythmic drugs in **pregnancy** have not been studied in humans. In studies of laboratory animals, this medicine increased the risk of **miscarriage**. In addition, some women who have taken these drugs while pregnant have had contractions of the uterus (womb). Women who are pregnant or who may become pregnant should check with their physicians before taking this medicine. Women who become pregnant while taking this medicine should let their physicians know right away.

BREASTFEEDING. Antiarrhythmic drugs pass into breast milk. Women who are breastfeeding should check with their physicians before taking this medicine.

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

- heart disorders such as structural heart disease or inflammation of the heart muscle
- congestive **heart failure**
- kidney disease
- liver disease
- diseases of the blood
- asthma or **emphysema**
- enlarged prostate or difficulty urinating
- overactive thyroid
- low blood sugar
- psoriasis
- **glaucoma**

- myasthenia gravis
- systemic lupus erythematosus

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

Side effects

The most common side effects are dry mouth and throat, diarrhea, and loss of appetite. These problems usually go away as the body adjusts to the drug and do not require medical treatment. Less common side effects, such as dizziness, lightheadedness, blurred vision, dry eyes and nose, frequent urge to urinate, bloating, **constipation**, stomach pain, and decreased sexual ability, also may occur and do not need medical attention unless they do not go away or they interfere with normal activities.

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

- fever and chills
- difficult urination
- swollen or painful joints
- pain when breathing
- skin rash or itching

People who are especially sensitive to quinidine may have a reaction to the first dose or doses. If any of these side effects occur after taking quinidine, check with a physician immediately:

- dizziness
- ringing in the ears
- breathing problems
- vision changes
- fever
- headache
- skin rash

Other rare side effects may occur with any antiarrhythmic drug. Anyone who has unusual symptoms after taking antiarrhythmic drugs should get in touch with his or her physician.

Interactions

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

- other heart medicines, including other antiarrhythmic drugs
- blood pressure medicine
- blood thinners
- pimozide (Orap), used to treat Tourette's syndrome

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

Nancy Ross-Flanigan

Antiasthmatic drugs

Definition

Antiasthmatic drugs are medicines that treat or prevent **asthma** attacks.

Purpose

For people with asthma, the simple act of breathing can be a struggle. Their airways become inflamed and blocked with mucus during asthma attacks, narrowing the opening through which air passes. This is not such a problem when the person breathes in, because the airways naturally expand when a person takes a breath. The real problem arises when the person with asthma tries to breathe out. The air cannot get out through the blocked airways, so it stays trapped in the lungs. With each new breath, the person can take in only a little more air, so breathing becomes shallow and takes more and more effort.

Asthma attacks can be caused by **allergies** to pollen, dust, pets or other things, but people without known allergies may also have asthma. **Exercise**, **stress**, intense emotions, exposure to cold, certain medicines and some medical conditions also can bring on attacks.

The two main approaches to dealing with asthma are avoiding substances and situations that trigger attacks and using medicines that treat or prevent the symptoms. With a combination of the two, most people with asthma can find relief and live normal lives.

Description

Three types of drugs are used in treating and preventing asthma attacks:

Antiasthmatic Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
AeroBid (aerobid-m, nasalide)	Diarrhea, headache, nausea, sore throat
Alupent (metaproterenol sulfate)	Cough, increased blood pressure and heart rate, nausea, upset stomach
Atrovent (ipratropium bromide)	Blurred vision, dry mouth, rash, headache
Azmacort (triamcinolone acetonide)	Dry mouth, dry and irritated throat
Beclovent Inhalation Aerosol, Beconase AQ Nasal Spray, Beconase Inhalation Aerosol (beclomethasone dipropionate)	Dry mouth, fluid retention, rash, headache, nasal irritation and burning, watery eyes
Brethine (terbutaline sulate)	Difficulty in breathing, drowsiness, headache, increased heartbeat, vomiting
Decadron Tables (dexamethasone)	Blood clots, bruising, fluid retention, increased blood pressure, hives
Decadron Turbinaire/Respihaler (dexamethasone sodium phosphate)	Headache, nausea, coughing, irritated throat
Deltasone (orasone)	Changes in behavior, mood and personality, may cause depression, fluid retention, increased blood pressure
Intal (cromolyn sodium)	Nausea, coughing and sneezing, irritated throat
Medrol (methylprednisolone)	Bruising, cataracts, increased blood pressure, stomach ulcer, rash, vertigo
Pediapred (prednisolone sodium phosphate)	Loss of bone and muscle mass, dizziness, fluid retention, diabetes, peptic ulcer
Provential (albuterol sulfate)	Diarrhea, headache, heartburn, muscle cramps, nausea, ringing in the ears
Theo-Dur (theophylline)	Nausea, diarrhea, hair loss, decreased blood pressure, rash, sleepiness
Tilade (neodocromil sodium)	Chest pain, headache, nausea, sore throat

- **Bronchodilators** relax the smooth muscles that line the airway. This makes the airways open wider, letting more air pass through them. These drugs are used mainly to relieve sudden asthma attacks or to prevent attacks that might come on after exercise. They may be taken by mouth, injected or inhaled.
- **Corticosteroids** block the inflammation that narrows the airways. Used regularly, these drugs will help prevent asthma attacks. Those attacks that do occur will be less severe. However, corticosteroids cannot stop an attack that is already underway. These drugs may be taken by mouth, injected or inhaled.
- Cromolyn also is taken regularly to prevent asthma attacks and may be used alone or with other asthma medicines. It cannot stop an attack that already has started. The drug works by preventing certain cells in the body from releasing substances that cause allergic reactions or asthma symptoms. One brand of this drug, Nasalcrom, comes in capsule and nasal spray forms and is used to treat hay **fever** and other allergies. The inhalation form of the drug, Intal, is used for asthma. It comes in aerosol canisters, in capsules that are inserted into an inhaler, and in liquid form that is used in a nebulizer.

Precautions

Using antiasthmatic drugs properly is important. Because bronchodilators provide quick relief, some people may be tempted to overuse them. However, with some kinds of bronchodilators, this can lead to serious and possibly life-threatening complications. In the long run, patients are better off using bronchodilators only as directed and also using corticosteroids, which eventually will reduce their need for bronchodilators.

Patients who are using their antiasthmatic drugs correctly but feel their asthma is not under control should see their physicians. The physician can either increase the dose, switch to another medicine or add another medicine to the regimen.

Corticosteroids are powerful drugs that may cause serious side effects when used over a long time. However, these problems are much less likely with the inhalant forms than with the oral and injected forms. While the oral and injected forms generally should be used only for one to two weeks, the inhalant forms may be used for long periods.

When used to prevent asthma attacks, cromolyn must be taken as directed every day. The drug may take as long as four weeks to start working. Unless told to do so by a physician, patients should not stop taking the drug just because it does not seem to be working. When symptoms do begin to improve, patients should continue taking all medicines that have been prescribed, unless a physician directs otherwise.

Side effects

Inhalant forms of antiasthmatic drugs may cause dryness or irritation in the throat, **dry mouth**, or an unpleasant taste in the mouth. To help prevent these problems, gargle and rinse the mouth or take a sip of water after each dose.

More serious side effects are not common when these medicines are used properly. However, anyone who

KEY TERMS

Asthma—A disease in which the air passages of the lungs become inflamed and narrowed.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Inhalant—Medicine that is breathed into the lungs.

Mucus—Thick fluid produced by the moist membranes that line many body cavities and structures.

Nebulizer—A device that turns liquid forms of medicine into a fine spray that can be inhaled.

has unusual or bothersome symptoms after taking an antiasthmatic drug should get in touch with a physician.

Interactions

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

Nancy Ross-Flanigan

Antibacterial bath *see* **Therapeutic baths**

Antibiotic-associated colitis

Definition

Antibiotic-associated colitis is an inflammation of the intestines that sometimes occurs following antibiotic treatment and is caused by toxins produced by the bacterium *Clostridium difficile*.

Description

Antibiotic-associated colitis, also called antibiotic-associated enterocolitis, can occur following antibiotic treatment. The bacteria *Clostridia difficile* are normally found in the intestines of 5% of healthy adults, but people can also pick up the bacteria while they are in a hospital or nursing home. In a healthy person, harmless resident intestinal bacteria compete with each other for food and places to "sit" along the inner intestinal wall. When **antibiotics** are given, most of the resident bacteria are killed. With fewer bacteria to compete with, the normally harmless *Clostridia difficile* grow rapidly and produce toxins. These toxins damage the inner wall of the intestines and cause inflammation and **diarrhea**.

Although all antibiotics can cause this disease, it is most commonly caused by clindamycin (Cleocin), ampicillin (Omnipen), amoxicillin (Amoxil, Augmentin, or Wymox), and any in the cephalosporin class (such as cefazolin or cephalexin). Symptoms of the condition can occur during antibiotic treatment or within four weeks after the treatment has stopped.

In approximately half of cases of antibiotic-associated colitis, the condition progresses to a more severe form of colitis called pseudomembranous enterocolitis in which pseudomembranes are excreted in the stools. Pseudomembranes are membrane-like collections of white blood cells, mucus, and the protein that causes blood to clot (fibrin) that are released by the damaged intestinal wall.

Causes and symptoms

Antibiotic-associated colitis is caused by toxins produced by the bacterium *Clostridium difficile* after treatment with antibiotics. When most of the other intestinal bacteria have been killed, *Clostridium difficile* grows rapidly and releases toxins that damage the intestinal wall. The disease and symptoms are caused by these toxins, not by the bacterium itself.

Symptoms of antibiotic-associated colitis usually begin four to ten days after antibiotic treatment has begun. The early signs and symptoms of this disease include lower abdominal cramps, an increased need to pass stool, and watery diarrhea. As the disease progresses, the patient may experience a general ill feeling, **fatigue**, abdominal **pain**, and **fever**. If the disease proceeds to pseudomembranous enterocolitis, the patient may also experience nausea, vomiting, large amounts of watery diarrhea, and a very high fever (104-105°F/40-40.5°C). Complications of antibiotic-associated colitis include severe **dehydration**, imbalances in blood **minerals**, low blood pressure, fluid accumulation in deep skin (**edema**), enlargement of the large intestine (toxic megacolon), and the formation of a tear (perforation) in the wall of the large intestine.

Clostridium difficile is easily spread from person to person in hospitals and nursing homes. The following individuals are most at-risk for developing this disease:

- the elderly
- severely ill individuals
- individuals with weakened or suppressed immune systems (immunocompromised)

- individuals with poor hygiene
- individuals who have been hospitalized for a long period of time

The *Clostridium difficile* toxin is found in the stools of persons older than 60 years of age 20-100 times more frequently than in the stools of persons who are 10-20 years old. As a result, the elderly are much more prone to developing antibiotic-associated colitis than younger individuals.

Diagnosis

Antibiotic-associated colitis can be diagnosed by the symptoms and recent medical history of the patient, by a laboratory test for the bacterial toxin, and/or by using a procedure called endoscopy.

If the diarrhea and related symptoms occurred after the patient received antibiotics, antibiotic-associated colitis may be suspected. A stool sample may be analyzed for the presence of the *Clostridium difficile* toxin. This toxin test is the preferred diagnostic test for antibiotic-associated colitis. One frequently used test for the toxin involves adding the processed stool sample to a human cell culture. If the toxin is present in the stool sample, the cells die. It may take up to two days to get the results from this test. A simpler test, which provides results in two to three hours, is also available. Symptoms and toxin test results are usually enough to diagnose the disease.

Another tool that may be useful in the diagnosis of antibiotic-associated colitis, however, is a procedure called an endoscopy that involves inserting a thin, lighted tube into the rectum to visually inspect the intestinal lining. Two different types of endoscopy procedures, the **sigmoidoscopy** and the **colonoscopy**, are used to view different parts of the large intestine. These procedures are performed in a hospital or doctor's office. Patients are sedated during the procedure to make them more comfortable and are allowed to go home after recovering from the **sedation**.

Treatment

Diarrhea, regardless of the cause, is always treated by encouraging the individual to replace lost fluids and prevent dehydration. One method to treat antibiotic-associated colitis is to simply stop taking the antibiotic that caused the disease. This allows the normal intestinal bacteria to repopulate the intestines and inhibits the overgrowth of *Clostridium difficile*. Many patients with mild disease respond well to this and are free from diarrhea within two weeks. It is important, however, to make sure that the original disease for which the antibiotics were prescribed is treated.

KEY TERMS

Colitis—Inflammation of the colon.

Edema—Fluid accumulation in a tissue.

Endoscopy—A procedure in which a thin, lighted instrument is inserted into the interior of a hollow organ, such as the rectum and used to visually inspect the inner intestinal lining.

Fibrin—A fibrous blood protein vital to coagulation and blood clot formation.

Rectum—The last part of the intestine. Stool passes through the rectum and out through the anal opening.

Toxic megacolon—Acute enlargement or dilation of the large intestine.

Because of the potential seriousness of this disease, most patients are given another antibiotic to control the growth of the *Clostridium difficile*, usually vancomycin (Vancocin) or metronidazole (Flagyl or Protostat). Both are designed to be taken orally four times a day for 10-14 days. Upon finishing antibiotic treatment, approximately 15-20% of patients will experience a relapse of diarrhea within one to five weeks. Mild relapses can go untreated with great success, however, severe relapses of diarrhea require another round of antibiotic treatment. Instead of further antibiotic treatment, a cholestyramine resin (Questran or Prevalite) may be given. The bacterial toxins produced in the intestine stick to the resin and are passed out with the resin in the stool. Unfortunately, however, vancomycin also sticks to the resin, so these two drugs cannot be taken at the same time. Serious disease may require hospitalization so that the patient can be monitored, treated, and rehydrated.

Alternative treatment

The goal of alternative treatment for antibiotic-associated enterocolitis is to repopulate the intestinal environment with microorganisms that are normal and healthy for the intestinal tract. These microorgansisms then compete for space and keep the *Clostridium difficile* from over-populating.

Several types of supplements can be used. Supplements containing *Lactobacillus acidophilus*, the bacteria commonly found in yogurt and some types of milk, *Lactobacillus bifidus*, and *Streptococcus faecium*, are available in many stores in powder, capsule, tablet, and liquid form. *Acidophilus* also acts as a mild antibiotic, which helps it to

KEY TERMS

Colitis—Inflammation of the colon.

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reestablish itself in the intestine, and all may aid in the production of some B **vitamins** and vitamin K. These supplements can be taken individually and alternated weekly or together following one or more courses of antibiotics.

Prognosis

With appropriate treatment and replenishment of fluids, the prognosis is generally excellent. One or more relapses can occur. Very severe colitis can cause a tear (perforation) in the wall of the large intestine that would require major surgery. Perforation of the intestine can cause a serious abdominal infection. Antibiotic-associated colitis can be fatal in people who are elderly and/or have a serious underlying illness, such as **cancer**.

Prevention

There are no specific preventative measures for this disease. Good general health can reduce the chance of developing a bacterial infection that would require antibiotic treatment and the chance of picking up the *Clostridia* bacteria. Maintaining good general health can also reduce the seriousness and length of the condition, should it develop following antibiotic therapy.

Resources

PERIODICALS

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Belinda Rowland, PhD

Antibiotic prophylaxis *see* **Prophylaxis**

Antibiotics

Definition

Antibiotics may be informally defined as the subgroup of anti-infectives that are derived from bacterial sources and are used to treat bacterial infections. Other classes of drugs, most notably the **sulfonamides**, may be effective antibacterials. Similarly, some antibiotics may have secondary uses, such as the use of demeclocycline (Declomycin, a tetracycline derivative) to treat the syndrome of inappropriate antidiuretic hormone (SIADH) secretion. Other antibiotics may be useful in treating protozoal infections.

Purpose

Antibiotics are used for treatment or prevention of bacterial infection.

Description

Classifications

Although there are several classification schemes for antibiotics, based on bacterial spectrum (broad versus narrow) or route of administration (injectable versus oral versus topical), or type of activity (bactericidal vs. bacteriostatic), the most useful is based on chemical structure. Antibiotics within a structural class will generally show similar patterns of effectiveness, toxicity, and allergic potential.

PENICILLINS. The **penicillins** are the oldest class of antibiotics, and have a common chemical structure which they share with the cephalopsorins. The two groups are classed as the beta-lactam antibiotics, and are generally bacteriocidal—that is, they kill bacteria rather than inhibiting growth. The penicillins can be further subdivided. The natural pencillins are based on the original penicillin G structure; penicillinase-resistant penicillins, notably methicillin and oxacillin, are active even in the presence of the bacterial enzyme that inactivates most natural penicillins. Aminopenicillins such as ampicillin and amoxicillin have an extended spectrum of action compared with the natural penicillins; extended spectrum

penicillins are effective against a wider range of bacteria. These generally include coverage for *Pseudomonas aeruginaosa* and may provide the penicillin in combination with a penicillinase inhibitor.

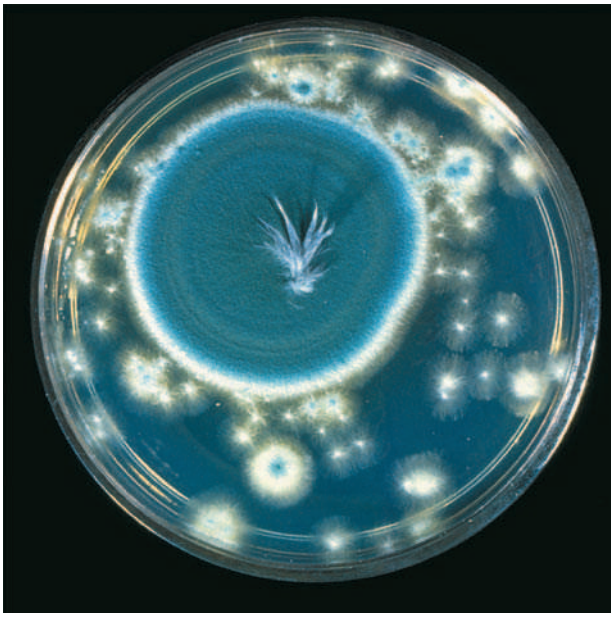
CEPHALOSPORINS. **Cephalosporins** and the closely related cephamycins and carbapenems, like the pencillins, contain a beta-lactam chemical structure. Consequently, there are patterns of cross-resistance and cross-allergenicity among the drugs in these classes. The "cepha" drugs are among the most diverse classes of antibiotics, and are themselves subgrouped into 1st, 2nd and 3rd generations. Each generation has a broader spectrum of activity than the one before. In addition, cefoxitin, a cephamycin, is highly active against anaerobic bacteria, which offers utility in treatment of abdominal infections. The 3rd generation drugs, cefotaxime, ceftizoxime, ceftriaxone and others, cross the blood-brain barrier and may be used to treat **meningitis** and **encephalitis**. Cephalopsorins are the usually preferred agents for surgical **prophylaxis**.

FLUROQUINOLONES. The fluroquinolones are synthetic antibacterial agents, and not derived from bacteria. They are included here because they can be readily interchanged with traditional antibiotics. An earlier, related class of antibacterial agents, the quinolones, were not well absorbed, and could be used only to treat urinary tract infections. The fluroquinolones, which are based on the older group, are broad-spectrum bacteriocidal drugs that are chemically unrelated to the penicillins or the cephaloprosins. They are well distributed into bone tissue, and so well absorbed that in general they are as effective by the oral route as by intravenous infusion.

TETRACYCLINES. **Tetracyclines** got their name because they share a chemical structure that has four rings. They are derived from a species of *Streptomyces* bacteria. Broad-spectrum bacteriostatic agents, the tetracyclines may be effective against a wide variety of microorganisms, including rickettsia and amebic parasites.

MACROLIDES. The macrolide antibiotics are derived from *Streptomyces* bacteria, and got their name because they all have a macrocyclic lactone chemical structure. Erythromycin, the prototype of this class, has a spectrum and use similar to penicillin. Newer members of the group, azithromycin and clarithyromycin, are particularly useful for their high level of lung penetration. Clarithromycin has been widely used to treat *Helicobacter pylori* infections, the cause of stomach ulcers.

OTHERS. Other classes of antibiotics include the **aminoglycosides**, which are particularly useful for their effectiveness in treating *Pseudomonas aeruginosa* infections; the lincosamindes, clindamycin and lincomycin, which are highly active against anaerobic pathogens. There are other, individual drugs which may have utility in specific infections.



A penicillin culture. *(Photograph by P. Barber, Custom Medical Stock Photo. Reproduced by permission.)*

Recommended dosage

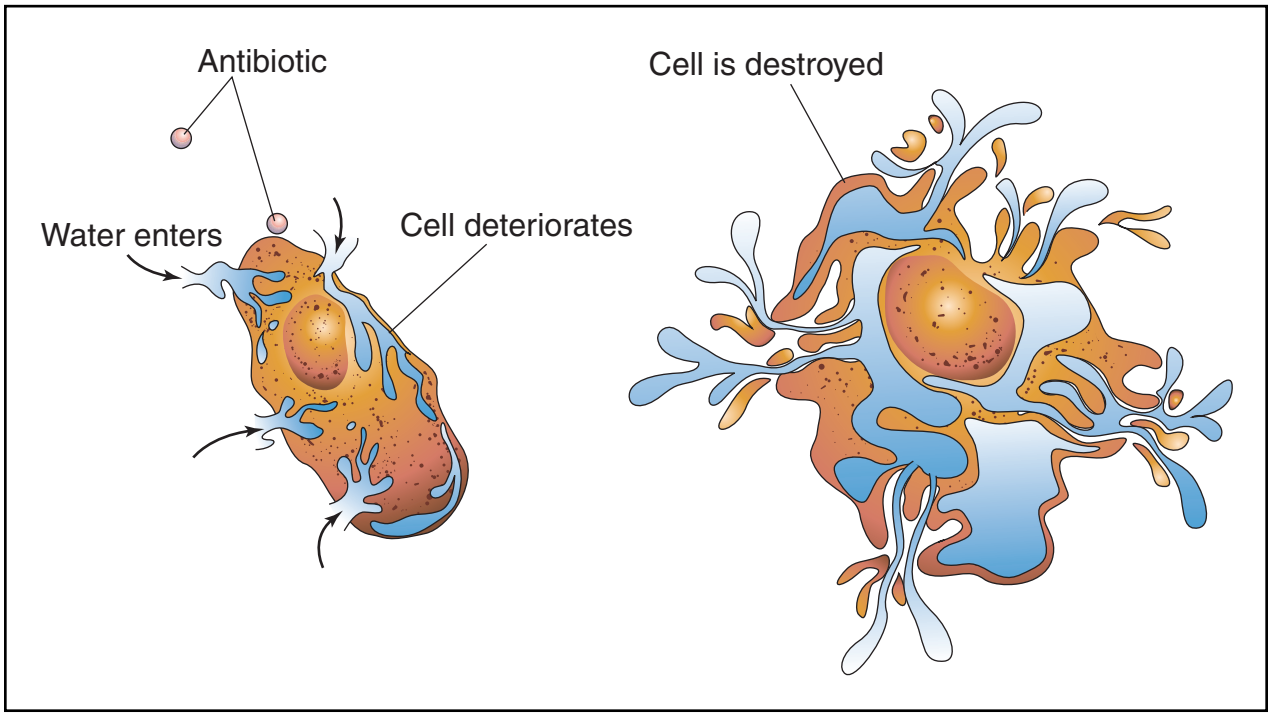
Dosage varies with drug, route of administration, pathogen, site of infection, and severity. Additional considerations include renal function, age of patient, and other factors. Consult manufacturers' recommendations for dose and route.

Side effects

All antibiotics cause risk of overgrowth by non-susceptible bacteria. Manufacturers list other major hazards by class; however, the health care provider should review each drug individually to assess the degree of risk. Generally, breastfeeding is not recommended while taking antibiotics because of risk of alteration to infant's intestinal flora, and risk of masking infection in the infant. Excessive or inappropriate use may promote growth of resistant pathogens.

Penicillins: Hypersensitivity may be common, and cross allergenicity with cephalosporins has been reported. Penicillins are classed as category B during **pregnancy**.

Cephalopsorins: Several cephalopsorins and related compounds have been associated with seizures. Cefmetazole, cefoperazone, cefotetan and ceftriaxone may be



Different antibiotics destroy bacteria in different ways. Some short-circuit the processes by which bacteria receive energy. Others disturb the structure of the bacterial cell wall, as shown in the illustration above. Still others interfere with the production of essential proteins. *(Illustration by Electronic Illustrators Group.)*

associated with a fall in prothrombin activity and coagulation abnormalities. Pseudomembranous colitis has been reported with cephalosporins and other broad spectrum antibiotics. Some drugs in this class may cause renal toxicity. Pregnancy category B.

Fluroquinolones: Lomefloxacin has been associated with increased **photosensitivity**. All drugs in this class have been associated with convulsions. Pregnancy category C.

Tetracyclines: Demeclocycline may cause increased photosensitivity. Minocycline may cause **dizziness**. Do not use tetracyclines in children under the age of eight, and specifically avoid during periods of tooth development. Oral tetracyclines bind to anions such as calcium and iron. Although doxycycline and minocycline may be taken with meals, patients must be advised to take other tetracycline antibiotics on an empty stomach, and not to take the drugs with milk or other calcium-rich foods. Expired tetracycline should never be administered. Pregnancy category D. Use during pregnancy may cause alterations in bone development.

Macrolides: Erythromycin may aggravate the weakness of patients with **myasthenia gravis**. Azithromycin has, rarely, been associated with allergic reactions, including angioedema, **anaphylaxis**, and dermatologic reactions, including Stevens-Johnson syndrome and **toxic epidermal necrolysis**. Oral erythromycin may be highly irritating to the stomach and when given by injection may cause severe phlebitis. These drugs should be used with caution in patients with liver dysfunction. Pregnancy category B: Azithromycin, erythromycin. Pregnancy category C: Clarithromycin, dirithromycin, troleandomycin.

Aminoglycosides: This class of drugs causes kidney and **ototoxicity**. These problems can occur even with normal doses. Dosing should be based on renal function, with periodic testing of both kidney function and hearing. Pregnancy category D.

Recommended usage

To minimize risk of adverse reactions and development of resistant strains of bacteria, antibiotics should be restricted to use in cases where there is either known or a reasonable presumption of bacterial infection. The use of antibiotics in viral infections is to be avoided. Avoid use of fluroquinolones for trivial infections.

In severe infections, presumptive therapy with a broad-spectrum antibiotic such as a 3rd generation cephalosporin may be appropriate. Treatment should be changed to a narrow spectrum agent as soon as the

KEY TERMS

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Meningitis—Inflammation of tissues that surround the brain and spinal cord.

Microorganism—An organism that is too small to be seen with the naked eye.

Organism—A single, independent unit of life, such as a bacterium, a plant or an animal.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

pathogen has been identified. After 48 hours of treatment, if there is clinical improvement, an oral antibiotic should be considered.

Resources

PERIODICALS

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"Consumer Alert: Antibiotic Resistance Is Growing!" *People's Medical Society Newsletter* 16 (August 1997): 1.

Swartz, Morton N. "The Path of Least Resistance." *Harvard Health Letter* 20 (April 1995): 6.

Samuel Uretsky, PharmD

Antibiotics, ophthalmic

Definition

Ophthalmic **antibiotics** are medicines that kill bacteria that cause eye infections.

Purpose

Ophthalmic antibiotics are applied to the eye, or under the eyelid, to treat eye infections caused by bacteria.

Description

The medicine described here, tobramycin (Tobrex), comes in the form of eye drops or ointment. It is available only with a physician's prescription.

Recommended dosage

The dosages given here are typical doses. Physicians may adjust the number of doses per day, the time between doses, and the length of treatment with the medicine, depending on the patient's particular medical problem. If the physician's directions are different from those given here, follow the physician's directions.

Be sure to follow package directions for applying drops or ointment properly.

Adults

EYE DROPS. For mild to moderate infections, use one to two drops in the affected eye or eyes every four hours.

For severe infections, use two drops in the affected eye or eyes every two hours until the condition improves. At that time, the physician will determine how much to use until the infection is completely cleared up.

OINTMENT. For mild to moderate infections, squeeze a half-inch ribbon of ointment into the affected eye or eyes two or three times a day. Do not let the tip of the ointment tube touch the eye.

For severe infections, squeeze a half-inch ribbon of ointment into the affected eye or eyes every three to four hours until the condition improves. At that time, the physician will determine how much to use until the infection is completely cleared up.

Children

The child's physician should determine the proper dose.

Precautions

Use this drug as often as directed, for as long as directed. Although the symptoms may have disappeared, the infection may not clear up completely if the drug is stopped too soon. Therefore, the medication may be prescribed for several days after the infection appears to have cleared. However, it is just as important to use the drug for *only* as long as directed. Using it for

KEY TERMS

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Ointment—A thick, spreadable substance that contains medicine and is meant to be used on the skin, or, if it is specifically an ophthalmic, or "eye" ointment, in the eye

too long may lead to the growth of bacteria that do not respond to the drug. These bacteria may then cause infections that can be very difficult to treat. Make sure the physician or pharmacist specifies how long the medication is to be used.

Anyone who has had an allergic reaction to tobramycin or any other ingredients of Tobrex should not use this medicine. Be sure to tell the physician about any past reactions to the drug or its ingredients.

Anyone who has an allergic reaction to tobramycin should stop using it immediately and call a physician.

Women who are pregnant or breastfeeding or who plan to become pregnant should check with their physicians before using tobramycin.

Side effects

The main side effects of this medicine are **itching**, redness, and swelling of the eye or eyelid. Allergic reactions also are possible. If any of these symptoms occur, call the physician who prescribed the medicine.

Interactions

Patients who are using any other prescription or nonprescription (over-the-counter) medicines in their eyes should check with their physicians before using tobramycin.

Nancy Ross-Flanigan

Antibiotics, topical

Definition

Topical **antibiotics** are medicines applied to the skin to kill bacteria.

Purpose

Topical antibiotics help prevent infections caused by bacteria that get into minor cuts, scrapes, and **burns**. Treating minor **wounds** with antibiotics allows quicker healing. If the wounds are left untreated, the bacteria will multiply, causing **pain**, redness, swelling, **itching**, and oozing. Untreated infections can eventually spread and become much more serious.

Different kinds of topical antibiotics kill different kinds of bacteria. Many antibiotic first-aid products contain combinations of antibiotics to make them effective against a broad range of bacteria.

When treating a wound, it is not enough to simply apply a topical antibiotic. The wound must first be cleaned with soap and water and patted dry. After the antibiotic is applied, the wound should be covered with a dressing, such as a bandage or a protective gel or spray. For many years, it was thought that wounds heal best when exposed to the air. But now most experts say it is best to keep wounds clean and moist while they heal. The covering should still allow some air to reach the wound, however.

Description

Some topical antibiotics are available without a prescription and are sold in many forms, including creams, ointments, powders, and sprays. Some widely used topical antibiotics are bacitracin, neomycin, mupirocin, and polymyxin B. Among the products that contain one or more of these ingredients are Bactroban (a prescription item), Neosporin, Polysporin, and Triple Antibiotic Ointment or Cream.

Recommended dosage

The recommended dosage depends on the type of topical antibiotic. Follow the directions on the package label or ask a pharmacist for directions.

In general, topical antibiotics should be applied within four hours after injury. Do not use more than the recommended amount and do not apply it more often than three times a day. Do not apply the medicine over large areas of skin or on open wounds.

Precautions

Many public health experts are concerned about antibiotic resistance, a problem that can develop when antibiotics are overused. Over time, bacteria develop new defenses against antibiotics that once were effective against them. Because bacteria reproduce so quickly, these defenses can be rapidly passed on through generations of bacteria until almost all are immune to the

effects of a particular antibiotic. The process happens faster than new antibiotics can be developed. To help control the problem, many experts advise people to use topical antibiotics only for short periods, that is, until the wound heals, and only as directed. For the topical antibiotic to work best, it should be used only to prevent infection in a fresh wound, not to treat an infection that has already started. Wounds that are not fresh may need the attention of a physician to prevent complications such as blood **poisoning**.

Topical antibiotics are meant to be used only on the skin and only for only a few days at a time. If the wound has not healed in five days, stop using the antibiotic and call a doctor.

Do not use topical antibiotics on large areas of skin or on open wounds. These products should not be used to treat **diaper rash** in infants or incontinence rash in adults.

Only minor cuts, scrapes, and burns should be treated with topical antibiotics. Certain kinds of injuries may need medical care and should not be self-treated with topical antibiotics. These include:

- large wounds
- deep cuts
- cuts that continue bleeding
- cuts that may need stitches
- burns any larger than a few inches in diameter
- scrapes imbedded with particles that won't wash away
- animal bites
- deep puncture wounds
- eye injuries

Never use regular topical antibiotics in the eyes. Special antibiotic products are available for treating eye infections.

Although topical antibiotics control infections caused by bacteria, they may allow fungal infections to develop. The use of other medicines to treat the fungal infections may be necessary. Check with the physician or pharmacist.

Some people may be allergic to one or more ingredients in a topical antibiotic product. If an allergic reaction develops, stop using the product immediately and call a physician.

No harmful or abnormal effects have been reported in babies whose mothers used topical antibiotics while pregnant or nursing. However, pregnant women generally are advised not to use any drugs during the first 3 months after conception. A woman who is pregnant or breastfeeding or who plans to become pregnant should check with her physician before using a topical antibiotic.

Unless a physician says to do so, do not use topical antibiotics on children under two years of age.

KEY TERMS

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Conception—The union of egg and sperm to form a fetus.

Fungal—Caused by a fungus.

Fungus—A member of a group of simple organisms that are related to yeast and molds.

Incontinence—The inability to control the bladder or bowel.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Side effects

The most common minor side effects are itching or burning. These problems usually do not require medical treatment unless they do not go away or they interfere with normal activities.

If any of the following side effects occur, check with a doctor as soon as possible:

- rash
- swelling of the lips and face
- sweating
- tightness or discomfort in the chest
- breathing problems
- fainting or **dizziness**
- low blood pressure
- nausea
- diarrhea
- hearing loss or ringing in the ears

Other rare side effects may occur. Anyone who has unusual symptoms after using a topical antibiotic should get in touch with the physician who prescribed or the pharmacist who recommedned the medication.

Interactions

Using certain topical antibiotics at the same time as hydrocortisone (a topical corticosteroid used to treat

inflammation) may hide signs of infection or allergic reaction. Do not use these two medicines at the same time unless told to do so by a health care provider.

Anyone who is using any other type of prescription or nonprescription (over-the-counter) medicine on the skin should check with a doctor before using a topical antibiotic.

Resources

PERIODICALS

Farley, Dixie. "Help for Cuts, Scrapes and Burns." *FDA Consumer* (May 1996):12.

Nancy Ross-Flanigan

Antibody screening *see* **Blood typing and crossmatching**

Anticancer drugs

Definition

Anticancer, or antineoplastic, drugs are used to treat malignancies, cancerous growths. Drug therapy may be used alone, or in combination with other treatments such as surgery or **radiation therapy**.

Purpose

Anticancer drugs are used to control the growth of cancerous cells. **Cancer** is commonly defined as the uncontrolled growth of cells, with loss of differentiation and commonly, with metastasis, spread of the cancer to other tissues and organs. Cancers are malignant growths. In contrast, benign growths remain encapsulated and grow within a well-defined area. Although benign tumors may be fatal if untreated, due to pressure on essential organs, as in the case of a benign **brain tumor**, surgery or radiation are the preferred methods of treating growths which have a well defined location. Drug therapy is used when the tumor has spread, or may spread, to all areas of the body.

Description

Several classes of drugs may be used in cancer treatment, depending on the nature of the organ involved. For example, breast cancers are commonly stimulated by estrogens, and may be treated with drugs which inactive the sex hormones. Similarly, **prostate cancer** may be treated with drugs that inactivate androgens, the male sex hormone. However, the majority of antineoplastic drugs act by interfering with cell growth. Since cancerous cells grow more rapidly than other cells, the drugs target those cells which are in the process of reproducing themselves. As a result, antineoplastic drugs will commonly affect not only the cancerous cells, but others cells that commonly reproduce quickly, including hair follicles, ovaries and testis, and the blood-forming organs.

KEY TERMS

Cataract—Clouding of the lens of the eye, leading to poor vision or blindness.

Impotent—Unable to achieve or maintain an erection of the penis.

Newer approaches to antineoplastic drug therapy have taken different approaches, including angigenesis—the inhibition of formation of blood vessels feeding the tumor and contributing to tumor growth. Although these approaches hold promise, they are not yet in common use.

Antineoplastic drugs may be divided into two classes: cycle specific and non-cycle specific. Cycle specific drugs act only at specific points of the cell's duplication cycle, such as anaphase or metaphase, while non-cycle specific drugs may act at any point in the cell cycle. In order to gain maximum effect, antineoplastic drugs are commonly used in combinations.

Precautions

Because antineoplastic agents do not target specific cell types, they have a number of common adverse side effects. Hair loss is common due to the effects on hair follicles, and anemia, immune system impairment, and clotting problems are caused by destruction of the blood forming organs, leading to reduction in the number of red cells, white cells, and platelets. Because of the frequency and severity of these side effects, it is common to administer **chemotherapy** in cycles, allowing time for recovery from the drug effects before administering the next dose. Doses are often calculated, not on the basis of weight, but rather based on blood counts, in order to avoid dangerous levels of anemia (red cell depletion), **neutropenia** (white cell deficiency), or **thrombocytopenia** (platelet deficiency.)

Nausea and vomiting are among the most common adverse effects of cancer chemotherapy, and in some cases may be severe enough to cause dose reduction or discontinuation of treatment.

The health professional has many responsibilities in dealing with patients undergoing chemotherapy. The

Anti Cancer Drugs

Generic (Brand Name)	Clinical Uses	Common Side Effects To Drug
Altretamine (Hexalen)	Treatment of advanced ovarian cancer	Bone marrow depression, nausea and vomiting
Asparaginase (Elspar)	Commonly used in combination with other drugs; refractory acute lymphocytic leukemia	Liver, kidney, pancreas, CNS abnormalities
Bleomycin (Blenoxane)	Lymphomas, Hodgkin's disease, testicular cancer	Hair loss, stomatitis, pulmonary toxicity, hyperpigmentation of skin
Busulfan (Myleran)	Chronic granulocytic leukemia	Bone marrow depression, pulmonary toxicity
Carboplatin (Paraplatin)	Pallilation of ovarian cancer	Bone marrow depression, nausea and vomiting
Carmustine	Hodgkin's disease, brain tumors, multiple myeloma, malignant melonoma	Bone marrow depression, nausea and vomiting, toxic damage to liver
Chlorambucil (Leukeran)	Chronic lymphocytic leukemia, non-Hodgkin's lymphomas, breast and ovarian cancer	Bone marrow depression, excess uric acid in blood
Cisplatin (Platinol)	Treatment of bladder, ovarian, uterine, testicular, head and neck cancers	Renal toxicity and ototoxicity
Cladribine (Leustatin)	Hairy cell leukemia	Bone marrow depression, nausea and vomiting, fever
Cyclophosphamide (Cytoxan)	Hodgkin's disease, non-Hodgkin's lymphomas, neuroblastoma. Often used with other drugs for breast, ovarian, and lung cancers; acute lymphoblastic leukemia in children; multiple myeloma	Bone marrow depression, hair loss, nausea and vomiting, inflammation of the bladder
Cytarabine (Cytosar-U)	Leukemias occurring in adults and children	Bone marrow depression, nausea and vomiting, diarrhea, stomatitis
Dacarbazine (DTIC-Dome)	Hodgkin's disease, malignant melanoma	Bone marrow depression, nausea and vomiting
Diethylstilbestrol (DES) (Stilbestrol)	Breast cancer in post-menopausal women, prostate cancer	Hair loss, nausea and vomiting, edema, excess calcium in blood; feminizing effects in men
Ethinyl estradiol (Estinyl)	Advanced breast cancer in post-menopausal women, prostate cancer	Excess calcium in blood, anorexia, edema, nausea and vomiting; feminizing effects in men
Etoposide (VePesid)	Acute leukemias, lymphomas, testicular cancer	Bone marrow depression, nausea and vomiting, hair loss

patient must be well informed of the risks and benefits of chemotherapy, and must be emotionally prepared for the side effects. These may be permanent, and younger patients should be aware of the high risk of sterility after chemotherapy.

The patient must also know which side effects should be reported to the practitioner, since many adverse effects do not appear until several days after a dose of chemotherapy. When chemotherapy is self-administered, the patient must be familiar with proper use of the drugs, including dose scheduling and avoidance of drug-drug and food-drug interactions.

Appropriate steps should be taken to minimize side effects. These may include administration of antinauseant medications to reduce nausea and vomiting, maintaining fluid levels to reduce drug toxicity, particularly to the kidneys, or application of a scalp tourniquet to reduce blood flow to the scalp and minimize hair loss due to drug therapy.

Patients receiving chemotherapy are also at risk of infections due to reduced white blood counts. While prophylactic **antibiotics** may be useful, the health care professional should also be sure to use standard precautions, including gowns and gloves when appropriate. Patients should be alerted to avoid risks of viral contamination, and live virus immunizations are contraindicated until the patient has fully recovered from the effects of chemotherapy. Similarly, the patient should avoid contact with other people who have recently had live virus immunizations.

Other precautions which should be emphasized are the risks to pregnant or nursing women. Because antineoplastic drugs are commonly harmful to the fetus, women of childbearing potential should be cautioned to use two effective methods of birth control while receiving cancer chemotherapy. This also applies if the woman's male partner is receiving chemotherapy. Breastfeeding should be avoided while the mother is being treated.

Before prescribing or administering anticancer drugs, health care providers should inquire whether the patient has any of the following conditions:

- **chickenpox** or recent exposure to someone with chickenpox
- shingles (Herpes zoster)
- mouth sores
- current or past seizures

Anti Cancer Drugs (continued)

Generic (Brand Name)	Clinical Uses	Common Side Effects To Drug
Floxuridine (FUDR)	Cancers of the liver, pancreas, GI and biliary tract, head and neck tumors	See Cytarabine
Fludarabine (Fludara)	Chronic lymphocytic leukemia	Bone marrow depression, nausea and vomiting, fever
Fluorouracil (5–FU)(Adrucil)	Breast, colon, pancreatic cancer, cancer of the rectum and stomach	See Cytarabine
Flutamide (Eulexin)	Advanced prostate cancer	Nausea and vomiting, hot flashes, diarrhea, impotence, decreased libido, gynecomastia
Goserelin (Zoladex)	Advanced prostate cancer	Pain in bones
Hydroxyurea (Hydrea)	Chronic granulocytic leukemia, malignant melanoma	Bone marrow depression, gastrointestinal irritation
Idarubicin (Idamycin)	Used in combination with other antileukemic drugs, acute myelogenous leukemia	See Doxorubicin
Ifosfamide (Ifex)	Germ cell testicular cancer	Bone marrow depression, nausea and vomiting, inflammation of the bladder
Leuprolide (Lupron)	Advanced prostate cancer	See Goserelin
Levamisole (Ergamisol)	Used in conjunction with Fluorouracil to treat colon cancer	Diarrhea, dermatitis, nausea and vomiting
Lomustine	Brain tumors, Hodgkin's disease	Bone marrow depression, nausea and vomiting, toxic damage to liver
Mechlorethamine (Mustargen)	Lung cancer, Hodgkin's disease and non-Hodgkin's lymphomas	Bone marrow depression, nausea and vomiting
Medroxyprogesterone (Depo-Provera)	Advanced uterine cancer	May cause edema
Megestrol (Megace)	Advanced uterine cancer, breast cancer	Masculinizing effects
Melphalan (Alkeran)	Multiple myeloma	Bone marrow depression, nausea and vomiting
Mercaptopurine (Purinethol)	Acute and chronic leukemias	Bone marrow depression, nausea, excess uric acid in blood
Methotrexate (Mexate)	Acute lymphoblastic leukemias in children, bone cancer, choriocaricinoma of the testes	Bone marrow depression, diarrhea, nausea, stomatitis

- head injury
- nerve or muscle disease
- hearing problems
- infection of any kind
- gout
- colitis
- intestine blockage
- stomach ulcer
- kidney stones
- kidney disease
- liver disease
- current or past alcohol abuse
- immune system disease
- **cataracts** or other eye problems
- high cholesterol

Other precautions

The anticancer drug methotrexate has additional precautions. Patients should be given advice on the effects of sun exposure and the use of alcohol and **pain** relievers.

Side effects

Tamoxifen

The anticancer drug tamoxifen (Nolvadex) increases the risk of cancer of the uterus in some women. It also causes cataracts and other eye problems. Women taking this drug may have hot flashes, menstrual changes, genital **itching**, vaginal discharge, and weight gain. Men who take tamoxifen may lose interest in sex or become impotent. Health care providers should keep in close contact with patients to assess the individual risks associated with taking this powerful drug.

Other anticancer drugs

These side effects are not common, but could be a sign of a serious problem. Health care providers should immediately be consulted if any of the following occur:

- black, tarry, or bloody stools
- blood in the urine
- diarrhea
- fever or chills
- cough or hoarseness
- wheezing or **shortness of breath**

Anti Cancer Drugs (continued)

Generic (Brand Name)	Clinical Uses	Common Side Effects To Drug
Mitomycin (Mutamycin)	Bladder, breast, colon, lung, pancreas, rectum cancers, head and neck cancer, malignant melanoma	Bone marrow depression, nausea and vomiting, diarrhea, stomatitis, possible tissue damage
Mitotane (Lysodren)	Cancer of the adrenal cortex (inoperable)	Damage to adrenal cortex, nausea, anorexia
Mitoxantrone (Novantrone)	Acute nonlymphocytic leukemia	Cardiac arrhythmias, labored breating, nausea and vomiting, diarrhea, fever, congestive heart failure
Paclitaxel (Taxol)	Advanced ovarian cancer	Bone marrow depression, hair loss, nausea and vomiting, hypotension, allergic reactions, slow heart action, muscle and joint pain
Pentastatin (Nipent)	Hairy cell leukemia unresponsive to alpha-interferon	Bone marrow depression, fever, skin rash, liver damage, nausea and vomiting
Pipobroman (Vercyte)	Chronic granulocytic leukemia	Bone marrow depression
Plicamycin (Mithracin)	Testucular tumors	Toxicity/damage to bone marrow, kidneys, and liver
Prednisone (Meticorten)	Used in adjunct therapy for palliation of symptoms in lymphomas, acute leukemia Hodgkin's disease	May be toxic to all body systems
Procarbazine (Matulane)	Hodgkin's disease	Bone marrow depression, nausea and vomiting
Streptozocin (Zanosar)	Islet cell carcinoma of pancreas	Nausea and vomiting, toxicity to kidneys
Tamoxifen (Nolvadex)	Advanced breast cancer in post menopausal	Nausea and vomiting, ocular toxicity, hot flashes
Teniposide (Vumon)	Acute lymphocytic leukemia in children	See Etoposide
Vinblastine (Velban)	Breast cancer, Hodgkin's disease, metastatic testicular cancer	Bone marrow depression, neurotoxicity
Vincristine (Oncovin)	Acute leukemia, Hodgkin's disease, lymphomas	Constipation, neurotoxicity, possible tissue necrosis

- sores in the mouth or on the lips
- unusual bleeding or bruising
- swelling of the face
- red "pinpoint" spots on the skin
- redness, pain, or swelling at the place on the body where an injectable anticancer drug is given
- pain in the side or lower back
- problems urinating or painful urination
- dizziness or faintness
- fast or irregular heartbeat

Other side effects do not need immediate care, but should have medical attention. They are:

- joint pain
- skin rash
- hearing problems or ringing in the ears
- numbness or tingling in the fingers or toes
- trouble walking or balance problems
- swelling of the feet or lower legs
- unusual tiredness or weakness
- loss of taste
- seizures
- dizziness
- confusion
- agitation
- headache
- dark urine
- yellow eyes or skin
- flushing of the face

In addition, there are other possible side effects that do not need medical attention unless they persist or interfere with normal activities. These include changes in menstrual period, itchy skin, nausea and vomiting, and loss of appetite.

Other rare side effects may occur. Anyone who has unusual symptoms after taking anticancer drugs should contact the physician who prescribed the medication.

Interactions

Anticancer drugs may interact with a number of other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. The health care provider should be aware of all other prescription or non-prescription (over-the-counter) medicines a patient is taking. The primary care provider should also be told if the patient has been treated with radiation or has taken other anticancer drugs.

Samuel Uretsky, PharmD

Anticholinergic drugs *see* **Antiparkinson drugs**

Anticlotting drugs *see* **Anticoagulant and antiplatelet drugs**

Anticoagulant and antiplatelet drugs

Definition

Anticoagulants are drugs used to prevent clot formation or to prevent a clot that has formed from enlarging. They inhibit clot formation by blocking the action of clotting factors or platelets. Anticoagulant drugs fall into three categories: inhibitors of clotting factor synthesis, inhibitors of thrombin and antiplatelet drugs.

Purpose

Anticoagulant drugs reduce the ability of the blood to form clots. Although blood clotting is essential to prevent serious bleeding in the case of skin cuts, clots inside the blood vessels block the flow of blood to major organs and cause heart attacks and strokes. Although these drugs are sometimes called blood thinners, they do not actually thin the blood. Furthermore, this type of medication will not dissolve clots that already have formed, although the drug stops an existing clot from worsening. However, another type of drug, used in **thrombolytic therapy**, will dissolve existing clots.

Anticoagulant drugs are used for a number of conditions. For example, they may be given to prevent blood clots from forming after the replacement of a heart valve or to reduce the risk of a **stroke** or another **heart attack** after a first heart attack. They are also used to reduce the chance of blood clots forming during open heart surgery or bypass surgery. Low doses of these drugs may be given to prevent blood clots in patients who must stay in bed for a long time after certain types of surgery.

Because anticoagulants affect the blood's ability to clot, they can increase the risk of severe bleeding and heavy blood loss. It is thus essential to take these drugs exactly as directed and to see a physician regularly as long as they are prescribed.

Description

Anticoagulant drugs, also called anticlotting drugs or blood thinners, are available only with a physician's prescription. They come in tablet and injectable forms. They fall into three groups:

- Inhibitors of clotting factor synthesis. These anticoagulants inhibit the production of certain clotting factors in the liver. One example is warfarin (brand name: coumadin).
- Inhibitors of thrombin. Thrombin inhibitors interfere with blood clotting by blocking the activity of thrombin. They include heparin, lepirudin (Refludan).
- Antiplatelet drugs. Antiplatelet drugs interact with platelets, which is a type of blood cell, to block platelets from aggregating into harmful clots. They include: **aspirin**, ticlopidine (Ticlid), clopidogrel (Plavix), tirofiban (Aggrastat), and eptifibatide (Integrilin).

Recommended dosage

The recommended dosage depends on the type of anticoagulant drug and the medical condition for which it is prescribed. The prescribing physician or the pharmacist who filled the prescription can provide information concerning the correct dosage. Usually, the physician will adjust the dose after checking the patient's clotting time.

Anticoagulant drugs must be taken exactly as directed by the physician. Larger or more frequent doses should not be taken, and the drug should also not be taken for longer than prescribed. *Taking too much of this medication can cause severe bleeding*. Anticoagulants should also be taken on schedule. A record of each dose should be kept as it is taken. If a dose is missed, it should be taken as soon as possible followed by the regular dose schedule. However, a patient who forgets to take a missed dose until the next day should not take the missed dose at all and should not double the next dose, as this could lead to bleeding. A record of all missed doses should be kept for the prescribing physician who should be informed at the scheduled visits.

Precautions

Persons who take anticoagulants should see a physician regularly while taking these drugs, particularly at the beginning of therapy. The physician will order periodic blood tests to check the blood's clotting ability. The results of these tests will help the physician determine the proper amount of medication to be taken each day.

Time is required for normal clotting ability to return after anticoagulant treatment. During this period, patients must observe the same precautions they observed while taking the drug. The length of time needed for the blood to return to normal depends on the type of anticoagulant drug that was taken. The prescribing physician will advise as to how long the precautions should be observed.

People who are taking anticoagulant drugs should tell all physicians, dentists, pharmacists, and other medical professionals who provide medical treatments or services to them that they are taking such a medication.

They should also carry identification stating that they are using an anticoagulant drug.

Other prescription drugs or over-the-counter medicine—especially aspirin—should be not be taken without the prescribing physician being informed.

Because of the risk of heavy bleeding, anyone who takes an anticoagulant drug must take care to avoid injuries. Sports and other potentially hazardous activities should be avoided. Any falls, blows to the body or head, or other injuries should be reported to a physician, as internal bleeding may occur without any obvious symptoms. Special care should be taken in shaving and in brushing and flossing the teeth. Soft toothbrushes should be used and the flossing should be very gentle. Electric razors should be used instead of a blade.

Alcohol can change the way anticoagulant drugs affect the body. Anyone who takes this medicine should not have more than one to two drinks at any time and should not drink alcohol every day.

Special conditions

People with specific medical conditions or who are taking certain other medicines can have problems if they take anticoagulant drugs. Before taking these drugs, the prescribing physician should be informed about any of these conditions:

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

PREGNANCY. Anticoagulants may cause many serious problems if taken during **pregnancy**. **Birth defects**, severe bleeding in the fetus, and other problems that affect the physical or mental development of the fetus or newborn are possible. The mother may also experience severe bleeding if she takes anticoagulants during pregnancy, during delivery, or even shortly after delivery. *Women should not take start taking anticoagulants during pregnancy and should not become pregnant while taking it. Any woman who becomes pregnant or suspects that she has become pregnant while taking an anticoagulant should check with her physician immediately.*

BREASTFEEDING. Some anticoagulant drugs may pass into breast milk. Blood tests can be done on nursing babies to see whether the drug is causing any problems. If it is, other medication may be prescribed to counteract the effects of the anticoagulant drug.

OTHER MEDICAL CONDITIONS. Before using anticoagulant drugs, people should inform their physician about *any* medical problems they have. They should also let the physician who prescribed the medicine know if they are being treated by any other medical physician or dentist. In addition, people who will be taking anticoagulant drugs should let their physician know if they have recently had any of the following:

- **fever** lasting more than one to two days
- severe or continuing **diarrhea**
- childbirth
- heavy or unusual menstrual bleeding
- insertion of an intrauterine contraceptive device (**IUD**)
- falls, injuries, or blows to the body or head
- any type of surgery, including dental surgery
- spinal anesthesia
- radiation treatment

USE OF CERTAIN FOODS AND MEDICINES. Many foods and drugs may affect the way the anticoagulant drugs work or may increase the risk of side effects.

Side effects

The most common minor side effects are bloating or gas. These problems usually go away as the body adjusts to the drug and do not require medical treatment.

More serious side effects may occur, especially if excessive anticoagulant is taken. If any of the following side effects occur, a physician should be notified immediately:

- bleeding gums
- sores or white spots in the mouth or throat
- unusual **bruises** or purplish areas on the skin
- unexplained nosebleeds
- unusually heavy bleeding or oozing from **wounds**
- unexpected or unusually menstrual bleeding
- blood in the urine
- cloudy or dark urine
- painful or difficult urination or sudden decrease in amount of urine
- black, tarry, or bloody stools
- coughing up blood
- vomiting blood or something that looks like coffee grounds
- constipation
- **pain** or swelling in the stomach or abdomen
- back pain
- stiff, swollen, or painful joints

KEY TERMS

Anticoagulant—Drug used to prevent clot formation or to prevent a clot that has formed from enlarging. Anticoagulant drugs inhibit clot formation by blocking the action of clotting factors or platelets. Anticoagulant drugs fall into three groups: inhibitors of clotting factor synthesis, inhibitors of thrombin and antiplatelet drugs.

Antiplatelet drug—Drug that inhibits platelets from aggregating to form a plug. They are used to prevent clotting and alter the natural course of atherosclerosis.

Atherosclerosis—Condition characterized by deposits of fatty plaque in the arteries.

Clot—A soft, semi-solid mass that forms when blood gels.

Platelet—A small, disk-shaped body in the blood that has an important role in blood clotting: they form the initial plug at the rupture site of a blood vessel.

Thrombin—Thrombin is a protein produced by the body. It is a specific clotting factor that plays an important role in the blood clotting process.

Thrombin inhibitor—Thrombin inhibitors are one type of anticoagulant medication, used to help prevent formation of harmful blood clots in the body by blocking the activity of thrombin.

- painful, bluish or purplish fingers or toes
- puffy or swollen eyelids, face, feet, or lower legs
- changes in the color of the face
- skin rash, **itching**, or **hives**
- yellow eyes or skin
- severe or continuing **headache**
- sore throat and fever, with or without chills
- breathing problems or **wheezing**
- tightness in the chest
- dizziness
- unusual tiredness or weakness
- weight gain

In addition, patients taking anticoagulant drugs should check with their physicians as soon as possible if any of these side effects occur:

- nausea or vomiting
- diarrhea
- stomach pain or cramps

Other side effects may occur. Anyone who has unusual symptoms while taking anticoagulant drugs should get in touch with his or her physician.

Interactions

Anticoagulants may interact with many other medications. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be increased. *Anyone who takes anticoagulants should inform the prescribing physician about other prescription or nonprescription (over-the-counter medicines) he or she is taking—even aspirin, laxatives, vitamins, and antacids.*

Diet also affects the way anticoagulant drugs work in the body. A normal, balanced diet should be followed every day while taking such medication. No dietary changes should be made without informing first the prescribing physician, who should also be told of any illness or other condition interfering with the ability to eat normally. Diet is a very important consideration because the amount of vitamin K in the body affects how anticoagulant drugs work. Dicoumarol and warfarin act by reducing the effects of vitamin K. Vitamin K is found in meats, dairy products, leafy, green vegetables, and some multiple **vitamins** and nutritional supplements. For the drugs to work properly, it is best to have the same amount of vitamin K in the body all the time. Foods containing vitamin K in the diet should not be increased or decreased without consulting with the prescribing physician. If the patient takes vitamin supplements, he should check the label to see if it contains vitamin K. Because vitamin K is also produced by intestinal bacteria, a severe case of diarrhea or the use of **laxatives** may also alter a person's vitamin K levels.

Nancy Ross-Flanigan

Anticonvulsant drugs

Definition

Anticonvulsant drugs are medicines used to prevent or treat convulsions (seizures).

Purpose

Anticonvulsant drugs are used to control seizures in people with epilepsy. Epilepsy is not a single disease—it is a set of symptoms that may have different causes in different people. The common thread is an imbalance in the brain's electrical activity. This imbalance causes seizures that may affect part or all of the body and may or may not cause a loss of consciousness. Anticonvulsant drugs act on the brain to reduce the frequency and severity of seizures.

Some cases of epilepsy are brought on by head injuries, brain tumors or infections, or metabolic problems such as low blood sugar. But in some people with epilepsy, the cause is not clear.

Anticonvulsant drugs are an important part of the treatment program for epilepsy. Different kinds of drugs may be prescribed for different types of seizures. In addition to taking medicine, patients with epilepsy should get enough rest, avoid **stress**, and practice good health habits.

Some physicians believe that giving the drugs to children with epilepsy may prevent the condition from getting worse in later life. However, others say the effects are the same, whether treatment is started early or later in life. Determining when treatment begins depends on the physician and his assessment of the patient's symptoms.

Physicians also prescribe certain anticonvulsant drugs for other conditions, including **bipolar disorder** and migraine headaches.

Description

Anticonvulsant drugs may be divided into several classes. The hydantoins include pheytoin (Dilantin) and mephenytoin (Mesantoin.) Ther succimides include ethosuximide (Zarontin)and methsuccimide (Celontin.) The **benzodiazepines**, which are better known for their use as tranquilizers and sedatives, include clonazepam (Klonopin), clorazepate (Tranxene) and diazepam (Valium.) There are also a large number of other drugs which are not related to larger groups. These include carbamazepine (Tegretol), valproic acid (Depakote, Depakene) gabapentin (Neurontin), topiramate (Topamax), felbamate (Felbatol) and several others. Phenobarbital has been used as an anticonvulsant, and is still useful for some patients. The drugs are available only with a physician's prescription and come in tablet, capsule, liquid, and "sprinkle" forms.

Recommended dosage

The recommended dosage depends on the type of anticonvulsant, its strength, and the type of seizures for which it is being taken. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Do not stop taking this medicine suddenly after taking it for several weeks or more. Gradually tapering the dose may reduce the chance of withdrawal effects.

Do not change brands or dosage forms of this medicine without checking with a pharmacist or physician. If a prescription refill does not look like the original medicine, check with the pharmacist who filled the prescription.

Precautions

Patients on anticonvulsant drugs should see a physician regularly while on therapy, especially during the first few months. The physician will check to make sure the medicine is working as it should and will note unwanted side effects. The physician may also need to adjust the dosage during this period.

Valproic acid can cause serious liver damage, especially in the first 6 months of treatment. Children are particularly at risk, but anyone taking this medicine should see their physician regularly for tests of liver function and should be alert to symptoms of liver damage, such as yellow skin and eyes, facial swelling, loss of appetite, general feeling of illness, loss of appetite, and vomiting. If liver problems are suspected, call a physician immediately.

Felbatol has caused serious liver damage and **aplastic anemia**, a condition in which the bone marrow stops producing blood cells. Patients taking this drug should have regular blood counts, and should stop taking the drug if there are too few red blood cells.

While taking anticonvulsant drugs, do not start or stop taking any other medicines without checking with a physician. The other medicines may affect the way the anticonvulsant medicine works.

Because anticonvulsant drugs work on the central nervous system, they may add to the effects of alcohol and other drugs that slow down the central nervous system, such as **antihistamines**, cold medicine, allergy medicine, sleep aids, other medicine for seizures, tranquilizers, some **pain** relievers, and **muscle relaxants**. Anyone taking anticonvulsant drugs should check with his or her physician before drinking alcohol or taking any medicines that slow the central nervous system.

Anticonvulsant drugs may interact with medicines used during surgery, dental procedures, or emergency treatment. These interactions could increase the chance of side effects. Anyone who is taking anticonvulsant drugs should be sure to tell the health care professional in charge before having any surgical or dental procedures or receiving emergency treatment.

Some people feel drowsy, dizzy, lightheaded, or less alert when using these drugs, especially when they first begin taking them or when their dosage is increased. Anyone who takes anticonvulsant drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Anticonvulsant drugs may affect the results of certain medical tests. Before having medical tests, people who take anticonvulsant drugs should make sure that the medical professional in charge knows what they are taking.

Children may be more likely to have certain side effects from anticonvulsant drugs, such as behavior changes; tender, bleeding, or swollen gums; enlarged facial features; and excessive hair growth. Problems with the gums may be prevented by regularly brushing and flossing, massaging the gums, and having the teeth cleaned every 3 months whether the patient is a child or an adult.

Children who take high doses of this medicine for a long time may have problems in school.

Older people may be more sensitive to the effects of anticonvulsant drugs. This may increase the chance of side effects and overdoses.

Special conditions

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

ALLERGIES. Anyone who has had unusual reactions to anticonvulsant drugs or to tricyclic antidepressants such as imipramine (Tofranil) or desipramine (Norpramin) in the past should let his or her physician know before taking the drugs again. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY. **Birth defects** have been reported in babies born to mothers who took anticonvulsant drugs during **pregnancy**. Women who are pregnant or who may become pregnant should check with their physicians about the safety of using anticonvulsant drugs during pregnancy.

Some anticonvulsant drugs taken during pregnancy may cause bleeding problems in the mother during delivery and in the baby after delivery. This problem can be avoided by giving vitamin K to the mother during delivery and to the baby after birth.

Pregnancy may affect the way the body absorbs anticonvulsant drugs. Women who are prone to seizures may have more seizures during pregnancy, even though they are taking their medicine regularly. If this happens, they should check with their physicians about whether the dose needs to be increased.

BREASTFEEDING. Some anticonvulsant drugs pass into breast milk and may cause unwanted effects in babies whose mothers take the medicine. Women who are breastfeeding should check with their physicians about the benefits and risks of using anticonvulsant drugs.

DIABETES. Anticonvulsant drugs may affect blood sugar levels. Patients with diabetes who notice changes in the results of their urine or blood tests should check with their physicians.

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

- liver disease
- kidney disease
- thyroid disease
- heart or blood vessel disease
- blood disease
- brain disease
- problems with urination
- current or past alcohol abuse
- behavior problems
- diabetes mellitus
- **glaucoma**
- porphyria
- systemic lupus erythematosus
- **fever** higher than 101°F (38.3°C) for more than 24 hours

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

Side effects

The most common side effects are **constipation**, mild nausea or vomiting, and mild **dizziness**, drowsiness, or lightheadedness. These problems usually go away as the body adjusts to the drug and do not require medical treatment. Less common side effects, such as **diarrhea**, sleep problems, aching joints or muscles, increased sensitivity to sunlight, increased sweating, hair loss, enlargement of facial features, excessive hair growth, muscle twitching, and breast enlargement in males also may

occur and do not need medical attention unless they persist or are troublesome.

Other side effects may need medical attention. If any of these side effects occur, check with a physician as soon as possible:

- clumsiness or unsteadiness
- slurred speech or stuttering
- trembling
- unusual excitement, irritability, or nervousness
- uncontrolled eye movements
- blurred or double vision
- mood or mental changes
- confusion
- increase in seizures
- bleeding, tender, or swollen gums
- skin rash or itching
- enlarged glands in neck or armpits
- muscle weakness or pain
- fever

Other side effects are possible. Anyone who has unusual symptoms after taking anticonvulsant drugs should get in touch with his or her physician.

KEY TERMS

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

Epilepsy—A brain disorder with symptoms that include seizures.

Glaucoma—A condition in which pressure in the eye is abnormally high. If not treated, glaucoma may lead to blindness.

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

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

Seizure—A sudden attack, spasm, or convulsion.

Systemic lupus erythematosus (SLE)—A chronic disease with many symptoms, including weakness, fatigue, joint pain, sores on the skin, and problems with the kidneys, spleen, and other organs.

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

Interactions

Some anticonvulsant drugs should not be taken within two to three hours of taking **antacids** or medicine for diarrhea. These medicines may make the anticonvulsant drugs less effective. Ask the pharmacist or physician for more information.

Birth control pills may not work properly when anticonvulsant drugs are being taken. To prevent pregnancy, ask the physician or pharmacist if additional methods of birth control should be used while taking anticonvulsant drugs.

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

- airway opening drugs (**bronchodilators**) such as aminophylline, theophylline (Theo-Dur and other brands), and oxtriphylline (Choledyl and other brands)
- medicines that contain calcium, such as antacids and calcium supplements
- blood thinning drugs
- caffeine
- antibiotics such as clarithromycin (Biaxin), **erythromycins**, and **sulfonamides** (sulfa drugs)
- disulfiram (Antabuse), used to treat alcohol abuse
- fluoxetine (Prozac)
- monoamine oxidase inhibitors (MAO inhibitors) such as phenelzine (Nardil) or tranylcypromine (Parnate), used to treat conditions including depression and **Parkinson's disease**
- tricyclic antidepressants such as imipramine (Tofranil) or desipramine (Norpramin)
- corticosteroids
- acetaminophen (Tylenol)
- aspirin
- female hormones (estrogens)
- male hormones (androgens)
- cimetidine (Tagamet)

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

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

Resources

PERIODICALS

Chadwick, David and Peter C. Rubin. "Case for Early Treatment Is Not Established." *British Medical Journal* 310 (January 21, 1995): 177.

Reynolds, E.H. "Do Anticonvulsant Drugs Alter the Natural Course of Epilepsy? Treatment Should Be Started as Early as Possible." *British Medical Journal* 310 (January 21, 1995): 176.

ORGANIZATIONS

American Epilepsy Society. 638 Prospect Avenue, Hartford, CT 06105. (203) 232-4825.

Epilepsy Foundation of America. 4351 Garden City Drive, #406, Landover, MD 20785. (800) 332-1000.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD 20824. (301) 496-5751.

Nancy Ross-Flanigan

Antidepressant drugs

Definition

Antidepressant drugs are medicines that relieve symptoms of **depressive disorders**.

Purpose

Depressive disorders may be either unipolar (depression alone) or bipolar (depression alternating with periods of extreme excitation). The formal diagnosis requires a cluster of symptoms, lasting at least two weeks. These symptoms include, but are not limited to mood changes, **insomnia** or hypersomnia, and diminished interest in daily activities. The symptoms are not caused by any medical condition, drug side effect, or adverse life event. The condition is severe enough to cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Secondary depression, depression caused by unfavorable life events, is normally self limiting, and may be best treated with cognitive/behavioral therapy rather than drugs.

Description

Antidepressant agents act by increasing the levels of excitatory neurostransmitters. The main types of antidepressant drugs in use today are:

- tricyclic antidepressants, such as amitriptyline (Elavil), imipramine (Tofranil), nortriptyline (Pamelor)
- **selective serotonin reuptake inhibitors** (SSRIs or serotonin boosters), such as fluoxetine (Prozac), paroxetine (Paxil), and sertraline (Zoloft)
- **monoamine oxidase inhibitors** (MAO inhibitors), such as phenelzine (Nardil), and tranylcypromine (Parnate)
- tetracyclic compounds and atypical antidepressants which do not fall into any of the above categories

Selective serotonin reuptake inhibitors maintain levels of the excitatory neurohormone serotonin in the brain. They do not alter levels of norepinephrine. These have become the drugs of choice for a variety of psychiatric disorders, primarily because of their low incidence of severe side effects as compared with other drugs in this therapeutic class. SSRIs show similar actions and side effect profiles, but may vary in duration of action.

Tricyclic compounds, identified by their chemical structure containing three carbon rings, are an older class of antidepressants. Although generally effective, they have a high incidence of anticholinergic effects, notably **dry mouth** and dry eyes, which can cause discomfort. They also cause cardiac arrythmias. Because tricyclics act on both serotonin and norepinephrine, they may have some value in treatment of patients who fail to respond to SSRIs. Drugs in this class are often available at low prices, which may be significant when cost is a major factor in treatment. They have also been found useful in control of some neurologic **pain** syndromes.

Tricyclic antidepressants are similar, but may vary in severity of side effects, most notably the degree of **sedation** and the extent of the anticholinergic effects.

Tetracyclic compounds and atypical antidepressants are chemically distinct from both the major groups and each other. Although maprotilene (no brand name, marketed in generic form only) and mirtazepine (Remeron) are similar in chemical structures, they differ in their balance of activity on serotonine and norepinephrine levels.

Monoamine oxidase inhibitors (phenelzine [Nardil], tranylcypromine [Parnate]) have largely been supplanted

Antidepressant Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Desyrel (trazodone hydrochloride)	Allergic skin reactions, blurred vision, decreased appetite, fluid retention, headache
Effexor (venlafaxine hydrochloride)	Diarrhea, dizziness, gas, headache, insommia, rash, vomiting
Elavil (amitriptyline hydrochloride)	Constipation, idzziness, high blood pressure, fever, nausea, rash, weight gain or loss
Nardil (phenelzine sulfate)	Dry mouth, fatigue, headache, muscle spasms, tremors
Norpramin (desipramine hydrochloride)	Blurred vision, cramps, hallucinations, hair loss, vomiting
Pamelor (nortriptyline hydrochloride)	Diarrhea, fatigue, headache, decreased coordination
Paxil (paroxetine hydrochloride)	Cold symptoms, drowsiness, nervousness, stomach pain
Prozac (fluoxetine hydrochloride)	Bronchitis, drowsiness, fatigue, nausea, tremors
Sinequan (doxepin hydrochloride)	Bruising, constipation, fluid retention, itching, increased heartbeat
Surmontil (trimipramine maleate)	Disorientation, flushing, headache, nausea, vomiting
Tofranil (imipramine hydrochloride)	Bleeding sores, fever, hives, decreased coordination
Travil	Asthma, diarrhea, dizziness, fatigue, seizures
Wellbutrin (bupropion hydrochloride)	Agitation, dry mouth, headache, nausea, rash
Zoloft (sertraline)	Diarrhea, fainting, gas, headache, nervousness

in therapy because of their high risk of severe adverse effects, most notably severe **hypertension**. They act by inhibiting the enzyme monoamine oxidase, which is responsible for the metabolism of the stimulatory neurohormones norepinephrine, epinephrine, dopamine, and serotonin. The MAOIs are normally reserved for patients who are resistant to safer drugs. Two drugs, eldepryl (Carbex, used in treatment of **Parkinson's disease**) and the herb, **St. John's wort**, have some action against monoamine oxidase B, and have shown some value as anti-depressants. They do not share the same risks as the non-selective MAO inhibitors.

All antidepressant agents, regardless of their structure, have a slow onset of action, typically three to five weeks. Although adverse effects may be seen as early as the first dose, significant therapeutic improvement is always delayed. Similarly, the effects of antidepressants will continue for a similar length of time after the drugs have been discontinued.

Recommended dosage

Dose varies with the specific drug and patient. Consult specialized references.

Precautions

Antidepressants have many significant cautions and adverse effects. Although a few are listed here, specific references should be consulted for more complete information.

SSRIs. The most common side effect of SSRIs is excitation and insomnia. Excitation has been reported in over 20% of patients, and insomnia in 33%. Significant weight loss has been frequently reported, but most commonly in patients who are already underweight. SSRIs may cause some sedation, and patients should be cautioned not to perform tasks requiring alertness until they have evaluated the effects of these drugs. SSRIs are **pregnancy** category C drugs. Most SSRIs are excreted in breast milk, and there have been anecdotal reports of somnolence in infants whose mothers were taking SSRIs while breastfeeding.

Tricyclic antidepressants. Amoxepine (not marketed by brand, generic available), although a tricyclic antidepressant rather than a neuroleptic (major tranquilizer), displays some of the more serious effects of the neuroleptics, including tardive dyskinesias (drug induced involuntary movements) and neuroleptic malignant syndrome, a potentially fatal syndrome whose symptoms include high **fever**, altered mental status, irregular pulse or blood pressure, and changes in heart rate. These adverse effects have not been reported with other tricyclic antidepressants.

The most common adverse effects of tricyclic antidepressants are sedation and the anticholinergic effects, such as dry mouth, dry eyes, and difficult urination. Alterations in heartbeat are also common, and may progress to congestive **heart failure**, **stroke**, and sudden **death**.

Tricyclic antidepressants are in pregnancy categories C or D, although there have been no formal studies of the drugs on fetal development. There are no studies of effects on newborns, but some anecdotal reports of malformations have resulted from animal studies. The drugs are excreted in breast milk.

Monoamine oxidase inhibitors. The greatest risk associated with these drugs is a hypertensive crisis which may be fatal and most often occurs when the drugs are taken with interacting foods or drugs. More common adverse reactions may include low blood pressure and slowing of heartbeat. Sedation and gastrointestinal disturbances are also common. MAOIs are in pregnancy category C. Safety in breast feeding has not been established.

KEY TERMS

Cognitive behavioral therapy—A type of psychotherapy in which people learn to recognize and change negative and self-defeating patterns of thinking and behavior.

Depression—A mental condition in which people feel extremely sad and lose interest in life. People with depression may also have sleep problems and loss of appetite and may have trouble concentrating and carrying out everyday activities.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk,

Tetracyclics and atypicals. Because these drugs are individual, there are no group patterns of adverse reactions. Consult specific references.

Interactions

The antidepressants have many drug interactions, some severe. Although a few are listed here, specific references should be consulted for more complete information.

SSRIs should not be administered with MAOIs. Allow a wash-out period of about four weeks before switching from one class of drugs to the other. Allow five weeks if switching from fluoxetine (Prozac) to an MAOI.

MAOIs have many interactions; however the best known are those with foods containing the amino acid tyramine. These include aged cheese, chianti wine, and many others. Patients and providers should review the MAOI diet restrictions before using or prescribing these drugs. Because of the severity of MAOI interactions, all additions to the patient's drug regimen should be reviewed with care.

Tricyclic compounds have many interactions, and specialized references should be consulted. Specifically avoid other drugs with anticholinergic effects. Tricyclics should not be taken with the **antibiotics** grepafloxacin and sprafloxacin, since the combination may cause serious heart arrythmias.

Tricyclic compounds should not be taken with the gastric acid inhibitor cimetidine (Tagamet), since this increases the blood levels of the tricyclic compound. Other acid inhibiting drugs do not share this interaction.

SSRIs interact with a number of other drugs which act on the central nervous system. Use care in combining these drugs with major or minor tranquilizers, or with anti-epileptic agents such as phenytoin (Dilantin) or carbamazepine (Tegretol).

Resources

PERIODICALS

"Treatment of Depression: Drugs Alone Are Not Enough." *HealthFacts* 20 (February 1995): 189.

Samuel Uretsky, PharmD

Antidepressants, tricyclic

Definition

Tricyclic antidepressants are medicines that relieve mental depression.

Purpose

Since their discovery in the 1950s, tricyclic antidepressants have been used to treat mental depression. Like other **antidepressant drugs**, they reduce symptoms such as extreme sadness, hopelessness, and lack of energy. Some tricyclic antidepressants are also used to treat bulimia, **cocaine** withdrawal, **panic disorder**, obsessive-compulsive disorders, certain types of chronic **pain**, and **bed-wetting** in children.

Description

Named for their three-ring chemical structure, tricyclic antidepressants work by correcting chemical imbalances in the brain. But because they also affect other chemicals throughout the body, these drugs may produce many unwanted side effects.

Tricyclic antidepressants are available only with a physician's prescription and are sold in tablet, capsule, liquid, and injectable forms. Some commonly used tricyclic antidepressants are amitriptyline (Elavil), desipramine (Norpramin), imipramine (Tofranil), nortriptyline (Pamelor), and protriptyline (Vivactil). Different drugs in this family have different effects, and physicians can choose the drug that best fits the patient's symptoms. For example, a physician might prescribe Elavil for

a person with depression who has trouble sleeping, because this drug is more likely to make people feel calm and sleepy. Other tricyclic antidepressants might be more appropriate for depressed people with low energy.

Recommended dosage

The recommended dosage depends on many factors, including the patient's age, weight, general health and symptoms. The type of tricyclic antidepressant and its strength also must be considered. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage.

Always take tricyclic antidepressants exactly as directed. Never take larger or more frequent doses, and do not take the drug for longer than directed. Do not stop taking the medicine just because it does not seem to be working. Several weeks may be needed for its effects to be felt. Visit the physician as often as recommended so that the physician can check to see if the drug is working and to note for side effects.

Do not stop taking this medicine suddenly after taking it for several weeks or more. Gradually tapering the dose may be necessary to reduce the chance of withdrawal symptoms.

Taking this medicine with food may prevent upset stomach.

Precautions

The effects of this medicine may continue for three to seven days after patients stop taking it. All precautions should be observed during this period, as well as throughout treatment with tricyclic antidepressants.

Some people feel drowsy, dizzy, or lightheaded, when taking these drugs. The drugs may also cause blurred vision. Anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Because tricyclic antidepressants work on the central nervous system, they may add to the effects of alcohol and other drugs that cause drowsiness, such as **antihistamines**, cold medicine, allergy medicine, sleep aids, medicine for seizures, tranquilizers, some pain relievers, and **muscle relaxants**. Anyone taking tricyclic antidepressants should check with his or her physician before drinking alcohol or taking any drugs that cause drowsiness.

These medicines make some people feel lightheaded, dizzy, or faint when they get up after sitting or lying down. To lessen the problem, get up gradually and hold onto something for support if possible.

Tricyclic antidepressants may interact with medicines used during surgery, dental procedures, or emergency treatment. These interactions could increase the chance of side effects. Anyone who is taking tricyclic antidepressants should be sure to tell the health care professional in charge before having any surgical or dental procedures or receiving emergency treatment.

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

This medicine may increase sensitivity to sunlight. Even brief exposure to sun can cause a severe **sunburn** or a rash. While being treated with this tricyclic antidepressants, avoid being in direct sunlight, especially between 10 A.M. and 3 P.M.; wear a hat and tightly woven clothing that covers the arms and legs; use a sunscreen with a skin protection factor (SPF) of at least 15; protect the lips with a sun block lipstick; and do not use tanning beds, tanning booths, or sunlamps.

Tricyclic antidepressants may cause **dry mouth**. To temporarily relieve the discomfort, chew sugarless gum, suck on sugarless candy or ice chips, or use saliva substitutes, which come in liquid and tablet forms and are available without a prescription.

Children and older people are especially sensitive to the effects of tricyclic antidepressants. This increased sensitivity may increase the chance of side effects.

Special conditions

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

ALLERGIES. Anyone who has had unusual reactions to tricyclic antidepressants or to carbamazepine (Tegretol), maprotiline (Ludiomil), or trazodone (Desyrel) in the past should let his or her physician know before taking tricyclic antidepressants. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY. Problems have been reported in babies whose mothers took tricyclic antidepressants just before delivery. Women who are pregnant or who may become pregnant should check with their physicians about the safety of using tricyclic antidepressants.

BREASTFEEDING. Tricyclic antidepressants pass into breast milk and may cause drowsiness in nursing babies whose mothers take the drugs. Women who are breast-

feeding should check with their physicians before using tricyclic antidepressants.

DIABETES. Tricyclic antidepressants may affect blood sugar levels. Diabetic patients who notice changes in blood or urine test results while taking this medicine should check with their physicians.

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

- current or past alcohol or drug abuse
- bipolar disorder (manic-depressive illness)
- schizophrenia
- seizures (convulsions)
- heart disease
- high blood pressure
- kidney disease
- liver disease
- overactive thyroid
- stomach or intestinal problems
- enlarged prostate
- problems urinating
- **glaucoma**
- **asthma**

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

Side effects

The most common side effects are **dizziness**, drowsiness, dry mouth, unpleasant taste, **headache**, nausea, mild tiredness or weakness, increased appetite or craving for sweets, and weight gain. These problems usually go away as the body adjusts to the drug and do not require medical treatment. Less common side effects, such as **diarrhea**, vomiting, sleep problems, sweating, and **heartburn** also may occur and do not need medical attention unless they do not go away or they interfere with normal activities.

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

- blurred vision
- eye pain
- confusion
- **hallucinations**
- fainting
- loss of balance
- swallowing problems
- difficulty speaking
- mask-like face
- shakiness or trembling
- nervousness or restlessness
- movement problems, such as shuffling walk, stiff arms and legs, or slow movement
- decreased sexual ability
- fast or irregular heartbeat
- constipation
- problems urinating

Some side effects may continue after treatment with tricyclic antidepressants has ended. Check with a physician if these symptoms occur:

- headache
- nausea, vomiting, or diarrhea
- sleep problems, including vivid dreams
- unusual excitement, restlessness, or irritability

Interactions

Life-threatening reactions, such as extrememly high blood pressure, may occur when tricyclic antidepressants are taken with other antidepressants called monoamine oxidase (MAO) inhibitors (such as Nardil and Parnate). *Do not take tricyclic antidepressants within 2 weeks of taking a MAO inhibitor. However, a patient can take an MAO inhibitor immediately after tricyclic antidepressant therapy is stopped by the physician.*

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

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

KEY TERMS

Asthma—A disease in which the air passages of the lungs become inflamed and narrowed.

Bulimia—An eating disorder in which a person binges on food and then induces vomiting, uses laxatives, or goes without food for some time.

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

Delusion—An abnormal mental state characterized by the acceptance of something as true that is actually false or unreal, such as the belief that one is Jesus Christ.

Depression—A mental condition in which a person feels extremely sad and loses interest in life. A person with depression may also have sleep problems and loss of appetite and may have trouble concentrating and carrying out everyday activities.

Glaucoma—A condition in which pressure in the eye is abnormally high. If not treated, glaucoma may lead to blindness.

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

Obsessive-compulsive disorder—An anxiety disorder in which a person cannot prevent himself from dwelling on unwanted thoughts, acting on urges, or performing repetitious rituals, such as washing his hands or checking to make sure he turned off the lights.

Panic disorder—An disorder in which a person has sudden and intense attacks of anxiety in certain situations. Symptoms such as shortness of breath, sweating, dizziness, chest pain, and extreme fear often accompany the attacks.

Prostate—A donut-shaped gland in males below the bladder that contributes to the production of semen.

Schizophrenia—A severe mental disorder in which a person loses touch with reality and may have illogical thoughts, delusions, hallucinations, behavioral problems and other disturbances.

Seizure—A sudden attack, spasm, or convulsion.

Serotonin—A natural chemical found in the brain and other parts of the body, that carries signals between nerve cells.

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

- amphetamines
- blood thinning drugs
- medicine for overactive thyroid
- cimetidine (Tagamet)
- other antidepressant drugs, including MAO inhibitors (such as Nardil and Parnate) and antidepressants that raise serotonin levels (such as Prozac and Zoloft)
- blood pressure medicines such as clonidine (Catapres) and guanethidine monosulfate (Ismelin)
- disulfiram (Antabuse), used to treat alcohol abuse
- major tranquilizers such as thioridazine (Mellaril) and chlorpromazine (Thorazine)
- antianxiety drugs such as chlordiazepoxide (Librium) and alprazolam (Xanax)
- antiseizure medicines such as carbamazaepine (Tegretol) and phenytoin (Dilantin)

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

Nancy Ross-Flanigan

Antidiabetic drugs

Definition

Antidiabetic drugs are medicines that help control blood sugar levels in people with **diabetes mellitus** (sugar diabetes).

Purpose

Diabetes may be divided into type I and type II, formerly termed juvenile onset or insulin-dependent, and

maturity onset or non insulin-dependent. Type I is caused by a deficiency of insulin production, while type II is characterized by insulin resistance.

Treatment of type I diabetes is limited to insulin replacement, while type II diabetes is treatable by a number of therapeutic approaches. Many cases of insulin resistance are asymptomatic due to normal increases in insulin secretion, and others may be controlled by diet and **exercise**. Drug therapy may be directed towards increasing insulin secretion, increasing insulin sensitivity, or increasing insulin penetration of the cells.

Description

Antidiabetic drugs may be subdivided into six groups: insulin, sufonylureas, alpha-glucosidase inhibitors, biguanides, meglitinides, and thiazolidinediones.

Insulin (Humulin, Novolin) is the hormone responsible for glucose utilization. It is effective in both types of diabetes, since, even in insulin resistance, some sensitivity remains and the condition can be treated with larger doses of insulin. Most insulins are now produced by recombinant DNA techniques, and are chemically identical to natural human insulin. Isophane insulin suspension, insulin zinc suspension, and other formulations are intended to extend the duration of action of insulin, and permit glucose control over longer periods of time.

Sulfonylureas (chlorpropamide [Diabinese], tolazamide [Tolinase], glipizide [Glucotrol] and others) act by increasing insulin release from the beta cells of the pancrease. Glimepiride (Amaryl), a member of this class, appears to have a useful secondary action in increasing insulin sensitivity in peripheral cells.

Alpha-glucosidase inhibitors (acarbose [Precose], miglitol [Glyset]) do not enhance insulin secretion. Rather, they inhibit the conversion of disaccharides and complex carbohydrates to glucose. This mechanism does not prevent conversion, but only delays it, reducing the peak blood glucose levels. Alpha-glucosidase inhibitors are useful for either monotherapy or in combination therapy with sulfonylureas or other hypoglycemic agents.

Metformin (Glucophage) is the only available member of the biguanide class. Metformin decreases hepatic glucose production, decreases intestinal absorption of glucose and increases peripheral glucose uptake and utilization. Metformin may be used as monotherapy, or in combination therapy with a sulfonylurea.

There are two members of the meglitinide class: repaglinide (Prandin) and nateglitinide (Starlix). The mechanism of action of the meglitinides is to stimulate insulin production. This activity is both dose dependent and dependent on the presence of glucose, so that the drugs have reduced effectiveness in the presence of low blood glucose levels. The meglitinides may be used alone, or in combination with metformin. The manufacturer warns that nateglitinide should not be used in combination with other drugs which enhance insulin secretion.

Rosiglitazone (Avandia) and pioglitazone (Actos) and the members of the thiazolidinedione class. They act by both reducing glucose production in the liver, and increasing insulin dependent glucose uptake in muscle cells. They do not increase insulin production. These drugs may be used in combination with metoformin or a sulfonylurea.

Recommended dosage

Dosage must be highly individualized for all antidiabetic agents and is based on blood glucose levels which must be taken regularly. Review specific literature.

Precautions

Insulin. The greatest short term risk of insulin is **hypoglycemia**, which may be the result of either a direct overdose or an imbalance between insulin injection and level of exercise and diet. This may also occur in the presence of other conditions which reduce the glucose load, such as illness with vomiting and **diarrhea**. Treatment is with glucose in the form of glucose tablets or liquid, although severe cases may require intravenous therapy. Allergic reactions and skin reactions may also occur. Insulin is classified as category B in **pregnancy**, and is considered the drug of choice for glucose control during pregnancy. Insulin glargine (Lantus), an insulin analog which is suitable for once-daily dosing, is classified as category C, because there have been reported changes in the hearts of newborns in animal studies of this drug. The reports are essentially anecdotal, and no cause and effect relationship has been determined. Insulin is not recommended during breast feeding because either low of high doses of insulin may inhibit milk production. Insulin administered orally is destroyed in the GI tract, and represents no risk to the newborn.

Sulonylureas. All sulfonylurea drugs may cause hypoglycemia. Most patients become resistant to these drugs over time, and may require either dose adjustments or a switch to insulin. The list of adverse reactions is extensive, and includes central nervous system problems and skin reactions, among others. Hematologic reactions, although rare, may be severe and include **aplastic anemia** and **hemolytic anemia**. The administration of oral hypoglycemic drugs has been associated with increased cardiovascular mortality as compared with treatment with diet alone or diet plus insulin. The sulfonylureas are classified as category C during pregnancy, based on ani-

Antidiabetic Drugs

Brand Name(Generic Name)	Possible Common Side Effects Include:
Diabinese (chlorpropamide)	Diarrhea, nausea, loss of appetite
Glucotrol (glipizide)	Dizziness, fatigue, headache, nervousness
*Insulin	Mild allergic reactions, decreased blood pressure, rash, shortness of breath
Micronase (glyburide)	Nausea, heartburn, bloating
orinase (tolbutamide)	Nausea, heartburn, bloating

*Insulin is the generic name for several brands which may be animal-based, human-based, or synthetic.

mal studies, although glyburide has not shown any harm to the fetus and is classified as category B. Because there may be significant alterations in blood glucose levels during pregnancy, it is recommended that patients be switch to insulin. These drugs have not been fully studied during breast feeding, but it is recommended that because their presence in breast milk might cause hypoglycemia in the newborn, breastfeeding be avoided while taking sulfonylureas.

Alpha-glucosidase inhibitors are generally well tolerated, and do not cause hypoglycemia. The most common adverse effects are gastrointestinal problems, including flatulence, diarrhea, and abdominal **pain**. These drugs are classified as category B in pregnancy. Although there is no evidence that the drugs are harmful to the fetus, it is important that rigid blood glucose control be maintained during pregnancy, and pregnant women should be switched to insulin. Alpha-glucosidase inhibitors may be excreted in small amounts in breast milk, and it is recommended that the drugs not be administered to nursing mothers.

Metformin causes gastrointestinal reactions in about a third of patients. A rare, but very serious, reaction to metformin is lactic acidosis, which is fatal in about 50% of cases. Lactic acidosis occurs in patients with multiple medical problems, including renal insufficiency. The risk may be reduced with careful renal monitoring, and careful dose adjustments to metformin. Metformin is category B during pregnancy. There have been no carefully controlled studies of the drug during pregnancy, but there is no evidence of fetal harm from animal studies. It is important that rigid blood glucose control be maintained during pregnancy, and pregnant women should be switched to insulin. Animal studies show that metformin is excreted in milk. It is recommended that metformin not be administered to nursing mothers.

Meglitinides. These drugs are generally well tolerated, with an adverse event profile similar to placebo. The drugs are classified as category C during pregnancy, based on fetal abnormalities in rabbits given about 40 times the normal human dose. It is important that rigid blood glucose control be maintained during pregnancy, and pregnant women should be switched to insulin. It is not known whether the meglitinides are excreted in human milk, but it is recommended that these drugs not be given to nursing mothers.

Thiazolidinediones. These drugs are generally well tolerated, however they are structurally related to an earlier drug, troglitazone, which was associated with liver function problems. It is strongly recommended that all patients treated with pioglitazone or rosiglitazone have regular liver function monitoring. The drugs are classified as pregnancy category C, based on evidence of inhibition of fetal growth in rats given more than four times the normal human dose. It is important that rigid blood glucose control be maintained during pregnancy, and pregnant women should be switched to insulin. It is not known whether the thiazolidinediones are excreted in human milk, however they have been identified in the milk of lactating rats. It is recommended that these drugs not be administered to nursing mothers.

Interactions

The sulfonylureas have a particularly long list of drug interactions, several of which may be severe. Review specific literature for these drugs.

The actions of oral hypoglycemic agents may be strengthened by highly protein bound drugs, including NSAIDs, salicylates, **sulfonamides**, chloramphenicol, coumarins, probenecid, MAOIs, and **beta blockers**.

Review the specific literature of each drugs for possible drug-drug or food-drug interactions.

Resources

PERIODICALS

Hingley, Audrey. "Diabetes Demands a Trial of Treatments." *FDA Consumer* 31 (May-June 1997): 33.

ORGANIZATIONS

American Diabetes Association. ADA National Service Center, 1660 Duke Street, Alexandria, VA 22314. (800)232-3472. <http://www.diabetes.org>.

KEY TERMS

Blood sugar—The concentration of glucose in the blood.

Glucose—A simple sugar that serves as the body's main source of energy.

Hormone—A substance that is produced in one part of the body, then travels through the bloodstream to another part of the body where it has its effect.

Metabolism—All the physical and chemical changes that occur in cells to allow growth and maintain body functions. These include processes that break down substances to yield energy and processes that build up other substances necessary for life.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Salicylates—A group of drugs that includes aspirin and related compounds. Salicylates are used to relieve pain, reduce inflammation, and lower fever.

Seizure—A sudden attack, spasm, or convulsion.

National Diabetes Information Clearinghouse. 1 Information Way, Bethesda, MD 20892-3560. (301)654-3327. ndic @info.niddk.nih.gov.

OTHER

National Institute of Diabetes and Digestive and Kidney Diseases. <http://www.niddk.nih.gov>.

Samuel Uretsky, PharmD

Antidiarrheal drugs

Definition

Antidiarrheal drugs are medicines that relieve **diarrhea**.

Purpose

Antidiarrheal drugs help control diarrhea and some of the symptoms that go along with it. An average, healthy person has anywhere from three bowel movements a day to three a week, depending on that person's diet. Normally the stool (the material that is passed in a bowel movement) has a texture something like clay. With diarrhea, bowel movements may be more frequent, and the texture of the stool is thin and sometimes watery.

Diarrhea is not a disease, but a symptom of some other problem. The symptom may be caused by eating or drinking food or water that is contaminated with bacteria, viruses, or parasites, or by eating something that is difficult to digest. People who have trouble digesting lactose (milk sugar), for example, may get diarrhea if they eat dairy products. Some cases of diarrhea are caused by **stress**, while others are brought on by taking certain medicines.

Description

Antidiarrheal drugs work in several ways. The drug loperamide, found in Imodium A-D, for example, slows the passage of stools through the intestines. This allows more time for water and salts in the stools to be absorbed back into the body. Adsorbents, such as attapulgite (found in Kaopectate) pull diarrhea-causing substances from the digestive tract. However, they may also pull out substances that the body needs, such as enzymes and nutrients. Bismuth subsalicylate, the ingredient in Pepto-Bismol, decreases the secretion of fluid into the intestine and inhibits the activity of bacteria. It not only controls diarrhea, but relieves the cramps that often accompany diarrhea.

These medicines come in liquid, tablet, caplet, and chewable tablet forms and can be bought without a physician's prescription.

Recommended dosage

The dose depends on the type of antidiarrheal drug. Read and follow the directions on the product label. For questions about dosage, check with a physician or pharmacist. Never take larger or more frequent doses, and do not take the drug for longer than directed.

Precautions

Diarrhea usually improves within 24-48 hours. If the problem lasts longer or if it keeps coming back, diarrhea could be a sign of a more serious problem. Anyone who has any of the symptoms listed below should get medical attention as soon as possible:

• diarrhea that lasts more than two days or gets worse

- fever
- blood in the stool
- vomiting
- cramps or tenderness in the abdomen
- Signs of **dehydration**, such as decreased urination, **dizziness** or lightheadedness, **dry mouth**, increased thirst, or wrinkled skin

Do not use antidiarrheal drugs for more than two days unless told to do so by a physician.

Severe, long-lasting diarrhea can lead to dehydration. In such cases, lost fluids and salts, such as calcium, sodium, and potassium, must be replaced.

People older than 60 should not use attapulgite (Kaopectate, Donnagel, Parepectolin), but may use other kinds of antidiarrheal drugs. However, people in this age group may be more likely to have side effects, such as severe **constipation**, from bismuth subsalicylate. Ask the pharmacist for more information.

Bismuth subsalicylate may cause the tongue or the stool to temporarily darken. This is harmless. However, do not confuse this harmless darkening of the stool with the black, tarry stools that are a sign of bleeding in the intestinal tract.

Children with flu or chicken pox should not be given bismuth subsalicylate. It can lead to **Reye's syndrome**, a life-threatening condition that affects the liver and central nervous system. To be safe, never give bismuth subsalicylate to a child under 16 years without consulting a physician. Children may have unpredictable reactions to other antidiarrheal drugs. Loperamide should not be given to children under six years and attapulgite should not be given to children under three years unless directed by a physician.

Anyone who has a history of liver disease or who has been taking **antibiotics** should check with his or her physician before taking the antidiarrheal drug loperamide. A physician should also be consulted before anyone with acute **ulcerative colitis** or anyone who has been advised to avoid constipation uses the drug.

Loperamide should not be used by people whose diarrhea is caused by certain infections, such as salmonella or shigella. To be safe, check with a physician before using this drug.

Anyone who has a medical condition that causes weakness should check with a physician about the best way to treat diarrhea.

Special conditions

Before taking antidiarrheal drugs, be sure to let the physician know about any of these conditions:

ALLERGIES. Anyone who has had unusual reactions to **aspirin** or other drugs containing salicylates should check with a physician before taking bismuth subsalicylate. Anyone who has developed a rash or other unusual reactions after taking loperamide should not take that drug again without checking with a physician. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

PREGNANCY AND BREASTFEEDING. Women who are pregnant or breastfeeding should check with their physicians before using antidiarrheal drugs. They should also ask advice on how to replace lost fluids and salts.

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

- dysentery
- gout
- hemophilia or other bleeding problems
- kidney disease
- stomach ulcer
- severe colitis
- liver disease

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

Side effects

The most common side effects of attapulgite are constipation, bloating, and fullness. Bismuth subsalicylate may cause ringing in the ears, but that side effect is rare. Possible side effects from loperamide include skin rash, constipation, drowsiness, dizziness, tiredness, dry mouth, nausea, vomiting, and swelling, **pain**, and discomfort in the abdomen. Some of these symptoms are the same as those that occur with diarrhea, so it may be difficult to tell if the medicine is causing the problems. Children may be more sensitive than adults to certain side effects of loperamide, such as drowsiness and dizziness.

Other rare side effects may occur with any antidiarrheal medicine. Anyone who has unusual symptoms after taking an antidiarrhea drug should get in touch with his or her physician.

Interactions

Attapulgite can decrease the effectiveness of other medicines taken at the same time. Changing the times at which the other medicines are taken may be necessary.

KEY TERMS

Colitis—Inflammation of the colon (large bowel).

Dehydration—Excessive loss of water from the body.

Enzyme—A type of protein, produced in the body, that brings about or speeds up chemical reactions.

Nutrient—A food substance that provides energy or is necessary for growth and repair. Examples of nutrients are vitamins, minerals, carbohydrates, fats, and proteins.

Check with a physician or pharmacist to work out the proper dose schedule.

Bismuth subsalicylate should not be taken with aspirin or any other medicine that contains salicylate. This drug may also interact with other drugs, such as blood thinners (warfarin, for example), methotrexate, the antigout medicine probenecid, and the antidiabetes drug tolbutamide. In addition, bismuth subsalicylate may interact with any drug that interacts with aspirin. Anyone taking these drugs should check with a physician or pharmacist before taking bismuth subsalicylate.

Nancy Ross-Flanigan

Antidiuretic hormone (ADH) test

Definition

Antidiuretic hormone (ADH) test, also called the Vasopressin test, is a test for the antidiuretic hormone, which is released from the pituitary gland and acts on the kidneys to increase their reabsorption of water into the blood.

Purpose

An ADH test is used to aid in the diagnosis of **diabetes insipidus** or the syndrome of inappropriate ADH called SIADH.

Precautions

Certain drugs can either increase or decrease ADH levels. Drugs that increase ADH levels include **acetaminophen**, **barbiturates**, cholinergic agents, estrogen, nicotine, oral **hypoglycemia** agents, some **diuretics** (e.g., thiazides), cyclophosphamide, narcotics, and tricyclic antidepressants. Drugs that decrease ADH levels include alcohol, beta-adrenergic agents, morphine antagonists, and phenytoin (Dilantin).

Description

The purpose of ADH is to control the amount of water reabsorbed by the kidneys. Water is continually being taken into the body in food and drink, as well as being produced by chemical reactions in cells. Water is also continually lost in urine, sweat, feces, and in the breath as water vapor. ADH release helps maintain the optimum amount of water in the body when there is an increase in the concentration of the blood serum or a decrease in blood volume. Physical **stress**, surgery, and high levels of **anxiety** can also stimulate ADH.

Various factors can affect ADH production, thereby disturbing the body's water balance. For example, alcohol consumption reduces ADH production by direct action on the brain, resulting in a temporarily increased production of urine. This may also occur in diabetes insipidus, when the pituitary gland produces insufficient ADH, or rarely, when the kidneys fail to respond to ADH. The reverse effect of water retention can result from temporarily increased ADH production after a major operation or accident. Water retention may also be caused by the secretion of ADH by some tumors, especially of the lung.

Preparation

The test requires collection of a blood sample. The patient must be **fasting** (nothing to eat or drink) for 12 hours, be adequately hydrated, and limit physical activity for 10-12 hours before the test.

Risks

Risks for this test are minimal, but may include slight bleeding from the blood-drawing site, **fainting** or feeling lightheaded after venipuncture, or hematoma (blood accumulating under the puncture site).

Normal results

ADH normal ranges are laboratory-specific but can range from 1-5 pg/ml or 1.5 ng/L (SI units).

Abnormal results

Patients who are dehydrated, who have a decreased amount of blood in the body (hypovolemia), or who are undergoing severe physical stress (e.g., trauma, **pain** or

KEY TERMS

Diabetes insipidus—A metabolic disorder in which the pituitary gland produces inadequate amounts of antidiuretic hormone (ADH) or the kidneys are unable to respond to release of the hormone. Primary symptoms are excessive urination and constant thirst.

Pituitary gland—The pituitary gland is sometimes referred to as the "master gland." As the most important of the endocrine glands (glands which release hormones directly into the bloodstream), it regulates and controls not only the activities of other endocrine glands but also many body processes.

prolonged mechanical ventilation) may exhibit increased ADH levels. Patients who are overly hydrated or who have an increased amount of blood in the body (hypervolemia) may have decreased ADH levels.

Other conditions that cause increased levels include SIADH, central nervous system tumors or infection, or **pneumonia**.

Resources

BOOKS

Jacobs, David S., et al. *Laboratory Test Handbook.* 4th ed. New York: Lexi-Comp Inc., 1996.

Pagana, Kathleen Deska. *Mosby's Manual of Diagnostic and Laboratory Tests.* St. Louis: Mosby, Inc., 1998.

Janis O. Flores

Antiemetic drugs *see* **Antinausea drugs**

Antiepileptic drugs *see* **Anticonvulsant drugs**

Antifungal drugs, systemic

Definition

Systemic antifungal drugs are medicines taken by mouth or by injection to treat deep infections caused by a fungus.

Purpose

Systemic antifungal drugs are used to treat infections in various parts of the body that are caused by a fungus. A fungus is an organism that can be either one-celled or filamentous. Unlike a plant, which makes its own food, or an animal, which eats plants or other animals, a fungus survives by invading and living off other living things. Fungi thrive in moist, dark places, including some parts of the body.

Fungal infections can either be systemic, meaning that the infection is deep, or topical (dermatophytic), meaning that the infection is superficial and occurs on the skin. Additionally, yeast infections can affect the mucous membranes of the body. Fungal infections on the skin are usually treated with creams or ointments (topical antifungal drugs). However, systemic infections, yeast infections or topical infections that do not clear up after treatment with creams or ointments may need to be treated with systemic antifungal drugs. These drugs are used, for example, to treat common fungal infections such as tinea (**ringworm**), which occurs on the skin or **candidiasis** (a yeast infection, also known as trush), which can occur in the throat, in the vagina, or in other parts of the body. They are also used to treat other deep fungal infections such as **histoplasmosis**, **blastomycosis**, and **aspergillosis**, which can affect the lungs and other organs. They are sometimes used to prevent or treat fungal infections in people whose immune systems are weakened, such as bone marrow or organ transplant patients and people with **AIDS**.

Description

Antifungal drugs are categorized depending on their route or site of action, their mechanism of action and their chemical nature.

Systemic antifungal drugs, such as capsofungin (Cancidas), flucytosine, fluconazole (Diflucan), itraconazole (Sporanox), ketoconazole (Nizoral), and miconazole (Monistat I.V.) are available only by prescription. They are available in tablet, capsule, liquid, and injectable forms.

Recommended dosage

The recommended dosage depends on the type of antifungal drug and the nature and extent of fungal infection being treated. Doses may also be different for different patients. The prescribing physician or the pharmacist can provide dosage information. Systemic antifungal drugs must be taken exactly as directed. Itraconazole and ketoconazole should be taken with food.

Fungal infections can take a long time to clear up, so it may be necessary to take the medication for several months, or even for a year or longer. It is very important to keep taking the medicine for as long as the physician says to take it, even if symptoms seem to improve. If the drug is stopped too soon, the symptoms may return.

Systemic antifungal drugs work best when their amount is kept constant in the body, meaning that they have to be taken regularly, at the same time every day, and without missing any doses.

Patients taking the liquid form of ketoconazole should use a specially marked medicine spoon or other medicine measuring device to make sure they take the correct amount. A regular household teaspoon may not hold the right amount of medicine. Ask the pharmacists about ways to accurately measure the dose of these drugs.

Precautions

If symptoms do not improve within a few weeks, the prescribing physician should be informed.

While taking this medicine, regular medical visits should be scheduled. The physician needs to keep checking for side effects throughout the antifungal therapy.

Some people feel drowsy or dizzy while taking systemic antifungal drugs. Anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

Liver problems, stomach problems and other problems may occur in people who drink alcohol while taking systemic antifungal drugs. Alcohol and prescription or nonprescription (over-the-counter) drugs that contain alcohol should be avoided while taking antifungal drugs. (Medicines that may contain alcohol include some **cough** syrups, tonics, and elixirs.) Alcohol should be avoided for at least a day after taking an antifungal drug.

The antifungal drug ketoconazole may make the eyes unusually sensitive to light. Wearing sunglasses and avoiding exposure to bright light may help.

Special conditions

People with certain medical conditions or who are taking certain other medicines can have problems if they take systemic antifungal drugs. Before taking these drugs, the prescribing physician should be informed about any of the following conditions:

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

PREGNANCY. In laboratory studies of animals, systemic antifungal drugs have caused **birth defects** and other problems in the mother and fetus. Studies have not been done on pregnant women, so it is not known whether these drugs cause similar effects in people. Women who are pregnant or who plan to become pregnant should check with their physicians before taking systemic antifungal drugs. Any woman who becomes pregnant while taking these drugs should let her physician know immediately.

BREASTFEEDING. Systemic antifungal drugs pass into breast milk. Women who are breastfeeding should check with their physicians before using systemic antifungal drugs.

OTHER MEDICAL CONDITIONS. People who have medical conditions that deplete stomach acid (achlorhydria) or decrease stomach acid (hypochlorhydria) should be sure to inform their physicians about their condition before they use a systemic antifungal drug. These drugs are not active in their natural form, but must be converted to the active form by an acid. If these is not enough stomach acid, the drugs will be ineffective. For people with insufficient stomach acid, it may help to take the medicine with an acidic drink, such as a cola. The patient's health care provider can suggest the best way to take the medicine.

Before using systemic antifungal drugs, people with any of these medical problems should also make sure their physicians are aware of their conditions:

- current or past alcohol abuse
- liver disease
- kidney disease

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

Side effects

Fluconazole

Although rare, severe allergic reactions to this medicine have been reported. Call a physician immediately if any of these symptoms develop after taking fluconazole (Diflucan):

- hives, **itching**, or swelling
- breathing or swallowing problems
- sudden drop in blood pressure
- **diarrhea**
- abdominal pain

Ketoconazole

Ketoconazole has caused **anaphylaxis** (a life-threatening allergic reaction) in some people after their first dose. This is a rare reaction.

Antifungal Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Diflucan (fluconazole)	Nausea, diarrhea, headache, vomiting
Femstat (butoconazole nitrate)	Vaginal discharge or burning, soreness, swelling
Gris-PEG, Grisactin, Fulvicin P/G (griseofulvin)	Rash, hives, diarrhea, fatigue, oral thrush
Gyne-Lotrimin, Mycelex-7 (clotrimazole)	Burning sensation, hives, itching/irritated skin, swelling
Loprox (ciclopiroz olamine)	This drug rarely causes side effects
Lotrisone	Blistering, hives, itching/irritated skin, swelling
Monistat (miconazole nitrate)	Burning sensation, headaches, hives, rash, vaginal itching
Mycolog-II	Burning, blistering, rash, itching/peeling of skin
Nizoral (ketoconazole)	Nausea, vomiting
Oxistat (oxiconazole nitrate)	Burning, cracked skin, rash, itching
Spectazole Cream (econazole nitrate)	Burning, itching
Sporanox (itraconazole)	Headache, diarrhea, increased blood pressure, fever

Systemic antifungal drugs in general

Systemic antifungal drugs may cause serious and possibly life-threatening liver damage. Patients who take these drugs should have **liver function tests** before they start taking the medicine and as often as their physician recommends while they are taking it. The physician should be notified immediately if any of these symptoms develop:

- loss of appetite
- nausea or vomiting
- yellow skin or eyes
- unusual **fatigue**
- dark urine
- pale stools

The most common minor side effects of systemic antifungal drugs are **constipation**, diarrhea, nausea, vomiting, **headache**, drowsiness, **dizziness**, and flushing of the face or skin. These problems usually go away as the body adjusts to the drug and do not require medical treatment. Less common side effects, such as menstrual problems in women, breast enlargement in men, and decreased sexual ability in men also may occur and do not need medical attention unless they do not improve in a reasonable amount of time.

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

- fever and chills
- skin rash or itching
- high blood pressure
- pain, redness, or swelling at site of injection (for injectable miconazole)

Other rare side effects are possible. Anyone who has unusual symptoms after taking systemic antifungal drugs should get in touch with his or her physician.

Interactions

Serious and possibly life-threatening side effects can result if the oral forms of itraconazole or ketoconazole or the injectable form of miconazole are taken with certain drugs. Do not take those types of systemic antifungal drugs with any of the following drugs unless the physician approves of the therapy:

- astemizole (Hismanal)
- cisapride (Propulsid)
- antacids
- theophylline-containing anti-wheezing medications

Taking an acid blocker such as cimetidine (Tagamet), famotidine (Pepcid), nizatidine (Axid), omeprazole (Prilosec), or ranitidine (Zantac) at the same time as a systemic antifungal drug may prevent the antifungal drug from working properly. For best results, take the acid blocker at least 2 hours after taking the antifungal drug.

In addition, systemic antifungal drugs may interact with many other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. *Anyone who takes systemic antifungal drugs should inform the prescribing physician about all other prescription and nonprescription (over-the-counter) medicines he or she is taking.* Among the drugs that may interact with systemic antifungal drugs are:

- acetaminophen (Tylenol)
- birth control pills
- male hormones (androgens)
- female hormones (estrogens)

KEY TERMS

Elixir—A sweetened liquid that contains alcohol, water, and medicine.

Fetus—A developing baby inside the womb.

Fungus—A unicellular to filamentous organism that causes parasitic infections.

Ointment—A thick substance that contains medicine and is meant to be spread on the skin, or if an ophthalmic ointment, in the eye.

Systemic—A term used to describe a medicine that has effects throughout the body, as opposed to topical drugs that work on the skin. Most medicines that are taken by mouth or by injection are systemic drugs.

- medicine for other types of infections
- antidepressants
- antihistamines
- muscle relaxants
- medicine for diabetes, such as tolbutamide (Orinase), glyburide (DiaBeta), and glipizide (Glucotrol)
- blood-thinning medicine, such as warfarin (Coumadin)

The list above does not include every drug that may interact with systemic antifungal drugs. Be sure to check with a physician or pharmacist before combining systemic antifungal drugs with any other medicine.

Nancy Ross-Flanigan

Antifungal drugs, topical

Definition

Topical antifungal drugs are medicines applied to the skin to treat skin infections caused by a fungus.

Purpose

Dermatologic fungal infections are usually described by their location on the body: tinea pedis (infection of the foot), tinea unguium (infection of the nails), tinia capitis (infection of the scalp.) Three types of fungus are involved in most skin infections: *Trichophyton, Epidermophyton,* and *Microsporum.* Mild infections are usually susceptible to topical therapy, however severe or resistant infections may require systemic treatment.

Description

There are a large number of drugs currently available in topical form for fungal infections. Other than the imidazoles, (miconazole [Micatin, Miconazole], clotrimazole [Lotrimin], econazole [Spectazole], ketoconazole [Nizoral], oxiconazole [Oxistat], sulconazole [Exelderm]) and the allylamine derivatives (butenafine [Mentax], naftifine [Naftin], terbinafine [Lamisil]), the drugs in this therapeutic class are chemically distinct from each other. All drugs when applied topically have a good margin of safety, and most show a high degree of effectiveness. There are no studies comparing drugs on which to base a recommendation for drugs of choice. Although some of the topical antifungals are available over-the-counter, they may be as effective as prescription drugs for this purpose.

Traditional antifungal drugs such as undecylinic acid (Cruex, Desenex) and gentian violet (also known as crystal violet) remain available, but have a lower cure rate (complete eradication of fungus) than the newer agents and are not recommended. Tolnaftate (Tinactin) has a lower cure rate than the newer drugs, but may be used prophylactically to prevent infection.

Recommended dosage

All drugs are applied topically. Consult individual product information for specific application recommendations.

As with all topical products, selection of the dosage form may be as important as proper drug selection. Consider factors such as presence or absence of hair on the affected area, and type of skin to which the medication is to be applied. Thin liquids may preferable for application to hairy areas, creams for the hands and face, and ointments may be preferable for the trunk and legs. Other dosage forms available include shampoos and sprays. Ciclopirox and triacetin are available in formulations for topical treatment of nail fungus as well as skin infections (ciclopirox as Penlac Nail Lacquer and triacetin as Ony-Clear Nail).

Most topical antifungal drugs require four weeks of treatment. Infections in some areas, particularly the spaces between toes, may take up to six weeks for cure.

Precautions

Most topical antifungal agents are well tolerated. The most common adverse effects are localized irritation caused by the vehicle or its components. This may

KEY TERMS

Cream—A spreadable substance, similar to an ointment, but not as thick. Creams may be more appropriate than ointments for application to exposed skin areas such as the face and hands.

Ointment—A thick, spreadable substance that contains medicine and is meant to be used on the skin, or if a vaginal preparation, in the vagina.

Opthalmic—Pertaining to the eye.

Otic—Pertaining to the ear.

Topical—A term used to describe medicine that has effects only in a specific area, not throughout the body, particularly medicine that is put directly on the skin.

include redness, itch, and a burning sensation. Some direct allergic reactions are possible.

Topical antifungal drugs should only be applied in accordance with labeled uses. They are not intended or ophthalmic (eye) or otic (ear) use. Application to mucous membranes should be limited to appropriate formulations.

The antifungal drugs have not been evaluated for safety in **pregnancy** and **lactation** on topical application under the pregnancy risk category system. Although systemic absorption is probably low, review specific references. Gentian violet is labeled with a warning against use in pregnancy.

Interactions

Topical antifungal drugs have no recognized drug-drug or food-drug interactions.

Samuel Uretsky, PharmD

Antigas agents

Definition

Antigas agents are medicines that relieve the uncomfortable symptoms of too much gas in the stomach and intestines.

Purpose

Excess gas can build up in the stomach and intestines for a number of reasons. Eating high-fiber foods, such as beans, grains, and vegetables is one cause. Some people unconsciously swallow air when they eat, drink, chew gum, or smoke cigarettes, which can lead to uncomfortable amounts of gas in the digestive system. Surgery and certain medical conditions, such as irritable colon, peptic ulcer, and diverticulosis, can also lead to gas build-up. Certain intestinal parasites can contribute to the production of severe gas - these parasites need to be treated separately with special drugs. Abdominal **pain**, pressure, bloating, and flatulence are signs of too much gas. Antigas agents help relieve the symptoms by preventing the formation of gas pockets and breaking up gas that already is trapped in the stomach and intestines.

Description

Antigas agents are sold as capsules, liquids, and tablets (regular and chewable) and can be bought without a physician's prescription. Some commonly used brands are Gas-X, Flatulex, Mylanta Gas Relief, Di-Gel, and Phazyme. The ingredient that helps relieve excess gas is simethicone. Simethicone does not relieve acid **indigestion**, but some products also contain **antacids** for that purpose. Check the label of the product or ask the pharmacist for more information.

Recommended dosage

Check the product container for dosing information. Typically, the doses should be taken after meals and at bedtime. Chewable forms should be chewed thoroughly.

Check with a physician before giving this medicine to children under age 12 years.

Precautions

Some anti-gas medicines may contain sugar, sodium, or other ingredients. Anyone who is on a special diet or is allergic to any foods, dyes, preservatives, or other substances should check with his or her physician or pharmacist before using any of these products.

Anyone who has had unusual reactions to simethicone—the active ingredient in antigas medicines—should check with his or her physician before taking these drugs.

Side effects

No common or serious side effects have been reported in people who use this medicine. However, anyone who has unusual symptoms after taking an antigas agent should get in touch with his or her physician.

KEY TERMS

Digestive tract—The stomach, intestines, and other parts of the body through which food passes.

Diverticulosis—A condition in which the colon (large intestine) develops a number of outpouchings or sacs.

Flatulence—Excess gas in the digestive tract.

Irritable colon—An intestinal disorder often accompanied by abdominal pain and diarrhea.

Interactions

Antigas agents are not known to interact with any other drugs.

Nancy Ross-Flanigan

Antigastroesophageal reflux drugs

Definition

These drugs are used to treat gastroesophageal reflux, the backward flow of stomach contents into the esophagus.

Purpose

The drug discussed here, cisapride (Propulsid), is used to treat nighttime **heartburn** resulting from gastroesophageal reflux disease (GERD). In this condition, food and stomach juices flow backward from the stomach into the esophagus, the part of the digestive tract through which food passes on its way from the mouth to the stomach. Normally, a muscular ring called the lower esophageal sphincter (LES) opens to allow food into the stomach and then closes to prevent the stomach's contents from flowing back into the esophagus. In people with GERD, this muscular ring is either weak or it relaxes at the wrong times. The main symptom is heartburn—a burning sensation centered behind the breastbone and spreading upward toward the neck and throat.

Cisapride works by strengthening the lower esophageal sphincter and making the stomach empty more quickly. This shortens the amount of time that the esophagus comes in contact with the stomach contents. Other drugs, such as H2-blockers are sometimes prescribed to reduce the amount of acid in the stomach.

Description

Cisapride is available only with a physician's prescription. Cisapride is sold in tablet and liquid forms.

Recommended dosage

The dose depends on the patient. The average dose for adults and children age 12 and over is 5-20 mg taken two to four times a day. The medicine should be taken 15 minutes before meals and at bedtime. For children under 12, the dose is based on body weight and should be determined by the child's physician.

Precautions

This medicine is effective in treating only nighttime heartburn, not daytime heartburn.

Cisapride may increase the effects of alcohol and tranquilizers.

Cisapride has caused dangerous irregular heartbeats in a few people who took it with other medicines. Anyone who takes this drug should let the physician know all other medicines he or she is taking. Patients with heart problems should check with their physicians before taking cisapride.

Anyone who has bleeding, blockage, or leakage in the stomach or intestines should not take cisapride. Cisapride should not be used by anyone who has had an unusual reaction to the drug in the past. In addition, people with any of the following medical problems should make sure their physicians are aware of their conditions:

- epilepsy or history of seizures
- kidney disease
- liver disease

The effects of taking cisapride during **pregnancy** have not been fully studied. Women who are pregnant or plan to become pregnant should check with their physicians before taking Cisapride. The drug passes into breast milk and may affect nursing babies. Women who are breastfeeding and need to take this medicine should check with their physicians. Avoiding breastfeeding while taking the drug may be necessary.

Side effects

The most common side effects are abdominal **pain**, bloating, gas, **diarrhea**, **constipation**, nausea, upper respiratory infections, inflammation of the nasal passages

KEY TERMS

Esophagus—The part of the digestive tract between the pharynx and the stomach. (The pharynx is the space just behind the mouth.)

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

and sinuses, **headache**, and viral infections. Other side effects may occur. Anyone who has unusual or troublesome symptoms after taking this drug should get in touch with his or her physician.

Interactions

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

- antifungal drugs such as ketoconazole (Nizoral), miconazole (Monistat), and fluconazole (Diflucan)
- antibiotics such as clarithromycin (Biaxin) and erythromycin (E-Mycin, ERYC)
- blood-thinners such as warfarin (Coumadin)
- H2-blockers such as cimetidine (Tagamet) and ranitidine (Zantac)
- tranquilizers such as chlordiazepoxide (Librium), diazepam (Valium), and alprazolam (Xanax)

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

Resources

ORGANIZATIONS

National Digestive Diseases Information Clearinghouse. 2 Information Way, Bethesda, MD 20892-3570. (800) 891-5389. <http://www.niddk.nih.gov/health/digest/nddic.htm>.

Pediatric/Adolescent Gastroesophageal Reflux Association, Inc. P.O. Box 1153, Germantown, MD 20875-1153. (301) 601-9541. <http://www.reflux.org>.

OTHER

GERD Information Resource Center. <http://www.gerd.com>.

Pharmaceutical Information Network. GERD Information Center. <http://pharminfo.com/disease/gerd/gerd_info.html>.

Nancy Ross-Flanigan

Antihelminthic drugs

Definition

Antihelminthic drugs are used to treat parasitic infestations.

Purpose

Parasitic infestations are caused by protozoa or worms gaining entry into the body. Most of these organisms cause infections by being ingested in the form of eggs or larvae, usually present on contaminated food or clothing, while others gain entry through skin abrasions. Common parasitic infestations include **amebiasis**, **malaria**, **giardiasis**, hookworm, pinworm, threadworm, whipworm and tapeworm infestations. Once in the body, parasitic worms may go unnoticed if they cause no severe symptoms. However, if they multiply rapidly and spread to a major organ, they can cause very serious and even life-threatening conditions. Antihelminthic drugs are prescribed to treat these infestations. They function either by destroying the worms on contact or by paralyzing them, or by altering the permeability of their plasma membranes. The dead worms then pass out of the body in the feces.

Description

Antihelminthic drugs are available only with a prescription and are available as liquids, tablets or capsules. Some commonly used antihelminthics include: albendazole (Albenza), mebendazole (Vermox), niclosamide (Niclocide), oxamniquine (Vansil), praziquantel (Biltricide), pyrantel (Antiminth), pyantel pamoate (Antiminth) and thiabendazole (Mintezol). Some types of parasitic infestations are rarely seen in the United States, thus, the corresponding antihelminthic drugs are not widely distributed and need to be obtained from the United States Center for Disease Control (CDC) when required. These include for example bitional and ivermectin, used to treat onchocerciasis infestations. Other antihelminthic drugs, such as diethylcarbamazepine citrate (Hetrezan), used for treatment of roundworms and other parasites, is supplied directly by its manufacturer when needed.

Most antihelminthic drugs are only active against specific parasites, some are also toxic. Before treatment, the parasites must therefore be identified using tests that look for parasites, eggs or larvae in feces, urine, blood, sputum, or tissues. Thus, niclosamide is used against tapeworms, but will not be effective for the treatment of pinworm or roundworm infestations, because it acts by inhibiting ATP production in tapeworm cells. Thiabendazole (Mintezole) is the drug usually prescribed for treatment of threadworm, but a similar drug, mebendazole (Vermox) works

KEY TERMS

Amebiasis—Parasitic infestation caused by amebas, especially by Entamoeba histolytica.

Colitis—Inflammation of the colon (large intestine).

Feces—The solid waste that is left after digestion. Feces form in the intestines and leave the body through the anus.

Flukes—Parasite worms that look like leeches. They usually have one or more suckers for attaching to the digestive mucosa of the host. Liver flukes infest the liver, destroying liver tissue and impairing bile production and drainage.

Giardiasis—Parasitic infestation caused by a flagellate protozoan of the genus Giardia, especially by G. lamblia.

Hallucination—A false or distorted perception of objective reality. Imaginary objects, sounds, and events are perceived as real.

Hookworm—Parasitic intestinal infestation caused by any of several parasitic nematode worms of the family Ancylostomatidae. These worms have strong buccal hooks that attach to the host's intestinal lining.

Larva—The immature, early form of an organism that at birth or hatching is not like its parent and has to undergo metamorphosis before assuming adult features.

Malaria—Disease caused by the presence of sporozoan parasites of the genus Plasmodium in the red blood cells, transmitted by the bite of anopheline mosquitoes, and characterized by severe and recurring attacks of chills and fever).

Microtubules—Slender, elongated anatomical channels in worms.

Nematode—Roundworm.

Organism—A single, independent life form, such as a bacterium, a plant or an animal.

Parasite—An organism that lives in or with another organism, called the host, in parasitism, a type of association characterized by the parasite obtaining benefits from the host, such as food, and the host being injured as a result.

Parasitic—Of, or relating to a parasite.

Pinworm—Enterobius vermicularis, a nematode worm of the family Oxyuridae that causes parasitic infestation of the intestines and cecum. Pinworm is endemic in both temperate and tropical regions and common especially in school age children.

Onchocerciasis—Parasitic infestation caused by filamentous worms of the genus Onchocerca, especially O. volvulus, that is found in tropical America and is transmitted by several types of blackflies.

Protozoan—Any unicellular or multicellular organism containing nuclei and organelles (eukaryotic) of the subkingdom Protozoa.

Roundworm—Any round-bodied unsegmented worm as distinguished from a flatworm. Also called a nematode, they look similar to the common earthworm.

Tapeworm—Flat and very long (up to 30 meters) intestinal parasitic worms, similar to a long piece of tape. Common tapeworms include: T. saginata (beef tapeworm), T. solium (pork tapeworm) D. latum (fish tapeworm), H. Nana (dwarf tapeworm) and E. granulosus (dog tapeworm). General symptoms are vague abdominal discomfort, nausea, vomiting, diarrhea and weight loss.

Threadworm—Any long, thin nematode worm.

Trematode—Any parasitic flatworm of the class Trematoda, as the liver fluke.

Whipworm—A nematode worm of the family Trichuridae with a body that is thick at one end and very long and slender at the other end.

better on whipworm by disrupting the microtubules of this worm. Praziquantel is another drug that acts by altering the membrane permeability of the worms.

Preparation

Dosage is established depending on the patient's general health status and age, the type of antihelminthic drug used, and the type of parasitic infestation being treated. The number of doses per day, the time between doses, and the length of treatment will also depend on these factors.

Antihelminthic drugs must be taken exactly as directed to completely rid the body of the parasitic infestation, and for as long as directed. A second round of treatment may be required to ensure that the infection has completely cleared.

Precautions

Some antihelminthic drugs work best when ingested along with fatty foods, such as milk or ice cream. Oral drugs should be taken with water during or after meals. The prescribing physician should be informed if the patient has a low-fat or other special diet.

Some antihelminthic drugs, such as praziquantel, come in chewable form. These tablets should not be chewed or kept in the mouth, but should swallowed whole because their bitter taste may cause gagging or vomiting.

Antihelminthic drugs sometimes need to be taken with other medications. For example, steroids such as prednisone are also prescribed together with the antihelminthic drug for tapeworm to reduce the inflammation that the worm may cause.

When required, pre- or post-treatment purges are also performed with magnesium or sodium sulfate.

Regular medical visits are recommended for people affected by parasitic infestations. The physician monitors whether the infection is clearing or not and also keeps track of unwanted side effects. The prescribing physician should be informed if symptoms do not disappear or if they get worse.

Hookworm or whipworm infections are also treated with iron supplements along with the antihelminthic prescription.

Some types of parasitic infestations (e.g. pinworms) can be passed from one person to another. It is then often recommended that everyone in the household of an infected person be asked to also take the prescribed antihelminthic drug.

Risks

People with the following medical conditions may have adverse reactions to antihelminthic drugs. The prescribing physician should accordingly be informed if any of these conditions are present:

- **Allergies**. Anyone who has had adverse reactions to antihelminthic drugs should inform the prescribing physician before taking the drugs again. The physician should also be informed about any other pre-existing allergies.
- Ulcers. Antihelminthic drugs are also contraindicated for persons diagnosed with ulcers of the digestive tract, especially **ulcerative colitis**.
- **Pregnancy**. There is research evidence reporting that some antihelminthic drugs cause **birth defects** or **miscarriage** in animal studies. No human birth defects have been reported, but antihelminthic drugs are usually not recommended for use during pregnancy. Pregnant women should accordingly inform the prescribing physician.
- Breastfeeding. Some antihelminthic drugs can pass into breast milk. Breastfeeding may have to be discontinued until the antihelminthic treatment has ended and breastfeeding mothers must also inform the prescribing physician.
- Other risk conditions. Any of the following medical conditions should also be reported to the prescribing physician: **Crohn's disease**, liver disease, kidney disease and worm cysts in the eyes.

Common side effects of antihelminthic drugs include **dizziness**, drowsiness, **headache**, sweating, dryness of the mouth and eyes, and ringing in the ears. Anyone taking these drugs should accordingly avoid driving, operating machines or other activities that may be dangerous until they know how they are affected by the drugs. Side effects usually wear off as the body adjusts to the drug and do not usually require medical treatment. Thiabendazole may cause the urine to have an unusual odor that can last for a day after the last dose. Other side effects of antihelminthic drugs, such as loss of appetite, **diarrhea**, nausea, vomiting, or abdominal cramps are less common. If they occur, they are usually mild and do not require medical attention.

More serious side effects, such as **fever**, chills, confusion, extreme weakness, **hallucinations**, severe diarrhea, nausea or vomiting, skin **rashes**, **low back pain**, dark urine, blurred vision, seizures, and **jaundice** have been reported in some cases. The patient's physician should be informed immediately if any should develop. As a rule, anyone who has unusual symptoms after starting treatment with antihelminthic drugs should notify the prescribing physician.

Antihelminthic drugs may interact with each other or with other drugs, whether prescribed or not. For example, it has been reported that use of the antihelminthic drugs pyrantel and piperazine together lowers the efficiency of pyrantel. Similarly, combining a given antihelminthic drug with another medication may increase the risk of side effects from either drug.

Nancy Ross-Flanigan

Antihemorrhoid drugs

Definition

Antihemorrhoid drugs are medicines that reduce the swelling and relieve the discomfort of **hemorrhoids** (swellings in the area around the anus).

Purpose

Hemorrhoids are bulges in the veins that supply blood to the skin and membranes of the area around the anus. They may form for various reasons. Frequent heavy lifting, sitting for long periods, or straining to have bowel movements may put **stress** on anal tissues, which can lead to hemorrhoids. Some women develop hemorrhoids during **pregnancy** as the expanding uterus puts pressure on the anal tissues. The strain of labor and delivery can also cause hemorrhoids or make existing hemorrhoids worse. Hemorrhoids sometimes result from certain medical problems, such as tumors pressing on the lower bowel.

The main symptoms of hemorrhoids are bleeding from the rectum, especially after a bowel movement, and **itching**, burning, **pain**, and general discomfort in the anal area. Over-the-counter antihemorrhoid products can relieve many of these symptoms. The products contain combinations of four main types of ingredients:

- local anesthetics, such as benzocaine, lidocaine and tetracaine, to temporarily relieve the pain
- vasoconstrictors, such as epinephrine base, epinephrine hydrochloride, ephedrine sulfate and phenylephrine hydrochloride that reduce swelling and relieve itching and discomfort by tightening blood vessels
- astringents (drying agents), such as witch hazel, calamine, and zinc oxide. These help shrink hemorrhoids by pulling water out of the swollen tissue. This, in turn, helps relieve itching, burning, and irritation.
- protectants, such as cocoa butter, lanolin, glycerin, mineral oil, and shark liver oil which soothe irritated tissues and form a protective barrier to prevent further irritation

Description

Antihemorrhoid drugs are available as creams, ointments and suppositories. Most can be bought without a physician's prescription.

Recommended dosage

Follow package instructions for using these products. Do not use more than the recommended amount of this medicine every day. For explanations or further information about how to use antihemorrhoid drugs, check with a physician or pharmacist.

Precautions

Do not use antihemorrhoid drugs for more than seven days in a row. If the problem gets worse or does not improve, check with a physician.

KEY TERMS

Anus—The opening at the end of the intestine through which solid waste (stool) passes as it leaves the body.

Rectum—The end of the intestine closest to the anus.

Uterus—A hollow organ in a female in which a fetus develops until birth.

If rectal bleeding continues, check with a physician. This could be a sign of a condition that needs medical attention.

Side effects

Side effects are rare, however, if a rash or any other sign of an allergic reaction occurs, stop using the medicine.

Interactions

Some antihemorrhoid drugs should not be used by people who are taking or have recently taken **monoamine oxidase inhibitors** (MAO inhibitors), such as phenelzine (Nardil) or tranylcypromine (Parnate), used to treat conditions including depression and **Parkinson's disease**. Anyone who is not sure if he or she has taken this type of drug should check with a physician or pharmacist before using an antihemorrhoid drug. People who are taking antidepressants or medicine for high blood pressure also should not use certain antihemorrhoid drugs. Check with a pharmacist for a list of drugs that may interact with specific antihemorrhoid drugs.

Nancy Ross-Flanigan

Antihistamines

Definition

Antihistamines are drugs that block the action of histamine (a compound released in allergic inflammatory reactions) at the H_1 receptor sites, responsible for immediate hypersensitivity reactions such as sneezing and **itching**. Members of this class of drugs may also be used for their side effects, including **sedation** and antiemesis (prevention of **nausea and vomiting**).

DANIELE BOVET (1907–1992)

A gifted researcher in therapeutic chemistry, Daniele Bovet was born in Neuchatel, Switzerland, one of four children of a professor of experimental education. Bovet studied zoology and comparative anatomy at the University of Geneva, receiving his doctor of science degree in 1929. He then joined the Pasteur Institute in Paris, becoming director of the Laboratory of Therapeutic Chemistry in 1936.

Bovet investigated histamine, thought to cause allergy symptoms. No antagonist of histamine was known, so Bovet—with his research student Anne-Marie Staub—began studying substances that blocked hormones similar to histamine. By 1937 he had produced the first antihistamine, thymoxydiethylamine. Since this substance was too toxic for human use, Bovet and Staub performed thousands more experiments seeking less toxic antihistamines. This work formed the basis for the development of subsequent clinically useful antihistamines.

KEY TERMS

Allergen—A substance that causes an allergy.

Anaphylaxis—A sudden, life-threatening allergic reaction.

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

Histamine—A chemical released from cells in the immune system as part of an allergic reaction.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Purpose

Antihistamines provide their primary action by blocking histamine H_1 at the receptor site. They have no effect on rate of histamine release, nor do they inactivate histamine. By inhibiting the activity of histamine, they can reduce capillary fragility, which produces the erythema, or redness, associated with allergic reactions. They will also reduce histamine-induced secretions, including excessive tears and salivation. Additional effects vary with the individual drug used. Several of the older drugs, called first-generation antihistamines, bind non-selectively to H_1 receptors in the central nervous system as well as to peripheral receptors, and can produce sedation, inhibition of nausea and vomiting, and reduction of **motion sickness**. The second-generation antihistamines bind only to peripheral H_1 receptors, and reduce allergic response with little or no sedation.

The first-generation antihistamines may be divided into several chemical classes. The side effect profile, which also determines the uses of the drugs, will vary by chemical class. The alkylamines include brompheniramine (Dimetapp) and chlorpheniramine (Chlor-Trimeton.) These agents cause relatively little sedation, and are used primarily for treatment of allergic reactions. Promethazine (Phenergan), in contrast, is a phenothiazine, chemically related to the major tranquilizers, and while it is used for treatment of **allergies**, may also be used as a sedative, the relieve **anxiety** prior to surgery, as an antinauseant, and for control of motion sickness. Diphenhydramine (Benadryl) is chemically an ethanolamine, and in addition to its role in reducing allergic reactions, may be used as a nighttime sedative, for control of drug-induced Parkinsonism, and, in liquid form, for control of coughs. Consult more detailed references for further information.

The second generation antihistamines have no central action, and are used only for treatment of allergic reactions. These are divided into two chemical classes. Cetirizine (Zyrtec) is a piperazine derivative, and has a slight sedative effect. Loratidine (Claritin) and fexofenadine (Allegra) are members of the piperadine class and are essentially non-sedating.

Recommended dosage

Dosage varies with drug, patient and intended use. Consult more detailed references for further information.

When used for control of allergic reactions, antihistamines should be taken on a regular schedule, rather than on an as-needed basis, since they have no effect on histamine itself, nor on histamine already bound to the receptor site.

Efficacy is highly variable from patient to patient. If an antihistamine fails to provide adequate relief, switch to a drug from a different chemical class. Individual drugs may be effective in no more than 40% of patients, and provide 50% relief of allergic symptoms.

Antihistamines

Brand Name (Generic Name)	Possible Common Side Effects Include:
*Atarax (hydroxyzine hydrochloride)	Drowsiness, dry mouth
Benadryl (diphenhydramine hydrochloride)	Dizziness, sleepiness, upset stomach, decreased coordination
Hismanal (astemiozole)	Drowsiness, dry mouth, fatigue, weight gain
PBZ-SR (tripelennamine hydrochloride)	Dizziness, drowsiness, dry mouth and throat, chest congestion, decreased coordination, upset stomach
Periactin (cyproheptadine hydrochloride)	Chest congestion, dizziness, fluttery heartbeat, loss of appetite, hives, sleepiness, vision problems
Phenergan (promethazine hydrochloride)	Changes in blood pressure, dizziness, blurred vision, nausea, rash
Polaramine (dexchlorpheniramine maleate)	Drowiness
Seldane, Seldane-D (terfenadine)	Upset stomach, nausea, drowiness, headache, fatigue
Tavist (clemastine fumarate)	Decreased coordination, dizziness, upset stomach
Trinalin Repetabs (azatadine maleate, pseudoephedrine sulfate)	Abdominal cramps, chest pain, dry mouth, headache

*Also used in the treatment of anxiety

Side effects

The frequency and severity of adverse effects will vary between drugs. Not all adverse reactions will apply to every member of this class.

Central nervous system reactions include drowsiness, sedation, **dizziness**, faintness, disturbed coordination, lassitude, confusion, restlessness, excitation, tremor, seizures, **headache**, **insomnia**, euphoria, blurred vision, **hallucinations**, disorientation, disturbing dreams/nightmares, schizophrenic-like reactions, weakness, vertigo, **hysteria**, nerve **pain**, and convulsions. Overdoses may cause involuntary movements. Other problems have been reported.

Gastrointestinal problems include increased appetite, decreased appetite, nausea, vomiting, **diarrhea**, and **constipation**.

Hematologic reactions are rare, but may be severe. These include anemia, or breakdown of red blood cells; reduced platelets; reduced white cells; and bone marrow failure.

A large number of additional reactions have been reported. Not all apply to every drug, and some reactions may not be drug related. Some of the other adverse effects are chest tightness; **wheezing**; nasal stuffiness; **dry mouth**, nose and throat; **sore throat**; respiratory depression; sneezing; and a burning sensation in the nose.

When taking antihistamines during **pregnancy**, Chlorpheniramine (Chlor-Trimeton), dexchlorpheniramine (Polaramine), diphenhydramine (Benadryl), brompheniramine (Dimetapp), cetirizine (Zyrtec), cyproheptadine (Periactin), clemastine (Tavist), azatadine (Optimine), loratadine (Claritin) are all listed as category B. Azelastine (Astelin), hydroxyzine (Atarax), promethazine (Phenergan) are category C.

Regardless of chemical class of the drug, it is recommended that mothers not breast feed while taking antihistamines.

Contraindications

The following are absolute or relative contraindications to use of antihistamines. The significance of the contraindication will vary with the drug and dose.

- glaucoma
- hyperthyroidism (overactive thyroid)
- high blood pressure
- enlarged prostate
- heart disease
- ulcers or other stomach problems
- stomach or intestinal blockage
- liver disease
- kidney disease
- bladder obstruction
- diabetes

Interactions

Drug interactions will vary with the chemical class of antihistamine. In general, antihistamines will increase the effects of other sedatives, including alcohol.

Monoamine oxidase inhibitor antidepressants (phenelzine [Nardil], tranylcypromine [Parnate]) may prolong and increase the effects of some antihistamines. When used with promethazine (Phenergan) this may cause reduced blood pressure and involuntary movements.

Resources

ORGANIZATIONS

Allergy and Asthma Network. 3554 Chain Bridge Road, Suite 200. (800) 878-4403.

American Academy of Allergy and Immunology. 611 East Wells Street, Milwaukee, WI 53202. (800)822-2762.
Asthma and Allergy Foundation of America. 1125 15th Street NW, Suite 502, Washington, DC 20005. (800)727-8462.

Samuel Uretsky, PharmD

Antihyperlipidemic drugs *see* **Cholesterol-reducing drugs**

Antihypertensive drugs

Definition

Antihypertensive drugs are medicines that help lower blood pressure.

Purpose

The overall class of antihypertensive agents lowers blood pressure, although the mechanisms of action vary greatly. Within this therapeutic class, there are several subgroups. There are a very large number of drugs used to control **hypertension**, and the drugs listed below are representatives, but not the only members of their classes.

The calcium channel blocking agents, also called slow channel blockers or calcium antagonists, inhibit the movement of ionic calcium across the cell membrane. This reduces the force of contraction of muscles of the heart and arteries. Although the **calcium channel blockers** are treated as a group, there are four different chemical classes, leading to significant variations in the activity of individual drugs. Nifedipine (Adalat, Procardia) has the greatest effect on the blood vessels, while verapamil (Calan, Isoptin) and diltiazem (Cardizem) have a greater effect on the heart muscle itself.

Peripheral **vasodilators** such as hydralazine (Apresoline), isoxuprine (Vasodilan), and **minoxidil** (Loniten) act by relaxing blood vessels.

There are several groups of drugs which act by reducing adrenergic nerve stimulation, the excitatory nerve stimulation that causes contraction of the muscles in the arteries, veins, and heart. These drugs include the beta-adrenergic blockers and alpha/beta adrenergic blockers. There are also non-specific adrenergic blocking agents.

Beta-adrenergic blocking agents include propranolol (Inderal), atenolol (Tenormin), and pindolol (Visken). Propranolol acts on the beta-adrenergic receptors anywhere in the body, and has been used as a treatment for emotional **anxiety** and rapid heart beat. Atenolol and acebutolol (Sectral) act specifically on the nerves of the heart and circulation.

There are two alpha/beta adrenergic blockers, labetolol (Normodyne, Trandate) and carvedilol (Coreg). These work similarly to the **beta blockers**.

Angiotensin-converting enzyme inhibitors (ACE inhibitors) act by inhibiting the production of angiotensin II, a substance that both induces constriction of blood vessels and retention of sodium, which leads to water retention and increased blood volume. There are 10 ACE inhibitors currently marketed in the United States, including captopril (Capoten), benazepril (Lotensin), enalapril (Vasotec), and quinapril (Acupril). The primary difference between these drugs is their onset and duration of action.

The ACE II inhibitors, losartan (Cozaar), candesartan (Atacand), irbesartan (Avapro), telmisartan (Micardis), valsartan (Diovan) and eprosartan (Teveten) directly inhibit the effects of ACE II rather than blocking its production. Their actions are similar to the ACE inhibitors, but they appear to have a more favorable side effect and safety profile.

In addition to these drugs, other classes of drugs have been used to lower blood pressure, most notably the thiazide **diuretics**. There are 12 thiazide diuretics marketed in the United States, including hydrochlorothiazide (Hydrodiuril, Esidrex), indapamide (Lozol), polythiazide (Renese), and hydroflumethiazide (Diucardin). The drugs in this class appear to lower blood pressure through several mechanisms. By promoting sodium loss they lower blood volume. At the same time, the pressure of the walls of blood vessels, the peripheral vascular resistance, is lowered. Thiazide diuretics are commonly used as the first choice for reduction of mild hypertension, and may be used in combination with other antihypertensive drugs.

Recommended dosage

Recommended dosage varies with patient, drug, severity of hypertension, and whether the drug is being used alone or in combination with other drugs. Consult specialized references for further information.

Precautions

Because of the large number of classes and individual drugs in this group, consult specialized references for complete information.

Peripheral vasodilators may cause **dizziness** and orthostatic hypotension—a rapid lowering of blood pressure when the patient stands up in the morning. Patients

Antihypertensive Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Accupril (quinapril hydrochloride)	Headache, dizziness
Aldatazide	Diarrhea, fever, headache, decreased coordination
Aldactone (spironolactone)	Cramps, drowsiness, stomach disorders
Aldomet (methyldopa)	Fluid retention, headache, weak feeling
Altace (ramipril)	Headache, cough
Calan, Calan SR (verapamil hydrochloride)	Constipation, fatigue, decreased blood pressure
Capoten (captopril)	Decreased sense of taste, decreased blood pressure tiching, rash
Cardene (nicardipine Hydrochloride)	Dizziness, headache, indigestion and nausea, increased heartbeat
Cardizem (diltiazem hydrochloride)	Dizziness, fluid retention, headache, nausea, skin rash
Cardura (doxazosin mesylate)	Dizziness, fatigue, drowsiness, headache
Catapres	Dry mouth, drowsiness, dizziness, constipation
Corgard (nadolol)	Behaviorial changes, dizziness, decreased heartbeat, tiredness
Corzide	Dizziness, decreased heartbeat, fatigue, cold hands and feet
Diuril (chlorothiazide)	Cramps, constipation or diarrhea, dizziness, fever, increased glocose level in urine
Dyazide	Blurred vision, muscle and abdominal pain, fatigue
DynaCirc (isradipine)	Chest pain, fluid retention, headache, fatigue
HydroDIURIL (hydrochlorothiazide)	Upset stomach, headache, cramps, loss of appetite
Hygroton (chlorthalidone)	Anemia, constipation or diarrhea, cramps, itching
Hytrin (terazosin hydrochloride)	Dizziness, labored breathing, nausea, swelling
Inderal (propranolol hydrochloride)	Constipation or diarrhea, tingling sensation, nausea and vomiting
Inderide	Blurred vision, cramps, fatigue, loss of appetite
Lasix (furosemide)	Back and muscle pain, indigestion, nausea
Lopressor (metoprolol tartrate)	Diarrhea, itching/rash, tiredness
Lotensin (benazepril hydrochloride)	Nausea, dizziness, fatigue, headache
Alozol (indapamide)	Anxiety, headache, loss of energy, muscle cramps
Maxzide	Cramps, labored breathing, drowsiness, irritated stomach
Minipress (prazosin hdrochloride)	Headache, nausea, weakness, dizziness
Moduretic	Diarrhea, fatigue, itching, loss of appetite
Monopril (fosinopril sodium)	Nausea and vomiting, headache, cough
Normodyne (labetalol hydrochloride)	Fatigue, nausea, stuffy nose
Plendil (felodipine)	Pain in back, chest, muscles, joints, and abdomen, itching, dry mouth, respiratory problems
Procardia, Procardia X (nifedipine)	Swelling, constipation, decreased blood pressure, nausea, fatigue
Sectral (acebutolol hydrochloride)	Constipation or diarrhea, gas, chest and joint pain
Ser-Ap-Es	Blurred vision, cramps, muscle pain, dizziness
Tenex (guanfacine hydrochloride)	Headache, constipation, dry mouth, weakness
Tenoretic	Decreased heartbeat, fatigue, nausea
Tenormin (atenolol)	Nausea, fatigue, dizziness
Veseretic	Diarrhea, muscle cramps, rash
Vasotec (enalapril maleate)	Chest pain, blurred vision, constipation or diarrhea, hives, nausea
Visken (pindolol)	Muscle cramps, labored breathing, nausea, fluid retention
Wytensin (guanabenz acetate)	Headache, drowsiness, dizziness
Zaroxolyn (metolazone)	Constipation or diarrhea, chest pain, spasms, nausea
Zestoretic (lisinopril hydrochlorothiazide)	Fatigue, headache, dizziness
Zestril (lisinopril)	Labored breathing, abdominal and chest pain, nausea, decreased blood pressure

taking these drugs must be instructed to rise from bed slowly. **Pregnancy** risk factors for this group are generally category C. Hydralazine has been shown to cause cleft palate in animal studies, but there is no human data available. Breastfeeding is not recommended.

ACE inhibitors are generally well tolerated, but may rarely cause dangerous reactions including laryngospasm and angioedema. Persistent **cough** is a common side effect. ACE inhibitors should not be used in pregnancy. When used in pregnancy during the second and third trimesters, angiotension-converting inhibitors (ACEIs) can cause injury to and even **death** in the developing fetus. When pregnancy is detected, discontinue the ACE inhibitor as soon as possible. Breastfeeding is not recommended.

ACE II inhibitors are generally well tolerated and do not cause cough. Pregnancy risk factor is category C during the first trimester and category D during the second and third trimesters. Drugs that act directly on the renin-angiotensin system can cause fetal and neonatal morbidity and death when administered to pregnant women. Several dozen cases have been reported in patients who were taking ACE inhibitors. When pregnancy is detected, discontinue AIIRAs as soon as possible. Breast feeding is not recommended.

Thiazide diuretics commonly cause potassium depletion. Patients should have potassium supplementation either through diet, or potassium supplements. Pregnancy risk factor is category B (chlorothiazide, chlorthalidone, hydrochlorothiazide, indapamide, metolazone) or catego-

KEY TERMS

Adrenergic—Activated by adrenalin (norepinephrine), loosely applied to the sympathetic nervous system responses.

Angioedema—An allergic skin disease characterized by patches of circumscribed swelling involving the skin and its subcutaneous layers, the mucous membranes, and sometimes the viscera—called also angioneurotic edema, giant urticaria, Quincke's disease, or Quincke's edema.

Arteries—Blood vessels that carry blood away from the heart to the cells, tissues, and organs of the body.

Laryngospasm—Spasmodic closure of the larynx.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Sympathetic nervous system—The part of the autonomic nervous system that is concerned especially with preparing the body to react to situations of stress or emergency; it contains chiefly adrenergic fibers and tends to depress secretion, decrease the tone and contractility of smooth muscle, and increase heart rate.

ry C (bendroflumethiazide, benzthiazide, hydroflumethiazide, methyclothiazide, trichlormethiazide). Routine use during normal pregnancy is inappropriate. Thiazides are found in breast milk. Breastfeeding is not recommended.

Beta blockers may cause a large number of adverse reactions including dangerous heart rate abnormalities. Pregnancy risk factor is category B (acebutolol, pindolol, sotalol) or category C (atenolol, labetalol, esmolol, metoprolol, nadolol, timolol, propranolol, penbutolol, carteolol, bisoprolol). Breastfeeding is not recommended.

Interactions

Consult specific drug references.

Samuel Uretsky, PharmD

Anti-hyperuricemic drugs

Definition

Anti-hyperuricemic drugs are used to treat hyperuricemia, the state of having too much uric acid in the blood.

Purpose

Anti-hyperuricemic drugs decrease the levels of uric acid in the blood, either by increasing the rate at which uric acid is excreted in the urine, or by preventing the formation of excess uric acid.

Precautions

Before taking any medication, patients should notify their physician of all other medications that they are currently taking. Patients should also notify their physician of any health problems they are currently experiencing. Patients must notify physicians if they have kidney problems, since this might affect the type of drug administered. Patients must also notify their physician if they are allergic to any of the medications used to treat acute or long-term **gout**. Since all of these factors contribute to the disease, patients suffering from gout should attempt to lose weight, avoid excess alcohol consumption, and avoid foods high in purines, such as asparagus, sardines, lobster, avocado, and peas.

Description

Gout and hyperuricemia

Persons with high levels of uric acid (hyperuricemia) may experience gout. Commonly gout occurs in males in their 40s and 50s. Gout is defined by the attacks of (arthritic) painful, reddened joints, and is often accompanied by hard lumps in the painful joints. The most common joint affected is the big toe. **Kidney stones**, and/or poor kidney function may also be associated with hyperuricemia, but may not be considered gout if the patient does not have painful joints. In persons with gout (and associated symptoms), uric acid forms crystals, which then cause the aforementioned symptoms. Although uric acid levels must be high in order for patients to have crystals form, and therefore have gout, most persons with high uric acid levels don't ever have symptoms. Thus, recent criteria for use of anti-hyperuricemic agents suggest that patients who have never experienced symptoms of gout should not receive drug therapy, unless their hyperuricemia is associated with **cancer** (may lead to kidney damage) or certain rare

genetic disorders (McGill, Rheumatologist, University of Sydney, Australia, 2000).

Acute gout attacks

When patients experience acute attacks of gout, drugs that lower the levels of uric acid can cause an acute gout attack or cause an attack to become more severe. Thus, drugs that lower uric acid levels and are used to treat gout in the long term are not used in the short term. Medications used in acute gout attacks include non-steroidal anti-inflammatory drugs (such as indomethacin), colchicine, and **corticosteroids**. Colchicine causes side effects in a large number of individuals (usually diarhhea). The most important factor in the effective treatment of gout may not be the drug used, but how quickly it is administered after an acute attack has begun.

Long-term treatment

Long-term treatment of gout or hyperuricemia usually involves one of four drugs: allopurinol, probenicid, sulphinpyrazone, or benzbromarone (as of this printing in 2001, benzbromarone is not available for use in the United States). While allopurinol decreases the amount of uric acid that is produced (and may help prevent acute attacks of gout), the other drugs all increase the rate at which uric acid is excreted in the urine. As previously mentioned, lowering the concentration of uric acid can cause gout attacks. Thus, patients taking these medications should have the dose slowly increased (and uric acid levels slowly lowered) to prevent acute attacks of gout. Patients may also be treated with colchicine or non-steroidal anti-inflammatory drugs to prevent acute attacks of gout (corticosteroids are not used in this scenario because over the long term corticosteroids have deleterious side effects).

Michael V Zuck, PhD

Anti-insomnia drugs

Definition

Anti-insomnia drugs are medicines that help people fall asleep or stay asleep.

Purpose

Physicians prescribe anti-insomnia drugs for short-term treatment of insomnia—a sleep problem in which people have trouble falling asleep or staying asleep or wake up too early and can't go back to sleep. These drugs should be used only for occasional treatment of temporary sleep problems and should not be taken for more than a week or two at a time. People whose sleep problems last longer than this should see a physician. Their sleep problems could be a sign of another medical problem.

Description

The anti-insomnia drug described here, zolpidem (Ambien), is a classified as a central nervous system (CNS) depressant. CNS depressants are medicines that slow the nervous system. Physicians also prescribe medicines in the benzodiazepine family, such as flurazepam (Dalmane), quazepam (Doral), triazolam (Halcion), estazolam (ProSom), and temazepam (Restoril), for **insomnia**. Benzodiazepine drugs are described in the essay on **antianxiety drugs**. Zaleplon (Sonata) is another anti-insomnia drug that is not related to other drugs with the same effect. The **barbiturates**, such as pentobarbital (Nembutal) and secobarbital (Seconal) are no longer commonly used to treat insomnia because they are too dangerous if they are taken in overdoses. For patients with mild insomnia, some **antihistamines**, such as diphenhydramine (Benadryl) or hydroxyzine (Atarax) may be used, since these also cause sleepiness.

Zolpidem is available only with a physician's prescription and comes in tablet form.

Recommended dosage

The recommended dose for adults is 5-10 mg just before bedtime. The medicine works quickly, often within 20 minutes, so it should be taken right before going to bed.

For older people and others who may be more sensitive to the drug's effects, the recommended starting dosage is 5 mg just before bedtime.

Never take more than 10 mg of zolpidem in one 24-hour period. Overdoses can lead to excessive sleepiness or coma.

Zolpidem may be taken with food or on an empty stomach, but it may work faster when taken on an empty stomach. Check with a physician or pharmacists for instructions on how to take the medicine.

Precautions

Zolpidem is meant only for short-term treatment of insomnia. If sleep problems last more than seven to 10 days, check with a physician. Longer-lasting sleep problems could be a sign of another medical problem. Also, this drug may lose its effectiveness when taken every night for more than a few weeks.

Anti-Insomnia Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Ambien (zolpidem tartrate)	Daytime drowsiness, dizziness, headache
Dalmane (flurazepam hydrochloride)	Decreased coordination, lightheadedness, dizziness
Doral (quazepam)	Daytime drowsiness, headache, dry mouth, fatigue
Halcion (triazolam)	Decreased coordination, chest pain, memory impairment
ProSom (estazolam)	Dizziness, headache, nausea, weakness
Restoril (temazepam)	Dizziness, fatigue, nausea, headache, sluggishness

Some people feel drowsy, dizzy, confused, lightheaded, or less alert the morning after they have taken zolpidem. The medicine may also cause clumsiness, unsteadiness, double vision, or other vision problems the next day. For these reasons, anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how zolpidem affects them.

This medicine has caused cause behavior changes in some people, similar to those seen in people whose behavior changes when they drink alcohol. Examples include giddiness and rage. More extreme changes, such as confusion, agitation, and **hallucinations**, also are possible. Anyone who starts having strange or unusual thoughts or behavior while taking this medicine should get in touch with his or her physician.

Zolpidem and other sleep medicines may cause a special type of temporary memory loss, in which the person does not remember what happens between the time they take the medicine and the time its effects wear off. This is usually not a problem, because people go to sleep right after taking the medicine and stay asleep until its effects wear off. But it could be a problem for anyone who has to wake up before getting a full night's sleep (seven to eight hours). In particular, travelers should not take this medicine on airplane flights of less than seven to eight hours.

Because zolpidem works work on the central nervous system, it may add to the effects of alcohol and other drugs that slow down the central nervous system, such as antihistamines, cold medicine, allergy medicine, medicine for seizures, tranquilizers, some **pain** relievers, and **muscle relaxants**. Zolpidem may also add to the effects of anesthetics, including those used for dental procedures. The combined effects of zolpidem and alcohol or other CNS depressants (drugs that slow the central nervous system) can be very dangerous, leading to unconsciousness or even **death**. People who take zolpidem should not drink alcohol and should check with their physicians before taking any other CNS depressant. Anyone who shows signs of an overdose or of the effects of combining zolpidem drugs with alcohol or other drugs should have immediate emergency help. Warning signs include severe drowsiness, severe nausea or vomiting, breathing problems, and staggering.

Anyone who takes zolpidem for more than one to two weeks should not stop taking it without first checking with a physician. Stopping the drug abruptly may cause rebound insomnia; increased difficulty falling asleep for the first one of two nights after the drug has been discontinued. In rare cases, withdrawal symptoms, such as vomiting, cramps, and unpleasant feelings may occur. Gradual tapering may be necessary.

Older people may be more sensitive to the effects of zolpidem. This may increase the chance of side effects, such as confusion, and may also increase the risk of falling.

In people with breathing problems, zolpidem may worsen the symptoms.

Special conditions

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

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

PREGNANCY. Women who are pregnant or who may become pregnant should check with their physicians about the safety of using zolpidem during **pregnancy**.

BREASTFEEDING. Women who are breastfeeding should check with their physicians before using zolpidem.

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

- chronic lung diseases (**emphysema**, **asthma**, or chronic bronchitis)

- liver disease
- kidney disease
- current or past alcohol or drug abuse
- depression
- sleep apnea

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

Side effects

The most common minor side effects are daytime drowsiness or a "drugged" feeling, vision problems, memory problems, nightmares or unusual dreams, vomiting, nausea, abdominal or stomach pain, **diarrhea**, **dry mouth**, **headache**, and general feeling of discomfort or illness. These problems usually go away as the body adjusts to the drug and do not require medical treatment.

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

- confusion
- depression
- clumsiness or unsteadiness

Patients who take zolpidem may notice side effects for several weeks after they stop taking the drug. They should check with their physicians if these or other troublesome symptoms occur:

- agitation, nervousness, feelings of panic
- uncontrolled crying
- worsening of mental or emotional problems
- seizures
- tremors
- lightheadedness
- sweating
- flushing
- nausea or abdominal or stomach cramps
- muscle cramps
- unusual tiredness or weakness

Other rare side effects may occur. Anyone who has unusual symptoms after taking zolpidem should get in touch with his or her physician.

Interactions

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

- other central nervous system (CNS) depressants such as medicine for allergies, colds, hay **fever**, and asthma; sedatives; tranquilizers; prescription pain medicine; muscle relaxants; medicine for seizures; barbiturates; and anesthetics.
- the major tranquilizer chlorpromazine (Thorazine).
- tricyclic antidepressants such as imipramine (Tofranil) and amitriptyline (Elavil)

Nancy Ross-Flanigan

KEY TERMS

Asthma—A disease in which the air passages of the lungs become inflamed and narrowed.

Bronchitis—Inflammation of the air passages of the lungs.

Emphysema—A lung disease in which breathing becomes difficult.

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

Sleep apnea—A condition in which a person temporarily stops breathing during sleep.

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

Anti-itch drugs

Definition

Anti-itch drugs are medicines taken by mouth or by injection to relieve **itching**.

Purpose

The medicine described here, hydroxyzine, is a type of antihistamine used to relieve itching caused by allergic

reactions. An allergic reaction occurs when the body is unusually sensitive to some substance, such as pollen, dust, mold, or certain foods or medicine. The body reacts by releasing a chemical called histamine that causes itching and other symptoms, such as sneezing and watery eyes. **Antihistamines** reduce the symptoms by blocking the effects of histamine.

Hydroxyzine is also prescribed for **anxiety** and to help people relax before or after having general anesthesia.

KEY TERMS

Anesthesia—Treatment with medicine that causes a loss of feeling, especially pain. Local anesthesia numbs only part of the body; general anesthesia causes loss of consciousness.

Antihistamine—Medicine that prevents or relieves allergy symptoms.

Description

Anti-itch drugs, also called antipruritic drugs, are available only with a physician's prescription and come in tablet and injectable forms. Some commonly used brands of the anti-itch drug hydroxyzine are Atarax and Vistaril.

Recommended dosage

When prescribed for itching, the usual dosage for adults is 25 mg, three to four times a day. For children over six years of age, the usual dosage 50-100 mg per day, divided into several small doses. The usual dosage for children under six years of age is 50 mg per day, divided into several small doses.

The dosage may be different for different people. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage, and take the medicine exactly as directed.

Precautions

This medicine should not be used for more than four months at a time because its effects can wear off. See a physician regularly while taking the medicine to determine whether it is still needed.

Hydroxyzine may add to the effects of alcohol and other drugs that slow down the central nervous system, such as other antihistamines, cold medicine, allergy medicine, sleep aids, medicine for seizures, tranquilizers, some **pain** relievers, and **muscle relaxants**. Anyone taking hydroxyzine should not drink alcohol and should check with his or her physician before taking any of the above.

Some people feel drowsy or less alert when using this medicine. Anyone who takes it should not drive, use machines, or do anything else that might be dangerous until they have found out how the drugs affect them.

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

A woman who is pregnant or who may become pregnant should check with her physician before taking this medicine. In studies of laboratory animals, hydroxyzine has caused **birth defects** when taken during **pregnancy**. Although the drug's effects on pregnant women have not been fully studied, physicians advise against taking it in early pregnancy.

BREASTFEEDING. Women who are breastfeeding should also check with their physicians before using hydroxyzine. The medicine may pass into breast milk and may cause problems in nursing babies whose mothers take it.

Side effects

The most common side effect, drowsiness, usually goes away as the body adjusts to the drug. If it does not, reducing the dosage may be necessary. Other side effects, such as **dry mouth**, also may occur and do not need medical attention unless they continue.

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

- twitches or **tremors**
- convulsions (seizures)

Interactions

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

- barbiturates such as phenobarbital and secobarbital (Seconal)
- opioid (narcotic) pain medicines such as meperidine (Demerol) and oxycodone (Percocet)

• non-narcotic pain medicines such as **acetaminophen** (Tylenol) and ibuprofen (Motrin, Advil)

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

Nancy Ross-Flanigan

Antimalarial drugs

Definition

Antimalarial drugs are medicines that prevent or treat **malaria**.

Purpose

Antimalarial drugs treat or prevent malaria, a disease that occurs in tropical, subtropical, and some temperate regions of the world. The disease is caused by a parasite, *Plasmodium*, which belongs to a group of one-celled organisms known as protozoa. The only way to get malaria is to be bitten by a certain type of mosquito that has bitten someone who has the disease.Thanks to mosquito control programs, malaria has been eliminated in the United States, almost all of Europe, and large parts of Central and South America. However, mosquito control has not worked well in other parts of the world, and malaria continues to be a major health problem in parts of Africa, Southeast Asia, Latin America, Haiti, the Dominican Republic, and some Pacific Islands. Every year, some 30,000 Americans and Europeans who travel to these areas get malaria. People planning to travel to the tropics are often advised to take antimalarial drugs before, during, and after their trips, to help them avoid getting the disease and bringing it home with them. These drugs kill *Plasmodium* or prevent its growth.

In recent years, some strains of *Plasmodium* have become resistant to antimalarial drugs, and medical researchers have stepped up efforts to develop a malaria vaccine. In early1997, researchers reported encouraging results from a small study of one vaccine and planned to test the vaccine in Africa.

Description

Antimalarial drugs are available only with a physician's prescription. They come in tablet, capsule, and injectable forms. Among the commonly used antimalarial drugs are chloroquine (Aralen), mefloquine (Lariam), primaquine, pyrimethamine (Daraprim), and quinine.

Recommended dosage

Recommended dosage depends on the type of antimalarial drug, its strength, and the form in which it is being used (such as tablet or injection). The dosage may also be different for different people. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage. Always take this medicine exactly as directed, and keep taking it for the full time of treatment. If the drug is being taken to treat malaria, do not stop taking it just because symptoms begin to improve. Symptoms may return if the drug is stopped too soon. Never take larger or more frequent doses than the physician has ordered, and do not take the drug for longer than directed.

Travelers taking this medicine to prevent malaria may be told to take it for one to two weeks before their trip and for 4 weeks afterward, as well as for the whole time they are away. It is important to follow these directions.

Antimalarial drugs work best when they are taken on a regular schedule. When taken once a week to prevent malaria, they should be taken on the same day every week. When taken daily or several times a day to treat malaria, they should be taken at the same time every day. Doses should not be missed or skipped.

Some antimalarial drugs should be taken with meals or with milk to prevent upset stomach. Others must be taken with a full glass of water. Be sure to follow directions for the best way to take the drug that is prescribed.

Precautions

Antimalarial drugs may cause lightheadedness, **dizziness**, blurred vision and other vision changes. Anyone who takes these drugs should not drive, use machines or do anything else thatmight be dangerous until they have found out how the drugs affect them.

The antimalarial drug mefloquine (Lariam) has received attention because of reports that it causes panic attacks, **hallucinations**, **anxiety**, depression, **paranoia**, and other mental and mood changes, sometimes lasting for months after the last dose. A study published in 1996 in the *British Medical Journal* noted that about one in 140 travelers who take the drug may have mental or mood changes severe enough to interfere with normal activities. This compares to about one in 1,100 patients who have such reactions to the antimalarial drug chloroquine. Anyone who has unexplained anxiety, depression, restlessness, confusion, or other troubling mental or mood changes after taking mefloquine should call a physician

right away. Switching to a different antimalarial drug may be an alternative and can allow the side effects to stop.

Anyone taking antimalarial drugs to prevent malaria who develops a **fever** or flu-like symptoms while taking the medicine or within two to three months after traveling to an area where malaria is common should call a physician immediately.

If the medicine is being taken to treat malaria, and symptoms stay the same or get worse, check with the physician who prescribed the medicine.

Patients who take this medicine over a long time need to have a physician check them periodically for unwanted side effects.

Babies and children are especially sensitive to the antimalarial drug chloroquine. Not only are they more likely to have side effects from the medicine, but they are also at greater risk of being harmed by an overdose. A single 300-mg tablet could kill a small child. *Keep this medicine out of the reach of children. Use safety vials.*

Special conditions

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

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

PREGNANCY. In laboratory animal studies, some antimalarial drugs cause **birth defects**. But it is also risky for a pregnant woman to get malaria. Untreated malaria can cause premature birth, **stillbirth**, and **miscarriage**. When given in low doses to prevent malaria, antimalarial drugs have not been reported to cause birth defects in humans. If possible, pregnant women should avoid traveling to areas where they could get malaria. If travel is necessary, women who are pregnant or who may become pregnant should check with their physicians about the use of antimalarial drugs.

BREASTFEEDING. Some antimalarial drugs pass into breast milk. Although no problems have been reported in nursing babies whose mothers took antimalarial drugs, babies and young children are particularly sensitive to some of these drugs. Women who are breastfeeding should check with their physicians before using antimalarial drugs.

OTHER MEDICAL CONDITIONS. Before using antimalarial drugs, people who have any of these medical problems (or have had them in the past) should make sure their physicians are aware of their conditions:

- blood disease
- liver disease
- nerve or brain disease or disorder, including seizures (convulsions)
- past or current mental disorder
- stomach or intestinal disease
- deficiency of the enzyme glucose-6-phosphate dehydrogenase (G6PD), which is important in the breakdown of sugar in the body
- deficiency of the enzyme nicotinamide adenine dinucleotide (NADH) methemoglobin reductase
- psoriasis
- heart disease
- family or personal history of the genetic condition favism (a hereditary allergic condition)
- family or personal history of **hemolytic anemia**, a condition in which red blood cells are destroyed
- purpura
- hypoglycemia (low blood sugar)
- blackwater fever (a serious complication of one type of malaria)
- myasthenia gravis (a disease of the nerves and muscles)

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

Side effects

High doses of the antimalarial drug pyrimethamine may cause blood problems that caninterfere with healing and increase the risk of infection. People taking this drug should be careful not to injure their gums when brushing or flossing their teeth or using toothpicks. If possible, dental work should be postponed until treatment is complete and the blood has returned to normal.

The most common side effects of antimalarial drugs are **diarrhea**, nausea or vomiting, stomach cramps or **pain**, loss of appetite, **headache**, **itching**, difficulty concentrating, dizziness, lightheadedness, and sleep problems. These problems usually go away as the body adjusts to the drug and do not require medical treatment. Less common side effects, such as hair loss or loss of color in the hair; skin rash; or blue-black discoloration of the skin, fingernails, or inside of the mouth also may

occur and do not need medical attention unless they are long-lasting.

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

- blurred vision or any other vision changes
- convulsions (seizures)
- mood or mental changes
- hallucinations
- anxiety
- confusion
- weakness or unusual tiredness
- unusual bruising or bleeding
- hearing loss or ringing or buzzing in the ears
- fever, with or without **sore throat**
- slow heartbeat
- pain in the back or legs
- dark urine
- pale skin
- taste changes
- soreness, swelling, or burning sensation in the tongue

Other rare side effects may occur. Anyone who has unusual symptoms after taking anantimalarial drug should get in touch with his or her physician.

Interactions

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

- beta blockers such as atenolol (Tenormin), propranolol (Inderal), and metoprolol (Lopressor)
- calcium channel blockers such as diltiazem (Cardizem), nicardipene (Cardene), and nifedipine (Procardia)
- other antimalarial drugs
- quinidine, used to treat abnormal heart rhythms
- antiseizure medicines such as vaproic acid derivatives (Depakote or Depakene)
- oral typhoid vaccine
- diabetes medicines taken by mouth
- sulfonamides (sulfa drugs)
- vitamin K

KEY TERMS

Glucose—A simple sugar that serves as the body's main source of energy.

Hypoglycemia—Abnormally low levels of glucose in the blood.

Organism—An individual of some type of life form, such as a plant or an animal.

Parasite—An organism that lives and feeds in or on another organism (the host) and does nothing to benefit the host.

Protozoa—Animal-like, one-celled organisms, some of which cause diseases in people.

Psoriasis—A skin disease in which people have itchy, scaly, red patches on the skin.

Purpura—A spotty or patchy purplish rash caused by bleeding under the surface of the skin.

- anticancer drugs
- medicine for overactive thyroid
- antiviral drugs such as zidovudine (Retrovir)

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

Resources

PERIODICALS

Schmidt, Elizabeth B. "The Road to Illville." *Harvard Health Letter* 19 (Nov. 1993): 6.

OTHER

"Should You Take Lariam?" Travel Health Information Page. <http://travelhealth.com/lariam.htm>.

Nancy Ross-Flanigan

Antimicrobial agents *see* **Antibiotics**

Antimigraine drugs

Definition

Antimigraine drugs are medicines used to prevent or reduce the severity of migraine headaches.

Purpose

Migraine headaches usually cause a throbbing **pain** on one side of the head. Nausea, vomiting, **dizziness**, increased sensitivity to light and sound, and other symptoms may accompany the pain. The attacks may last for several hours or for a day or more and may come as often as several times a week. Some people who get migraine headaches have warning signals before the headaches begin, such as restlessness, tingling in an arm or leg, or seeing patterns of flashing lights. This set of signals is called an aura. The antimigraine drugs discussed in this section are meant to be taken as soon as the pain begins, to relieve the pain and other symptoms. Other types of drugs, such as antiseizure medicines, antidepressants, **calcium channel blockers** and **beta blockers**, are sometimes prescribed to prevent attacks in people with very severe or frequent migraines.

Description

Migraine is thought to be caused by electrical and chemical imbalances in certain parts of the brain. These imbalances affect the blood vessels in the brain—first tightening them up, then widening them. As the blood vessels widen, they stimulate the release of chemicals that increase sensitivity to pain and cause inflammation and swelling. Antimigraine drugs are believed to work by correcting the imbalances and by tightening the blood vessels.

Examples of drugs in this group are ergotamine (Cafergot), naratriptan (Amerge), sumatriptan (Imitrex), rizatriptan (Maxalt) and zolmitriptan (Zomig). Methysergide maleate (Sansert) may be used by patients whose headaches are not controlled by other drugs, while some patients do well on other drugs. For example, combinations or ergotamine and **caffeine** may be very effective. The caffeine acts by constricting blood vessels to relieve the **headache**. Sometimes, an analgesic such as **acetaminophen**, caffeine, and a barbiturate which acts as a sedative, are combined, as in Fioricet and similar compounds. These medicines are available only with a physician's prescription and come in several forms. Ergotamine is available as tablets and rectal suppositories; sumatriptan as tablets, injections, and nasal spray; and zolmitriptan as tablets.

Antimigraine drugs are used to treat headaches once they have started. These drugs should not be taken to prevent headaches.

Recommended dosage

Recommended dosage depends on the type of drug. Typical recommended dosages for adults are given below for each type of drug.

Ergotamine

Take at the first sign of a migraine attack. Patients who get warning signals (aura) may take the drug as soon as they know a headache is coming.

TABLETS. No more than six tablets for any single attack.

No more than 10 tablets per week.

SUPPOSITORIES. No more than two suppositories for any single attack.

No more than five suppositories per week.

Naratriptan

Take as soon as pain or other migraine symptoms begin. Also effective if taken any time during an attack. Do not take the drug until the pain actually starts as not all auras result in a migraine.

TABLETS. Usual dose is one 1-mg tablet taken with water or other liquid.

Doses of 2.5-mg may be used, but they may cause more side effects.

If the headache returns or if there is only partial response, the dose may be repeated once after four hours, for a maximum dose of 5 mg in a 24-hour period. Larger doses do not seem to offer any benefit.

Sumatriptan

Take as soon as pain or other migraine symptoms begin. Also effective if taken any time during an attack. Do not take the drug until the pain actually starts as not all auras result in a migraine.

TABLETS. Usual dose is one 25-mg tablet, taken with water or other liquid.

Doses should be spaced at least two hours apart.

Anyone with liver disease should consult with a physician for proper dosing.

INJECTIONS. No more than 6 mg per dose, injected under the skin.

No more than two 6-mg injections per day. These doses should be taken at least 1 hour apart.

Zolmitriptan

Take as soon as symptoms begin.

TABLETS. Usual dose is 1-5 mg. Additional doses may be taken at two-hour intervals.

No more than 10 mg per 24-hour period.

Antimigraine Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Cafergot	Nausea, increased blood pressure, fluid retention, numbness, increased heart rate, tingling sensation
Imitrex (sumatriptan succinate)	Burning, flushing, neck pain, inflammation at injection site, sore throat, tingling sensation
Inderal (propranolol hydrochloride)	Constipation or diarrhea, headache, nausea, rash
Midrin	Dizziness, rash

General dosage advice

Always take antimigraine drugs exactly as directed. Never take larger or more frequent doses, and do not take the drug for longer than directed.

If possible, lie down and relax in a dark, quiet room for a few hours after taking the medicine.

Precautions

These drugs should be used only to treat the type of headache for which they were prescribed. Patients should not use them for other headaches, such as those caused by **stress** or too much alcohol, unless directed to do so by a physician.

Anyone whose headache is unlike any previous headache should check with a physician before taking these drugs. If the headache is far worse than any other, emergency medical treatment should be sought immediately.

Taking too much of the antimigraine drug ergotamine (Cafergot), can lead to ergot **poisoning**. Symptoms include headache, muscle pain, numbness, coldness, and unusually pale fingers and toes. If not treated, the condition can lead to **gangrene** (tissue **death**).

Sumatriptan (Imitrex), naratriptan (Amerge), rizatriptan (Maxalt) and zolmitriptan (Zomig) may interact with ergotamine. These drugs should not be taken within 24 hours of taking any drug containing ergotamine.

Some antimigraine drugs work by tightening blood vessels in the brain. Because these drugs also affect blood vessels in other parts of the body, people with coronary heart disease, circulatory problems, or high blood pressure should not take these medicines unless directed to do so by their physicians.

Special conditions

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

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

PREGNANCY. Women who are pregnant should not take ergotamine (Cafergot). The effects of other antimigraine drugs during **pregnancy** have not been well studied. Any woman who is pregnant or plans to become pregnant should let her physician know before an antimigraine drug is prescribed.

BREASTFEEDING. Some antimigraine drugs can pass into breast milk and may cause serious problems in nursing babies. Women who are breastfeeding should check with their physicians about whether to stop breastfeeding while taking the medicine.

OTHER MEDICAL CONDITIONS. Before using antimigraine drugs, people with any of these medical problems should make sure their physicians know about their conditions:

- coronary heart disease
- angina (crushing chest pain)
- circulatory problems or blood vessel disease
- high blood pressure
- liver problems
- kidney problems
- any infection
- eye problems

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

Side effects

The most common side effects are fluid retention, flushing; high blood pressure; unusually fast or slow heart rate; numbness; tingling; **itching**; nausea; vomiting; weakness; neck or jaw pain and stiffness; feelings of tightness, heaviness, warmth, or coldness; **sore throat**; and discomfort of the mouth and tongue.

More serious side effects are not common, but they may occur. If any of the following side effects occur, call a physician immediately:

- tightness in the chest
- bluish tinge to the skin
- cold arms and legs
- signs of gangrene, such as coldness, dryness, and a shriveled or black appearance of a body part
- dizziness
- drowsiness
- shortness of breath or **wheezing**
- skin rash
- swelling of the eyelids or face

Other side effects may occur with any antimigraine drug. Anyone who has unusual symptoms after taking this medicine should get in touch with his or her physician.

Interactions

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

- beta blockers such as atenolol (Tenormin) and propranolol (Inderal)
- drugs that tighten blood vessels such as epinephrine (EpiPen) and pseudoephedrine (Sudafed)
- nicotine such as cigarettes or Nicoderm, Habitrol, and other **smoking-cessation drugs**
- certain **antibiotics**, such as erythromycin and clarithromycin (Biaxin)
- monoamine oxidase inhibitors such as phenelzine (Nardil) and tranylcypromine (Parnate)
- certain antidepressants, such as sertraline (Zoloft), fluoxetine (Prozac), and paroxetine (Paxil)
- fluvoxamine (Luvox), prescribed for obsessive compulsive disorder or chronic pain

Remember naratriptan, sumatriptan, rizatriptan and zolmitriptan may interact with ergotamine. These drugs should not be taken within 24 hours of taking any drug containing ergotamine.

Resources

BOOKS

Duckro, Paul N., William D. Richardson, and Janet E. Marshall. *Taking Control of Your Headaches: How to Get the Treatment You Need*. New York, NY: The Guilford Press, 1995.

ORGANIZATIONS

American Council for Headache Education (ACHE). 19 Mantua Road, Mt. Royal, NJ 08061. (800) 255-2243. <http://www.achenet.org>.

National Headache Foundation. 428 W. St. James Place, Chicago, IL 60614. (800) 843-2256. <http://www.headaches.org>.

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

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KEY TERMS

Aura—A set of warning symptoms, such as seeing flashing lights, that some people have 10-30 minutes before a migraine attack.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Antimyocardial antibody test

Definition

Testing for antimyocardial antibodies is done when evaluating a person for heart damage or heart disease.

Purpose

Antimyocardial antibodies are autoantibodies. Normal antibodies are special proteins built by the body as a defense against foreign material entering the body. Autoantibodies are also proteins built by the body, but instead of attacking foreign material, they inappropriately attack the body's own cells. Antimyocardial antibodies attack a person's heart muscle, or myocardium.

This test may be done on a person who recently had trauma to the heart, such as heart surgery or a myocardial infarction (**heart attack**). It also may be done on someone with heart disease, such as cardiomyopathy or **rheumatic fever**.

Although the presence of antimyocardial antibodies does not diagnose heart damage or disease, there is a connection between the presence of these antibodies and damage to the heart. The amount of damage, however, cannot be predicted by the amount of antibodies.

These antibodies usually appear after heart surgery or the beginning of disease, but they may be present before surgery or the onset of disease. In 30% of people with myocardial infarction and 70% of people having heart surgery, antimyocardial antibodies will appear within two to three weeks and stay for three to eight weeks.

Description

A 5-10 mL sample of venous blood is drawn from the patient's arm in the region of the inner elbow. Antimyocardial antibodies are detected by combining a patient's serum (clear, thin, sticky fluid in blood) with cells from animal heart tissue, usually that of a monkey. Antimyocardial antibodies in the serum bind to the heart tissue cells. A fluorescent dye is then added to the mixture. This dye will attach to any antibodies and heart tissue cells bound together. The final mixture is studied under a microscope that is designed to show fluorescence. If fluorescent cells are seen under the microscope, the test is positive.

When the test is positive, the next step is to find out how much antibody is present. The patient's serum is diluted, or titered, and the test is done again. The serum is then further diluted and the test repeated until the serum is so dilute that fluorescence is no longer seen. The last dilution that showed fluorescence is the titer reported.

Preparation

No **fasting** or special prepartion is needed. Before the test is done it should be explained to the patient.

Aftercare

Discomfort or bruising may occur at the puncture site after the blood is drawn or the person may feel dizzy or faint. Pressure to the puncture site until the bleeding stops reduces bruising. Warm packs on the puncture site relieve discomfort.

Normal results

Antimyocardial antibodies are not normally seen in healthy individuals.

Abnormal results

A positive result means that antimyocardial antibodies are present and that heart disease or damage is likely. Further testing may be needed as other autoantibodies could also be present, causing a false abnormal test.

Resources

BOOKS

Clinical Diagnosis and Management by Laboratory Methods. 19th ed. Ed. John B. Henry. Philadelphia: W. B. Saunders Co., 1996.

A Manual of Laboratory and Diagnostic Tests. 5th ed. Ed. Francis Fishback. Philadelphia: Lippincott, 1996.

Mayo Medical Laboratories. *Interpretive Handbook.* Rochester, MN: Mayo Medical Laboratories, 1997.

Pagana, Kathleen Deska. *Mosby's Manual of Diagnostic and Laboratory Tests.* St. Louis: Mosby, Inc., 1998.

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KEY TERMS

Antibody—A special protein built by the body as a defense against foreign material entering the body.

Antimyocardial antibody—An autoantibody that attacks a person's own heart muscle, or myocardium.

Autoantibody—An antibody that attacks the body's own cells or tissues.

Myocardial infarction—A block in the blood supply to the heart, resulting in what is commonly called a heart attack.

Myocardium—The muscular middle layer of the heart.

Titer—A dilution of a substance with an exact known amount of fluid. For example, one part of serum diluted with four parts of saline is a titer of 1:4.

Antinausea drugs

Definition

Antinausea drugs are medicines that control nausea—a feeling of sickness or queasiness in the stomach with an urge to vomit. These drugs also prevent or stop vomiting. Drugs that control vomiting are called antiemetic drugs.

Purpose

The drug described here, prochlorperazine (Compazine), controls both **nausea and vomiting**. Prochlorperazine is also sometimes prescribed for symptoms of mental disorders, such as **schizophrenia**.

Description

Prochlorperazine is available only with a physician's prescription. It is sold in syrup, capsule, tablet, injection, and suppository forms.

Antinausea Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Compazine (phochlorperazine)	Involuntary muscle spasms, dizziness, jitteriness, puckering of the mouth
Phenergan (promethazine hydrochloride)	Dizziness, dry mouth, nausea and vomiting, rash
Reglan (metoclopramide hydrochloride)	Fatigue, drowsiness, restlessness
Tigan (trimethobenzamide hydrochloride)	Blurred vision, diarrhea, cramps, headache
Zofan (ondansetron hydrochloride)	Constipation, headache, fatigue, abdominal pain

Recommended dosage

To control nausea and vomiting in adults, the usual dose is:

- tablets: one 5-mg or 10-mg tablet three to four times a day
- extended-release capsules: one 15-mg capsule first thing in the morning or one 10-mg capsule every 12 hours
- suppository: 25 mg, twice a day
- syrup: 5-10 mg three to four times a day
- injection: 5-10 mg injected into a muscle three to four times a day

Doses for children must be determined by a physician.

Precautions

Prochlorperazine may cause a movement disorder called **tardive dyskinesia**. Signs of this disorder are involuntary twitches and muscle spasms in the face and body and jutting or rolling movements of the tongue. The condition may be permanent. Older people, especially women, are particularly at risk of developing this problem when they take prochlorperazine.

Some people feel drowsy, dizzy, lightheaded, or less alert when using this medicine. The drug may also cause blurred vision, and movement problems. For these reasons, anyone who takes this drug should not drive, use machines or do anything else that might be dangerous until they have found out how the drug affects them.

Prochlorperazine makes some people sweat less, which can allow the body to overheat. The drug may also make the skin and eyes more sensitive to the sun. People who are taking prochlorperazine should try to avoid extreme heat and exposure to the sun. When going outdoors, they should wear protective clothing, a hat, a sunscreen with a skin protection factor (SPF) of at least 15, and sunglasses that block ultraviolet (UV) light. Saunas, sunlamps, tanning booths, tanning beds, hot baths, and hot tubs should be avoided while taking this medicine. Anyone who must be exposed to extreme heat while taking the drug should check with his or her physician.

This medicine adds to the effects of alcohol and other drugs that slow down the central nervous system, such as **antihistamines**, cold and flu medicines, tranquilizers, sleep aids, anesthetics, some **pain** medicines, and **muscle relaxants**. Do not drink alcohol while taking prochlorperazine, and check with the physician who prescribed the drug before combining it with any other medicines.

Do not stop taking this medicine without checking with the physician who prescribed it. Stopping the drug suddenly can **dizziness**, nausea, vomiting, **tremors**, and other side effects. When stopping the medicine, it may be necessary to taper down the dose gradually.

Prochlorperazine may cause false **pregnancy** tests.

Women who are pregnant (or planning to become pregnant) or breast feeding should check with their physicians before using this medicine.

Before using prochlorperazine, people with any of these medical problems should make sure their physicians are aware of their conditions:

- previous sensitivity or allergic reaction to prochlorperazine
- heart disease
- glaucoma
- brain tumor
- intestinal blockage
- abnormal blood conditions, such as leukemia
- exposure to pesticides.

Side effects

Many side effects are possible with this drug, including, but not limited to, **constipation**, dizziness, drowsiness, decreased sweating, **dry mouth**, stuffy nose, movement problems, changes in menstrual period, increased sensitivity to sun, and swelling or pain in breasts. Anyone who has unusual or troublesome symptoms after taking prochlorperazine should get in touch with his or her physician.

KEY TERMS

Anesthetic—Medicine that causes a loss of feeling, especially pain. Some anesthetics also cause a loss of consciousness.

Antihistamine—Medicine that prevents or relieves allergy symptoms.

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

Spasm—Sudden, involuntary tensing of a muscle or a group of muscles.

Tranquilizer—Medicine that has a calming effect and is used to treat anxiety and mental tension.

Interactions

Prochlorperazine may interact with other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Among the drugs that may interact with prochlorperazine are antiseizure drugs such as phenytoin (Dilantin) and carbamazepine (Tegretol), anticoagulants such as warfarin (Coumadin), and drugs that slow the central nervous system such as alprazolam (Xanax), diazepam (Valium), and secobarbital (Seconal). Not every drug that interacts with prochlorperazine is listed here. Be sure to check with a physician or pharmacist before taking any other prescription or nonprescription (over-the-counter) drug with Prochlorperazine.

Nancy Ross-Flanigan

Antinuclear antibody test

Definition

The antinuclear antibody (ANA) test is a test done early in the evaluation of a person for autoimmune or rheumatic disease, particularly **systemic lupus erythematosus** (SLE).

Purpose

In autoimmune diseases, the body makes antibodies that work against its own cells or tissues. Rheumatic diseases (diseases that affect connective tissue, including the joints, bone, and muscle) are also associated with these antibodies. Autoantibodies are proteins built by the body, but instead of guarding against foreign material (including bacteria, viruses, and fungi) as normal antibodies do, they attack the body's own cells.

Autoimmune and rheumatic diseases can be difficult to diagnose. People with the same disease can have very different symptoms. A helpful strategy in the diagnosis of these diseases is to find and identify an autoantibody in the person's blood.

The antinuclear antibody test looks for a group of autoantibodies that attack substances found in the center (nucleus) of all cells. It is useful as a screen for many autoantibodies associated with diseases that affect the entire body (systemic diseases).

This test is particularly useful when diagnosing a person with symptoms of SLE, an illness that affects many body organs and tissues. If the test is negative, it is unlikely that the person has SLE; if the test is positive, more tests are done to confirm whether the person has SLE or another related disease. Other diseases, such as **scleroderma**, **Sjögren's syndrome**, **Raynaud's disease**, **rheumatoid arthritis**, and autoimmune hepatitis, often have a positive test for antinuclear antibodies.

Description

Five to 10 mL of blood is needed for this test. The antinuclear antibody test is done by adding a person's serum to commercial cells mounted on a microscope slide. If antinuclear antibodies are in the serum, they bind to the nuclei of cells on the slide. Next, a second antibody is added to the mixture. This antibody is "tagged" with a fluorescent dye so that it can be seen. The second antibody attaches to any antibodies and cells bound together and, because of the fluorescent "tag," the areas with antinuclear antibodies seem to glow, or fluoresce, when the slide is viewed under an ultraviolet microscope.

If fluorescent cells are seen, the test is positive. When positive, the serum is diluted, or titered, and the test done again. These steps are repeated until the serum is so dilute it no longer gives a positive result. The last dilution that shows fluorescence is the titer reported.

The pattern of fluorescence within the cells gives the physician clues as to what the disease might be. The test result includes the titer and the pattern.

This test is also called the fluorescent antinuclear antibody test or FANA. Results are available within one to three days.

Preparation

No special preparations or diet changes are required before a person undergoes an antinuclear antibody test.

KEY TERMS

Antibody—A special protein built by the immune system as a defense against foreign material entering the body.

Autoantibody—An antibody that attacks the body's own cells or tissues.

Antinuclear antibodies—Autoantibodies that attack substances found in the center, or nucleus, of all cells.

Autoimmune disease—Disease in which the body makes antibodies against its own cells or tissues.

Titer—A dilution of a substance with an exact known amount of fluid. For example, one part of serum diluted with four parts of saline is a titer of 1:4.

Aftercare

Discomfort or bruising may occur at the puncture site or the person may feel dizzy or faint. Pressure to the puncture site until the bleeding stops reduces bruising. Warm packs relieve discomfort.

Normal results

Normal results will be negative, showing no antinuclear antibodies.

Abnormal results

A positive test in a person with symptoms of an autoimmune or rheumatic disease helps the physician make a diagnosis. More than 95% of people with SLE have a positive ANA test. Scleroderma has a 60-71% positive rate; Sjögren's disease, 50-60%, and rheumatoid arthritis, 25-30%.

Several factors must be considered when interpreting a positive test. Diseases other than autoimmune diseases can cause autoantibodies. Some healthy people have a positive test. More testing is done after a positive test to identify individual autoantibodies associated with the various diseases.

Resources

BOOKS

Clinical Diagnosis and Management by Laboratory Methods. 19th ed. Ed. John B. Henry. Philadelphia: W. B. Saunders Co., 1996.

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Antiparkinson drugs

Definition

Antiparkinson drugs are medicines that relieve the symptoms of **Parkinson's disease** and other forms of parkinsonism.

Purpose

Antiparkinson drugs are used to treat symptoms of parkinsonism, a group of disorders that share four main symptoms: tremor or trembling in the hands, arms, legs, jaw, and face; stiffness or rigidity of the arms, legs, and trunk; slowness of movement (bradykinesia); and poor balance and coordination. Parkinson's disease is the most common form of parkinsonism and is seen more frequently with advancing age. Other forms of the disorder may result from viral infections, environmental toxins, **carbon monoxide poisoning**, and the effects of treatment with **antipsychotic drugs**.

The immediate cause of Parkinson's disease or Parkinsonian-like syndrome is the lack of the neurotransmitter dopamine in the brain. Drug therapy may take several forms, including replacement of dopamine, inhibition of dopamine metabolism to increase the effects of the dopamine already present, or sensitization of dopamine receptors. Drugs may be used singly or in combination.

Description

Levodopa (Larodopa) is the mainstay of Parkinson's treatment. The drug crosses the blood-brain barrier, and is converted to dopamine. The drug may be administered alone, or in combination with carbidopa (Lodosyn) which

Antiparkinson Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Artane (trihexyphenidyl hydrochloride)	Dry mouth, nervousness, blurred vision, nausea
Benadryl (diephenhydramine hydrochloride)	Dizziness, sleepiness, upset stomach, decreased coordination
Cogentin (benztropine mesylate)	Constipation, dry mouth, nausea and vomiting, rash
Eldepryl (selegiline hydrochloride)	Abdominal and back pain, drowsiness, decreased coordination
Parlodel (bromocriptine mesylate)	Constipation, decreased blood pressure, abdominal cramps
Sinemet CR	Involuntary body movements, confusion, nausea, hallucinations

inhibits the enzyme responsible for the destruction of levodopa. The limitation of levodopa or levodopa-carbidopa therapy is that after approximately two years of treatment, the drugs cease to work reliably. This has been termed the "on-off phenomenon." Additional treatment strategies have been developed to retard the progression of Parkinsonism, or to find alternative approaches to treatment.

Anticholinergic drugs reduce some of the symptoms of Parkinsonism, and reduce the reuptake of dopamine, thereby sustaining the activity of the natural neurohormone. They may be effective in all stages of the disease. All drugs with anticholinergic properties, the naturally occurring belladonna alkaloids (atropine, scopolamine, hyoscyamine), some **antihistamines** with anticholinergic properties, and synthetics such as benztropin (Cogentin), procyclidine (Kemadrin) and biperiden (Akineton) are members of this group. Although the anticholinergic drugs have only limited activity against Parkinson's disease, they are useful in the early stages, and may be adjuncts to levodopa as the disease progresses.

Amantadine (Symmetrel), was developed for prevention of **influenza** virus infection, but has anti-Parkinsonian properties. Its mechanism of action is not known.

Bromocriptine (Parlodel) is a prolactin inhibitor, which is used for a variety of indications including amenorrhea/galactorrhea, female **infertility**, and acromegaly. It appears to work by direct stimulation of the dopamine receptors. Bromocriptine is used as a late adjunct to levodopa therapy, and may permit reduction in levodopa dosage. Pergolide (Permax) is similar to bromocriptine, but has not been studied as extensively in Parkinson's disease.

Entacapone (Comtan) appears to act by maintaining levels of dopamine through enzyme inhibition. It is used as an adjunct to levodopa was the patient is beginning to experience the on-off effect. Tolcapone (Tasmar) is a similar agent, but has demonstrated the potential for inducing severe liver failure. As such, tolcapone is reserved for cases where all other adjunctive therapies have failed or are contraindicated.

Selegeline (Carbex, Eldepryl) is a selective monoamine oxidase B (MAO-B) inhibitor, however its mechanism of action in Parkinsonism is unclear, since other drugs with MAO-B inhibition have failed to show similar anti-Parkinsonian effects. Selegeline is used primarily as an adjunct to levodopa, although some studies have indicated that the drug may be useful in the early stages of Parkinsonism, and may delay the progression of the disease.

Pramipexole (Mirapex) and ropinirole (Requip) are believed to act by direct stimulation of the dopamine receptors in the brain. They may be used alone in early Parkison's disease, or as adjuncts to levodopa in advanced stages.

Recommended dosage

Dosages of anti-Parkinsonian medications must be highly individualized. All doses must be carefully titrated. Consult specific references.

Precautions

There are a large number of drugs and drug classes used to treat Parkinson's disease, and individual references should be consulted.

The anticholinergics have a large number of adverse effects, all related to their primary mode of activity. Their cardiovascular effects include tachycardia, **palpitations**, **hypotension**, postural hypotension, and mild bradycardia. They may also cause a wide range of central nervous system effects, including disorientation, confusion, memory loss, **hallucinations**, psychoses, agitation, nervousness, **delusions**, **delirium**, **paranoia**, euphoria, excitement, lightheadedness, **dizziness**, **headache**, listlessness, depression, drowsiness, weakness, and giddiness. **Dry mouth**, dry eyes and gastrointestinal distress are common problems. **Sedation** has been reported with some drugs in this group, but this may be beneficial in patients who suffer from **insomnia**. **Pregnancy** risk factor is C. Because anticholinergic drugs may inhibit milk production, their use during breastfeeding is not recommended. Patients should be warned that anticholinergic

KEY TERMS

Anorexia—Lack or loss of appetite.

Anticholigerginc—An agent that blocks the parasympathetic nerves and their actions.

Bradykinesia—Extremely slow movement.

Bruxism—Compulsive grinding or clenching of the teeth, especially at night.

Carbon monoxide—A colorless, odorless, highly poisonous gas.

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

Chronic—A word used to describe a long-lasting condition. Chronic conditions often develop gradually and involve slow changes.

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

Heat stroke—A severe condition caused by prolonged exposure to high heat. Heat stroke interferes with the body's temperature regulating abilities and can lead to collapse and coma.

Parkinsonism—A group of conditions that all have these typical symptoms in common: tremor, rigidity, slow movement, and poor balance and coordination.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Seizure—A sudden attack, spasm, or convulsion.

Spasm—Sudden, involuntary tensing of a muscle or a group of muscles.

Tremor—Shakiness or trembling.

medications will inhibit perspiration, and so **exercise** during periods of high temperature should be avoided.

Levodopa has a large number of adverse effects. Anorexia, loss of appetite, occurs in roughly half the patients using this drug. Symptoms of gastrointestinal upset, such as **nausea and vomiting**, have been reported in 80% of cases. Other reported effects include increased hand tremor; headache; dizziness; numbness; weakness and faintness; **bruxism**; confusion; insomnia; nightmares; hallucinations and delusions; agitation and **anxiety**; malaise; **fatigue** and euphoria. Levodopa has not been listed under the pregnancy risk factor schedules, but should be used with caution. Breastfeeding is not recommended.

Amantadine is generally well tolerated, but may cause dizziness and nausea. It is classified as pregnancy schedule C. Since amantadine is excreted in breast milk, breastfeeding while taking amantidine is not recommended.

Pergolide and bromocriptine have been generally well tolerated. **Orthostatic hypotension** are common problems, and patients must be instructed to risk slowly from bed. This problem can be minimized by low initial doses with small dose increments. Hallucinations may be a problem. Bromocriptine has not been evaluated for pregnancy risk, while pergolide is category B. Since both drugs may inhibit **lactation**, breastfeeding while taking these drugs is not recommended.

Pramipexole and ropinirole cause orthostatic hypotension, hallucinations and dizziness. The two drugs are in pregnancy category C. In animals, ropinirole has been shown to have adverse effects on embryo-fetal development, including teratogenic effects, decreased fetal body weight, increased fetal **death** and digital malformation. Because these drugs inhibit prolactin secretion, they should not be taken while breastfeeding.

Side effects

The most common side effects are associated with the central nervous system, and include dizziness, lightheadedness, mood changes and hallucinations. Gastrointestinal problems, including nausea and vomiting, are also common.

Interactions

All anti-Parkinsonian regimens should be carefully reviewed for possible drug interactions. Note that combination therapy with anti-Parkinsonian drugs is, in itself, use of additive and potentiating interactions between

drugs, and so careful dose adjustment is needed whenever a drug is added or withdrawn.

Resources

ORGANIZATIONS

American Parkinson Disease Association. 60 Bay Street, Suite 401, Staten Island, NY 10301. (800) 223-2732.

National Institute of Neurological Disorders and Stroke. P.O. Box 5801, Bethesda, MD 20824. (800) 352-9424.

National Parkinson Foundation, Inc. 1501 N.W. 9th Avenue, Miami, FL 33136-1494. (800) 327-4545.

Samuel Uretsky, PharmD

Antiplatelet drugs *see* **Anticoagulant and antiplatelet drugs**

Antiprotozoal drugs

Definition

Antiprotozoal drugs are medicines that treat infections caused by protozoa.

Purpose

Antiprotozoal drugs are used to treat a variety of diseases caused by protozoa. Protozoa are animal-like, one-celled animals, such as amoebas. Some are parasites that cause infections in the body. African **sleeping sickness**, **giardiasis**, **amebiasis**, *Pneumocystis carinii* **pneumonia** (PCP), and **malaria** are examples of diseases caused by protozoa.

Description

Antiprotozoal drugs come in liquid, tablet, and injectable forms and are available only with a doctor's prescription. Some commonly used antiprotozoal drugs are metronidazole (Flagyl), eflornithine (Ornidyl), furazolidone (Furoxone), hydroxychloroquine (Plaquenil), iodoquinol (Diquinol, Yodoquinol, Yodoxin), and pentamidine (Pentam 300).

Recommended dosage

The recommended dosage depends on the type of antiprotozoal drug, its strength, and the medical problem for which it is being used. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for the correct dosage. Always take antiprotozoal drugs exactly as directed.

Precautions

Some people feel dizzy, confused, lightheaded, or less alert when using these drugs. The drugs may also cause blurred vision and other vision problems. For these reasons, anyone who takes these drugs should not drive, use machines or do anything else that might be dangerous until they have found out how the drugs affect them.

The antiprotozoal drug furazolidone may cause very dangerous side effects when taken with certain foods or beverages. Likewise, metronidazole (Flagyl) can cause serious liver damage if taken with alcohol. Check with the physician who prescribed the drug or the pharmacist who filled the prescription for a list of products to avoid while taking these medicines.

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

Some antiprotozoal drugs may cause problems with the blood. This can increase the risk of infection or excessive bleeding. Patients taking these drugs shouldbe careful not to injure their gums when brushing or flossing their teeth or using a toothpick. They shouldcheck with the physician before having any dentalwork done. Care should also be taken to avoidcuts from razors, nail clippers, or kitchen knives, orhousehold tools. Anyone who has any of these symptoms while taking antiprotozoal drugs should call the physician immediately:

- fever or chills
- signs of cold or flu
- signs of infection, such as redness, swelling, or inflammation
- unusual bruising or bleeding
- black, tarry stools
- blood in urine or stools
- pinpoint red spots on the skin
- unusual tiredness or weakness.

Anyone taking this medicine should also check with a physician immediately if any of these symptoms occur:

- blurred vision or other vision changes
- skin rash, **hives**, or **itching**
- swelling of the neck
- clumsiness or unsteadiness
- numbness, tingling, **pain**, or weakness in the hands or feet
- decrease in urination

Children are especially sensitive to the effects of some antiprotozoal drugs. *Never give this medicine to a child unless directed to do so by a physician, and always keep this medicine out of the reach of children. Use safety vials.*

The effects of antiprotozoal drugs on pregnant women have not been studied. However, in experiments with pregnant laboratory animals, some antiprotozoal drugs cause **birth defects** or **death** of the fetus. Women who are pregnant or who plan to become pregnant should check with their physicians before taking antiprotozoal drugs. Mothers who are breastfeeding should also check with their physicians about the safety of taking these drugs.

Before using antiprotozoal drugs, people with any of these medical problems should make sure their physicians are aware of their conditions:

- anemia or other blood problems
- kidney disease
- heart disease
- low blood pressure
- diabetes
- hypoglycemia (low blood sugar)
- liver disease
- stomach or intestinal disease
- nerve or brain disease or disorder, including convulsions (seizures)
- psoriasis (a skin condition)
- hearing loss
- deficiency of the enzyme glucose-6-phosphate dehydrogenase (G6PD)
- eye or vision problems
- thyroid disease

Side effects

The most common side effects are **diarrhea**, nausea, vomiting, and stomach pain. These problems usually go away as the body adjusts to the drug and do not require medical treatment.

Other rare side effects may occur. Anyone who has unusual symptoms after taking an antiprotozoal drug should get in touch with his or her physician.

Interactions

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

- alcohol
- anticancer drugs
- medicine for overactive thyroid
- antiviral drugs such as zidovudine (Retrovir)
- antibiotics
- medicine used to relieve pain or inflammation
- amphetamine
- diet pills (appetite suppressants)
- monoamine oxidase inhibitors (MAO inhibitors) such as phenelzine (Nardil) and tranylcypromine (Parnate), used to treat conditions including depression and **Parkinson's disease**
- tricyclic antidepressants such as amitriptyline (Elavil) and imipramine (Tofranil)
- decongestants such as phenylephrine (Neo-Synephrine) and pseudoephedrine (Sudafed)
- other antiprotozoal drugs

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

Nancy Ross-Flanigan

KEY TERMS

Amebiasis—An infection caused by an ameba, which is a type of protozoan.

Fetus—A developing baby inside the womb.

Giardiasis—A condition in which the intestines are infected with *Giardia lamblia*, a type of protozoan.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Parasite—An organism that lives and feeds in or on another organism (the host) and does nothing to benefit the host.

***Pneumocystis carinii* pneumonia**—A severe lung infection caused by a parasitic protozoan. The disease mainly affects people with weakened immune systems, such as people with AIDS.

Antipruritic drugs *see* **Anti-itch drugs**

Antipsychotic drugs

Definition

Antipsychotic drugs are a class of medicines used to treat **psychosis** and other mental and emotional conditions.

Purpose

Psychosis is defined as "a serious mental disorder (as **schizophrenia**) characterized by defective or lost contact with reality often with **hallucinations** or delusions." Psychosis is an end-stage condition arising from a variety of possible causes. Anti-psychotic drugs control the symptoms of psychosis, and in many cases are effective in controlling the symptoms of other disorders that may lead to psychosis, including bipolar mood disorder (formerly termed manic-depressive), in which the patient cycles from severe depression to feelings of extreme excitation. This class of drugs is primarily composed of the major tranquilizers; however, lithium carbonate, a drug that is largely specific to bipolar mood disorder, is commonly classified among the antipsychotic agents.

Description

The antipsychotic agents may be divided by chemical class. The phenothiazines are the oldest group, and include chlorpromazine (Thorazine), mesoridazine (Serentil), prochlorperazine (Compazine), and thioridazine (Mellaril). These drugs are essentially similar in action and adverse effects. They may also be used as anti-emetics, although prochlorperazine is the drug most often used for this indication.

The phenylbutylpiperadines are haloperidol (Haldol) and pimozide (Orap). They find primary use in control of Tourette's syndrome. Haloperidol has been extremely useful in controlling aggressive behavior.

The debenzapine derivatives, clozapine (Clozaril), loxapine (Loxitane), olanzapine (Zyprexa) and quetiapine (Seroquel), have been effective in controlling psychotic symptoms that have not been responsive to other classes of drugs.

The benzisoxidil group is composed of resperidone (Resperidal) and ziprasidone (Geodon). Resperidone has been found useful for controlling bipolar mood disorder, while ziprasidone is used primarily as second-line treatment for schizophrenia.

In addition to these drugs, the class of antipsychotic agents includes lithium carbonate (Eskalith, Lithonate), which is used for control of bipolar mood disorder, and thiothixene (Navane), which is used in the treatment of psychosis.

Recommended dosage

Dose varies with the drug, condition being treated, and patient response. See specific references.

Precautions

Neuroleptic malignant syndrome (NMS). NMS is a rare, idiosyncratic combination of extra-pyramidal symptoms (EPS), hyperthermia, and autonomic disturbance. Onset may be hours to months after drug initiation, but once started, proceeds rapidly over 24 to 72 hours. It is most commonly associated with haloperidol, long-acting fluphenazine, but has occurred with thiothixene, thioridazine, and clozapine, and may occur with other agents. NMS is potentially fatal, and requires intensive symptomatic treatment and immediate discontinuation of neuroleptic treatment. There is no established treatment. Most patients who develop NMS will have the same problem if the drug is restarted.

Tardive dyskinesia (TD). Tardive dyskinesia is a syndrome of involuntary movements that may appear in patients treated with neuroleptic drugs. Although prevalence of TD appears highest among the elderly, especially women, it is impossible to predict which patients are likely to develop the syndrome. Both the risk of developing TD and the likelihood that it will become irreversible are increased with higher doses and longer periods of treatment. The syndrome can develop after short treatment periods at low doses. Anticholinergic agents may worsen these effects. Clozapine has occasionally been useful in controlling the TD caused by other antipsychotic drugs.

Agranulocytosis has been associated with clozapine. This is a potentially fatal reaction, but can be prevented with careful monitoring of the white **blood count**. There are no well-established risk factors for developing agranulocytosis, and so all patients treated with this drug must follow the clozapine Patient Management System. For more information, call 1-800-448-5938.

Anticholinergic effects, particularly **dry mouth**, have been reported with all of the phenothiazines, and can be severe enough to cause patients to discontinue their medication.

Photosensitization is a common reaction to chlorpromazine. Patients must be instructed to use precautions when exposed to sunlight.

Antipsychotic Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Clozaril (clozapine)	Seizures, agranulocytosis, dizziness, increased blood pressure
Compazine (prochlorperazine)	Involuntary muscle spasms, dizziness, jitteriness, puckering of the mouth
Haldol (haloperidol)	Involuntary muscle spasms, blurred vision, dehydration, headache, puckering of the mouth
Mellaril (thioridazine)	Involuntary muscle spasms, constipation and diarrhea, sensitivity to light
Navane (thiothixene)	Involuntary muscle spasms, dry mouth, rash, hives
Risperdal (risperidone)	Involuntary muscle spasms, abdominal and chest pain, fever, headache
Stelazine (trifluoperazine hydrochloride)	Involuntary muscle spasms, drowsiness, fatigue
Thorazine (chlorpromazine)	Involuntary muscle spasms, labored breathing, fever, puckering of the mouth
Triavil	Involuntary muscle spasms, disorientation, excitability, lightheadedness

Lithium carbonate commonly causes increased frequency of urination.

Antipsychotic drugs are **pregnancy** category C. (Clozapine is category B.) The drugs in this class appear to be generally safe for occasional use at low doses during pregnancy, but should be avoided near time of delivery. Although the drugs do not appear to be teratogenic, when used near term, they may cross the placenta and have adverse effects on the newborn infant, including causing involuntary movements. There is no information about safety in breast feeding.

As a class, the antipsychotic drugs have a large number of potential side effects, many of them serious. Specific references should be consulted.

Interactions

Because the phenothiazines have anticholinergic effects, they should not be used in combination with other drugs that may have similar effects.

Because the drugs in this group may cause **hypotension**, or low blood pressure, they should be used with extreme care in combination with blood pressure-lowering drugs.

The antipsychotic drugs have a large number of drug interactions. Consult specific references.

Samuel D. Uretsky, PharmD

Antipsychotic drugs, atypical

Definition

The atypical antipsychotic agents, sometimes called the "novel" antipsychotic agents are a group of drugs which are different chemically from the older drugs used to treat **psychosis**. The "conventional" **antipsychotic drugs** are classified by their chemical structures as the phenothiazines, thioxanthines (which are chemically very similar to the phenothiazines), butyrophenones, diphenylbutylpiperadines and the indolones. All of the atypical antipsychotic agents are chemically classified as dibenzepines. They are considered *atypical* or *novel* because they have different side effects from the conventional antipsychotic agents. The atypical drugs are far less likely to cause extra-pyrammidal side-effects(EPS), drug induced involuntary movements, than are the older drugs. The atypical antipsychotic drugs may also be effective in some cases that are resistant to older drugs.

The drugs in this group are clozapine (Clozaril), loxapine (Loxitane), olanzapine (Zyprexa), and quetiapine (Seroquel).

Purpose

The antipsychotic drugs are used to treat severe emotional disorders. Although there may be different names for these disorders, depending on severity and how long the symptoms last, psychotic disorders all cause at least one of the following symptoms:

- delusions
- **hallucinations**
- disorganized speech
- grossly disorganized or catatonic behavior

Loxapine has also been used to treat **anxiety** with mental depression.

Recommended dosage

The recommended dose depends on the drug, the patient, and the condition being treated. The normal practice is to start each patient at a low dose, and gradually increase the dose until a satisfactory response is achieved. The odse should be held at the lowest level that gives satisfactory results.

Clozapine usually requires doses between 300 and 600 milligrams a day, but some people require as much as 900 milligrams/day. Doses higher than 900 millgrams/day are not recommended.

Loxapine is usually effective at doses of 60-100 milligrams/day, but may be used in doses as high as 250 mg/day if needed.

Olanzapine doses vary with the condition being treated. The usual maximum dose is 20 milligrams/day.

Quetiapine may be dosed anywhere from 150-750 milligrams/day, depending on how well the patient responds.

Precautions

Although the atypical antipsychotics are generally safe, clozapine has been associated with severe agranulocytosis, a shortage of white blood cells. For this reason, people who may be treated with clozapine should have blood counts before starting the drug, blood counts every week for as long as they are using clozapine, and blood counts every week for the first four weeks after they stop taking clozapine. If there is any evidence of a drop in the white **blood count** while using clozapine, the drug should be stopped.

Atypical antipsychotics should not be used in patients with liver damage, brain or circulatory problems, or some types of blood problems.

Allergies

People who have had an allergic reaction to one of the atypical antipsychotics should not use that medication again. However, sometimes it is possible to use a different drug from the same group safely.

Pregnancy

The atypical antipsychotics have not been proved safe in **pregnancy**. They should be used only when clearly needed and when potential benefits outweigh potential hazards to the fetus. These drugs have not been reported in human milk.

Side effects

Although the atypical antipsychotics are less likely to cause involuntary movements than the older antipsychotic drugs, they still have a large number of adverse effects. The following list is not complete. Review each drug individually for a full list of possible adverse effects.

- chest pain
- high blood pressure
- low blood pressure
- fast heart beat
- aggitation
- memory loss
- confusion
- dizziness
- tiredness
- headache
- sleep disturbances
- stuttering
- dry skin
- nausea
- constipation
- fever
- weight gain
- visual disturbances

KEY TERMS

Anxiety—An abnormal and overwhelming sense of apprehension and fear often marked by physiological signs (as sweating, tension, and increased pulse), by doubt concerning the reality and nature of the threat, and by self-doubt about one's capacity to cope with it.

Delusions—A false belief regarding the self or persons or objects outside the self that persists despite the facts.

Depression—A state of being depressed marked especially by sadness, inactivity, difficulty with thinking and concentration, a significant increase or decrease in appetite and time spent sleeping, feelings of dejection and hopelessness, and sometimes suicidal thoughts or an attempt to commit suicide.

Glucocorticoid—Any of a group of corticosteroids (as hydrocortisone or dexamethasone) that are anti-inflammatory and immunosuppressive, and that are used widely in medicine (as in the alleviation of the symptoms of rheumatoid arthritis).

Psychosis—A serious mental disorder characterized by defective or lost contact with reality often with hallucinations or delusions.

Interactions

Taking atypical antipsychotic medications with certain other drugs may affect the way the drugs work or may increase the chance of side effects. While taking antipsychotic drugs, do not take any other prescription or

nonprescription (over-the-counter) drugs without first checking with a physician.

Because the atypical antipsychotics may cause lowering of blood pressure, care should be used when these drugs are taken at the same time as other drugs which lower blood pressure.

Quetiapine has many interactions. Doses should be carefully adjusted when quetiapine is used with ketoconazole, itraconazole, fluconazole, erythromycin, carbamazepine, **barbiturates**, rifampin or glucocorticoids including prednisone, dexamethasone and methylprednisolone.

These drugs will also require dose adjustments when used with **antiparkinson drugs**.

Resources

BOOKS

Brain Basics: An Integrated Biological Approach to Understanding and Assessing Human Behavior. Phoenix: Biological-Psychiatry-Institute, June 1999.

Contemporary Treatment of Psychosis: Healing Relationships in the "Decade of the Brain." Northvale: Jason-Aronson-Publishers, May 1996.

PERIODICALS

McDougle, C. J. "A double-blind, placebo-controlled study of risperidone addition in serotonin reuptake inhibitor-refractory obsessive-compulsive disorder." *Archives of General Psychiatry* (August 2000): 794.

Samuel David Uretsky, PharmD

Antiretroviral drugs

Definition

Antiretroviral drugs inhibit the reproduction of retroviruses—viruses composed of RNA rather than DNA. The best known of this group is HIV, human **immunodeficiency** virus, the causative agent of **AIDS**.

Purpose

Antiretroviral agents are virustatic agents which block steps in the replication of the virus. The drugs are not curative; however continued use of drugs, particularly in multi-drug regimens, significantly slows disease progression.

Description

There are three main types of antiretroviral drugs, although only two steps in the viral replications process are blocked. Nucleoside analogs, or nucleoside reverse transcriptase inhibitors (NRTIs), such as didanosine (ddI, Videx), lamivudine (3TC, Epivir), stavudine (d4T, Zerit), zalcitabine (ddC, Hivid), and zidovudine (AZT, Retrovir), act by inhibiting the enzyme reverse transcriptase. Because a retrovirus is composed of RNA, the virus must make a DNA strand in order to replicate itself. Reverse transcriptase is an enzyme that is essential to making the DNA copy. The nucleoside reverse transcriptase inhibitors are incorporated into the DNA strand. This is a faulty DNA molecule which is incapable of reproducing.

The **non-nucleoside reverse transcriptase inhibitors** (NNRTIs), such as delavirdine (Rescriptor), loviride, and nevirapine (Viramune) act by binding directly to the reverse transcriptase molecule, inhibiting its activity.

Protease inhibitors, such as indinavir (Crixivan), nelfinavir (Viracept), ritonavir (Norvir), and saquinavir (Invirase) act on the enzyme protease, which is essential for the virus to break down the proteins in infected cells. Without this essential step, the virus produces immature copies of itself, which are non-infectious.

Because HIV mutates readily, the virus can develop resistance to single drug therapy. However, treatment with drug combinations appears to produce a durable response. Proper treatment appears to slow the progression of HIV infections and reduce the frequency of opportunistic infections.

Recommended dosage

Doses must be individualized based on the patient, and use of interacting drugs. The optimum combinations of antiretroviral drugs have not been determined, nor is there agreement on the stage of infection at which to start treatment.

Precautions

Although the antiretroviral drugs fall into three groups, each drug has a unique pattern of adverse effects and drug interactions. Since the drugs are used in various combinations, the frequency and severity of adverse effects will vary with the combination. Although most drug combinations show a higher rate of adverse events that single drug therapy, some patterns are not predictable. For example, indinavir has been reported to cause **insomnia** in 3% of patients, however, when used in combination with zidovudine, only 1.5% of patients complained of sleep difficulties.

The most severe adverse effects associated with the protease inhibitors are renal and hepatic toxicity. Patients have also reported a syndrome of abdominal distention

KEY TERMS

Antiviral drugs—Medicines that cure or control virus infections.

Bioavailability—A measure of the amount of drug that is actually absorbed from a given dose.

Immune system—The body's natural defenses against disease and infection.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Insomnia—A sleep disorder characterized by inability to either fall asleep or to stay asleep.

Mutates—Undergoes a spontaneous change in the make-up of genes or chromosomes.

Pancreas—A gland located beneath the stomach. The pancreas produces juices that help break down food and secretes insulin that helps the body use sugar for energy.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies; or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies; or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Retrovirus—A virus composed of ribonucleic acid (RNA) instead of deoxynucleic acid (DNA).

Virus—A tiny, disease-causing particle that can reproduce only in living cells.

and increased body odor, which may be socially limiting. Hemophilic patients have reported increased bleeding tendencies while taking protease inhibitors. The drugs are **pregnancy** category B. There have been no controlled studies of safety in pregnancy. HIV-infected mothers are advised not to breast feed in order to prevent transmission of the virus to the newborn.

The nucleoside reverse transcriptase inhibitors have significant levels of toxicity. Lactic acidosis in the absence of hypoxemia and severe hepatomegaly with steatosis have been reported with zidovudine and zalcitabine, and are potentially fatal. Rare cases of hepatic failure, considered possibly related to underlying **hepatitis B** and zalcitabine monotherapy, have been reported.

Abacavir has been associated with fatal hypersensitivity reactions. Didanosine has been associated with severe **pancreatitis**. Nucleoside reverse transcriptase inhibitors are pregnancy category C. There is limited information regarding safety during pregnancy. Zidovudine has been used during pregnancy to reduce the risk of HIV infection to the infant. HIV-infected mothers are advised not to breastfeed in order to prevent transmission of the virus to the newborn.

Efavirenz has been associated with a high frequency of skin rash, 27% in adults and 40% in children. Nevirapine has been associated with severe liver damage and skin reactions. All of the non-nucleoside reverse transcriptase inhibitors are pregnancy category C, based on animal studies.

Because of the high risk of viral resistance development, antiretroviral agents should be used in combination. If one drug in the group must be discontinued, it is recommended that all antiretroviral therapy be discontinued until a multi-drug regimen can be resumed. The non-nucleoside reverse transcriptase inhibitors particularly should not be used alone.

Interactions

Because of the high frequency of drug interactions associated with AIDS therapy, specialized references should be consulted.

Saquinavir is marketed in both hard and soft gelatin capsules. Because saquinavir in the hard gelatin capsule formulation (Invirase) has poor bioavailability, it is recommended that this formulation only be used in combination with other drugs which interact to raise saquinavir blood levels. Saquinavir soft gelatin capsules (Fortovase) are the preferred dosage form of this drug.

Resources

PERIODICALS

Lipsky, James J. "Antiretroviral Drugs for AIDS." *The Lancet* 348 (September 21, 1996): 800.

Williams, Ann B. "New Horizons: Antiretroviral Therapy in 1997." *Journal of the Association of Nurses in AIDS Care* 8 (July-August 1997): 26.

ORGANIZATIONS

Project Inform. 205 13th Street, #2001, San Francisco, CA 94103. (415) 558-8669. <http://www.projinf.org>.

OTHER

AIDS Clinical Trials Information Service website and telephone information line. Sponsored by Centers for Disease Control and Prevention, Food and Drug Administration, National Institute of Allergy and Infectious Diseases, and National Library of Medicine. 800-TRIALS-A (800-874-2572). <http://actis.org>.

HIV/AIDS Treatment Information Service website and telephone information line. Sponsored by Agency for Health Care Policy and Research, Centers for Disease Control and Prevention, Health Resources and Services Administration, Indian Health Service, National Institutes of Health, and Substance Abuse and Mental Health Services Administration. 800-HIV-0440 (800-448-0440). <http://www.hivatis.org>.

Project Inform National HIV/AIDS Treatment Hotline. 800-822-7422.

Samuel Uretsky, PharmD

Antirheumatic drugs

Definition

Antirheumatic drugs are drugs used to treat **rheumatoid arthritis**.

Purpose

Rheumatoid arthritis is a progressive form of arthritis that has devastating effects on joints and general health. It is classified as an auto-immune disease, because the disease is caused by the body's own immune system acting against the body itself. Symptoms include painful, stiff, swollen joints, **fever**, **fatigue**, and loss of appetite.

In recent years, there has been a change in attitude concerning the treatment of rheumatoid arthritis. Physicians now use Disease Modifying Anti-Rheumatic Drugs (DMARDs) early in the history of the disease and are less inclined to wait for crippling stages before resorting to the more potent drugs. Fuller understanding of the side-effects of non-steroidal anti-inflammatory drugs (NSAIDs) has also stimulated reliance on other types of antirheumatic drugs.

Description

The major classes of antirheumatic drugs include:

- Nonsteroidal Anti-Inflammatory Drugs (NSAIDs. Drugs belonging to this class bring symptomatic relief of both inflammation and **pain**, but have a limited effect on the progressive bone and cartilage loss associated with rheumatoid arthritis. They act by slowing the body's production of prostaglandins. Common NSAIDs include: ibuprofen (Motrin, Nuprin or Advil), naproxen (Naprosyn, Aleve) and indomethacin(Indocin).
- **Corticosteroids**. These drugs are very powerful anti-inflammatory agents. They are the synthetic analogs of cortisone, produced by the body. Corticosteroids are used to reduce inflammation and suppress activity of the immune system. The most commonly prescribed are prednisone and dexamethasone.
- Disease Modifying Anti-Rheumatic Drugs (DMARDs). DMARDs influence the disease process itself and do not only treat symptoms, hence their name. DMARDs also have anti-inflammatory effects, and most were borrowed from the treatment of other diseases, such as **cancer** and **malaria**. Antimalarials DMARDs include chloroquine (Aralen) and hydroxychloroquine (Plaquenil). Powerful DMARDs include: methotrexate (Rheumatrex), sulfasalazine, cyclosporine, azathioprine (Imuran) and cyclophosphamide (Cytoxan), azathioprine, sulfasalazine, penicillamine, and organic gold compounds such as aurothioglucose (Solganol), gold sodium thiomalate (Aurolate) and auranofin (Ridaura).
- Slow-Acting Antirheumatic Drugs (SAARDs). SAARDs are a special class of DMARDs and the effect of these drugs is slow acting and not so quickly apparent as that of the NSAIDs. Examples are hydroxychloroquine and aurothioglucose.
- Immunosuppresive cytotoxic drugs. This class of drugs is used if treatment with NSAIDs and SAARDs have no effect. Immunosuppresive drugs have a stabilizing effect on the immune system. Since the inflammation associated with chronic arthritis is due to malfunctions of the immune system, use of this class of drugs has been shown to be beneficial for the treatment of rheumatoid arthritis as well. Examples are: methotrexate, mechlorethamine, cyclophosphamide, chlorambucil, and azathioprine.

Recommended dosage

Recommended dosage depends on the type of drug. The prescribing physician or the pharmacist provide information for the correct dosage. The drugs must be taken exactly as directed.

When taking methotrexate for rheumatoid arthritis, it should be taken only *once or twice a week as prescribed,* not every day. Taking it every day can lead to a fatal overdose.

Precautions

Many antirheumatic drugs such as, for example, azathioprine (Imuran) and methotrexate (Rheumatrex), are very

KEY TERMS

Anti-inflammatory drugs—A class of drugs that lower inflammation and that includes NSAIDs and corticosteroids.

Arthritis—A painful condition that involves inflammation of one or more joints.

Conception—The union of egg and sperm to form a fetus.

Corticosteroids—A class of drugs that are synthetic versions of the cortisone produced by the body. They rank among the most powerful anti-inflammatory agents.

Cortisone—Glucocorticoid produced by the adrenal cortex in response to stress. Cortisone is a steroid and has anti-inflammatory and immunosuppressive properties.

Cytotoxic drugs—Drugs that function by destroying cells.

Disease Modifying Anti-Rheumatic Drugs (DMARDs)—A class of drugs that function by.

Inflammation—A process occurring in body tissues, characterized by increased circulation and the accumulation of white blood cells. Inflammation also occurs in disorders such as arthritis and causes harmful effects.

Inflammatory—Pertaining to inflammation.

Immune response—Physiological response of the body controlled by the immune system that involves the production of antibodies to fight off specific foreign substances or agents (antigens).

Immune system—The sum of the defence mechanisms of the body that protects it against foreign substances and organisms causing infection.

Immunosuppressive—Any agent that suppresses the immune response of an individual.

Immunosuppresive cytotoxic drugs—A class of drugs that function by destroying cells and suppressing the immune response.

Methotrexate—A drug that interferes with cell growth and is used to treat rheumatoid arthritis as well as various types of cancer. Side-effects may include mouth sores, digestive upsets, skin rashes, and hair loss.

Non steroidal—Not containing steroids or cortisone. Usually refers to a class of drugs called Non Steroidal Anti-Inflammatory Drugs (NSAID).

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)—A class of drugs that is used to relieve pain, and symptoms of inflammation, such as ibuprofen and ketoprofen.

Osteoarthritis—A form of arthritis that occurs mainly in older people and involves the gradual degeneration of the cartilage of the joints.

Prostaglandins—Prostaglandins are produced by the body and are responsible for inflammation features, such as swelling, pain, stiffness, redness and warmth.

powerful drugs. They are usually prescribed in severe cases, when all other treatments have failed. Thus, they may have serious side effects, so it is important to be monitored closely by a physician while taking any of these drugs.

Side effects

Hydroxychloroquine (Plaquenil) may cause vision problems. Anyone taking it should see an ophthalmologist (a physician who specializes in treating eyes) for a thorough **eye examination** every six months.

Methotrexate and penicillamine may cause **birth defects**. Women taking these drugs must stop taking them during **pregnancy** and for several months before a planned pregnancy. Methotrexate may also cause lung damage or fertility problems and should not be taken by anyone with serious kidney or liver disease or by anyone who drinks alcohol.

Azathioprine may cause birth defects if either the man or woman is using it at the time of conception. Anyone who uses this drug and is sexually active should consult with a physician about an effective birth control method.

Other common side effects of antirheumatic drugs include abdominal cramps, **diarrhea**, **dizziness**, loss of appetite, **headache**, nausea, vomiting, fever and chills, and mouth sores. A variety of other side effects may occur. Anyone who has unusual symptoms while taking antirheumatic drugs should notify the treating physician.

The gold compounds may cause serious blood problems by reducing the ability of the blood forming organs to produce blood cells. These drugs may decrease the number

of white blood cells, red blood cells, or both. Patients taking these drugs should have regular blood counts.

Entanercept (Enbrel) may also cause blood problems, and some patients who received this drug have developed eye problems and **multiple sclerosis**. It is not certain whether these reactions were caused by entanercept, but multiple sclerosis has been seen in patients taking other drugs which act against tumor necrosis factor.

Interactions

Antirheumatic drugs may interact with a variety of other medicines or other antirheumatic drugs. When this happens, the effects of one or both of the drugs may change, or the risk of side effects may be greater. Anyone who takes this type of drug should inform the prescribing physician about any other medication he or she is taking. Among the drugs that may interact with antirheumatic drugs are phenytoin (Dilantin), **aspirin**, sulfa drugs such as Bactrim and Gantrisin, tetracycline and some other **antibiotics** and cimetidine (Tagamet). NSAIDs such as ibuprofen (Motrin, Advil) are also known to interact with other classes of antirheumatic drugs.

Resources

ORGANIZATION

Arthritis Foundation. 1300 W. Peachtree St., Atlanta, GA 30309. (800) 283-7800. <http://www.arthritis.org>.

Nancy Ross-Flanigan

Antiseptics

Definition

An antiseptic is a substance which inhibits the growth and development of microorganisms. For practical purposes, antiseptics are routinely thought of as topical agents, for application to skin, mucous membranes, and inanimate objects, although a formal definition includes agents which are used internally, such as the urinary tract antiseptics.

Purpose

Antiseptics are a diverse class of drugs which are applied to skin surfaces or mucous membranes for their anti-infective effects. This may be either bacteriocidal or bacteriostatic. Their uses include cleansing of skin and wound surfaces after injury, preparation of skin surfaces prior to injections or surgical procedures, and routine disinfection of the oral cavity as part of a program of **oral hygiene**. Antiseptics are also used for disinfection of inanimate objects, including instruments and furniture surfaces.

Commonly used antiseptics for skin cleaning include benzalkonium chloride, chlorhexidine, hexachlorophine, iodine compounds, mercury compounds, alcohol and hydrogen peroxide. Other agents which have been used for this purpose, but have largely been supplanted by more effective or safer agents, include boric acid and volatile oils such as methyl salicylate (oil of wintergreen.)

Chlorhexidine shows a high margin of safety when applied to mucous membranes, and has been used in oral rinses and preoperative total body washes.

Benzalkonium chloride and hexachlorophine are used primarily as hand scrubs or face washes. Benzalkonium may also find application is a disinfecting agent for instruments, and in low concentration as a preservative for drugs including ophthalmic solutions. Benzalkonium chloride is inactivated by organic compounds, including soap, and must not be applied to areas which have not been fully rinsed.

Iodine compounds include tincture of iodine and povidone iodine compounds. Iodine compounds have the broadest spectrum of all topical anti-infectives, with action against bacteria, fungi, viruses, spores, protozoa, and yeasts. Iodine tincture is highly effective, but its alcoholic component is drying and extremely irritating when applied to abraided (scraped or rubbed) skin. Povidone iodine, an organic compound, is less irritating and less toxic, but not as effective. Povidone iodine has been used for hand scrubs and disinfection of surgical sites. Aqueous solutions of iodine have also been used as antiseptic agents, but are less effective than alcoholic solutions and less convenient to use that the povidone iodine compounds.

Hydrogen peroxide acts through the liberation of oxygen gas. Although the antibacterial activity of hydrogen peroxide is relatively weak, the liberation of oxygen bubbles produces an effervescent action, which may be useful for wound cleansing through removal of tissue debris. The activity of hydrogen peroxide may be reduced by the presence of blood and pus. The appropriate concentration of hydrogen peroxide for antiseptic use is 3%, although higher concentrations are available.

Thimerosol (Mersol) is a mercury compound with activity against bacteria and yeasts. Prolonged use may result in mercury toxicity.

Recommended dosage

Dosage varies with product and intended use. Consult individualized references.

Precautions

Precautions vary with individual product and use. Consult individualized references.

KEY TERMS

Antibiotic—A medicine used to treat infections.

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Mucous membrane—The moist lining of a body cavity or structure, such as the mouth or nose.

Residue—Traces that remain after most of the rest of the material is gone.

Hypersensitivity reactions should be considered with organic compounds such as chlorhexidine, benzalkonium and hexachlorophine.

Skin dryness and irritation should be considered with all products, but particularly with those containing alcohol.

Systemic toxicity may result from ingestion of iodine containing compounds or mercury compounds.

Chlorhexidine should not be instilled into the ear. There is one anecdotal report of deafness following use of chlorhexidine in a patient with a **perforated eardrum**. Safety in **pregnancy** and breastfeeding have not been reported, however there is one anecdotal report of an infant developing slowed heartbeat apparently related to maternal use of chlorhexidine.

Iodine compounds should be used sparingly during pregnancy and **lactation** due to risk of infant absorption of iodine with alterations in thyroid function.

Interactions

Antiseptics are not known to interact with any other medicines. However, they should not be used together with any other topical cream, solution, or ointment.

Resources

PERIODICALS

Farley, Dixie. "Help for Cuts, Scrapes and Burns." *FDA Consumer* (May 1996):12.

Samuel Uretsky, PharmD

Antispasmodic drugs

Definition

Antispasmodic drugs relieve cramps or spasms of the stomach, intestines, and bladder.

Purpose

Antispasmodic drugs have been used to treat stomach cramps. Traditionally, they were used to treat stomach ulcers, but for this purpose they have largely been replaced by the acid inhibiting compoundsa, the H-2 receptor blockers such as cimetidine and ranitidine and the proton pump inhibtors such as omeprazole, lansoprazole and rabetazole.

Most of the drugs used for this purpose as "anticholinergics", since they counteract the effects of the neurohormone acetylcholine. Some of these drugs are derived from the plant belladonna, also known as Deadly Nightshade. There is also a group of drugs with similar activity, but not taken from plant sources. The anticholingergics decrease both the movements of the stomach and intestine, and also the secretions of stomach acid and digestive enzymes. They may be used for other purposes including treatment of **Parkinson's Disease**, and bladder urgency. Because these drugs inhibit secretions, they cause **dry mouth** and dry eyes because of reduced salivation and tearing. Dicyclomine is an antispasmodic with very lettle effect on secretions. It is used to treat **irritable bowel syndrome**.

Description

Dicyclomine is available only with a prescription and is sold as capsules, tablets (regular and extended-release forms), and syrup.

Recommended dosage

The usual dosage for adults is 20 mg, four times a day. However, the physician may recommend starting at a lower dosage and gradually increasing the dose to reduce the chance of unwanted side effects.

The dosage for children depends on the child's age. Check with the child's physician for the correct dosage.

Precautions

Dicyclomine makes some people sweat less, which allows the body to overheat and may lead to heat prostration (**fever** and heat **stroke**). Anyone taking this drug should try to avoid extreme heat. If that is not possible, check with the physician who prescribed the drug. If heat prostration occurs, stop taking the medicine and call a physician immediately.

This medicine can cause drowsiness and blurred or double vision. People who take this drug should not drive, use machines, or do anything else that might be dangerous until they have found out how the medicine affects them.

Dicyclomine should not be given to infants or children unless the physician decides the use of this drug is necessary. Diclyclomine should not be used by women who are breast feeding. Women who are pregnant or plan to become pregnant should check with their physicians before using this drug.

Anyone with the following medical conditions should not take dicyclomine unless directed to do so by a physician:

- previous sensitivity or allergic reaction to dicyclomine
- glaucoma
- myasthenia gravis
- blockage of the urinary tract, stomach, or intestines
- severe **ulcerative colitis**
- reflux esophagitis

In addition, patients with these conditions should check with their physicians before using dicyclomine:

- liver disease
- kidney disease
- high blood pressure
- heart problems
- enlarged prostate gland
- hiatal **hernia**
- autonomic neuropathy (a nerve disorder)
- hyperthyroidism

Side effects

The most common side effects are **dizziness**, drowsiness, lightheadedness, nausea, nervousness, blurred vision, dry mouth, and weakness. Other side effects may occur. Anyone who has unusual symptoms after taking dicyclomine should get in touch with his or her physician.

Interactions

Dicyclomine may interact with other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Among the drugs that may interact with Dicyclomine are:

- antacids such as Maalox
- antihistamines such as clemastine fumarate (Tavist)
- bronchodilators (airway opening drugs) such as albuterol (Proventil, Ventolin)
- corticosteroids such as prednisone (Deltasone)
- monoamine oxidase inhibitors (MAO inhibitors) such as phenelzine (Nardil) and tranylcypromine (Parnate)
- tranquilizers such as diazepam (Valium) and alprazolam (Xanax)

KEY TERMS

Heat stroke—A serious condition that results from exposure to extreme heat. The body loses its ability to cool itself. Severe headache, high fever, and hot, dry skin may result. In severe cases, a person with heat stroke may collapse or go into a coma.

Hiatal hernia—A condition in which part of the stomach protrudes through the diaphragm.

Hyperthyroidism—Secretion of excess thyroid hormones by the thyroid gland.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Myasthenia gravis—A condition in which certain muscles weaken and may become paralyzed.

Reflux esophagitis—Inflammation of the lower esophagus caused by the backflow of stomach contents.

Spasm—Sudden, involuntary tensing of a muscle or a group of muscles

Ulcerative colitis—Long-lasting and repeated inflammation of the colon with the development of sores.

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

Nancy Ross-Flanigan

Antistreptolysin O titer (ASO) *see* **Streptococcal antibody tests**

Antithrombin III deficiency *see* **Hypercoagulation disorders**

Antituberculosis drugs

Definition

Antituberculosis drugs are medicines used to treat **tuberculosis**, an infectious disease that can affect the lungs and other organs.

Purpose

Tuberculosis is a disease caused by Mycobacterium tuberculae, a bacteria that is passed between people through the air. The disease can be cured with proper drug therapy, but because the bacteria may become resistant to any single drug, combinations of antituberculosis drugs are used to treat tuberculosis (TB) are normally required for effective treatment. At the start of the 20th Century, tuberculosis was the most common cause of **death** in the United States, but was laregly eliminated with better living conditions. It is most common in areas of crowding and poor ventilation, suich as crowded urban areas and prisons. In some areas, the **AIDS** epidemic has been accompanied by an increase in the prevalence of tuberculosis.

Some antituberculosis drugs also are used to treat or prevent other infections such as *Mycobacterium avium* complex (MAC), which causes disease throughout the bodies of people with AIDS or other diseases of the immune system.

Description

Antituberculosis drugs are available only with a physician's prescription and come in tablet, capsule, liquid and injectable forms. Some commonly used antituberculosis drugs are cycloserine (Seromycin), ethambutol (Myambutol), ethionamide (Trecator-SC), isoniazid (Nydrazid, Laniazid), pyrazinamide, rifabutin (Mycobutin), and rifampin (Rifadin, Rimactane).

Recommended dosage

The recommended dosage depends on the type of antituberculosis drug and may be different for different patients. Check with the physician who prescribed the medicine or the pharmacist who filled the prescription for the proper dosage. The physician may gradually increase the dosage during treatment. Be sure to follow the physician's orders. Patients who are infected with HIV must usually take larger combinations of drugs for a longer period of time than is needed for patients with an unimpaired immune system.

Some antituberculosis drugs must be taken with other drugs. If they are taken alone, they may encourage the bacteria that cause tuberculosis to become resistant to drugs used to treat the disease. When the bacteria become resistant, treating the disease becomes more difficult.

To clear up tuberculosis completely, antituberculosis drugs must be taken for as long as directed. This may mean taking the medicine every day for a year or two or even longer. Symptoms may improve very quickly after treatment with this medicine begins. However, they may come back if the medicine is stopped too quickly. Do not stop taking the medicine just because symptoms improve.

Because people may neglect to take their medication for tuberculosis, it is common to have tuberculosis centers develop a program of Directly Observed Therapy (DOT.) In these programs, patients come to the hospital or clinic, and take their medication in front of an observer. These programs may be annoying to the patients, but are justified by the risks to public health if tuberculosis germs which have become resistant to drugs were to be spread.

Cycloserine works best when it is at constant levels in the blood. To help keep levels constant, take the medicine in doses spaced evenly through the day and night. Do not miss any doses. If taking medicine at night interferes with sleep, or if it is difficult to remember to take the medicine during the day, check with a health care professional for suggestions.

Do not take **antacids** that contain aluminum, such as Maalox, within 1 hour of taking isoniazid, as this may keep the medicine from working.

Precautions

Seeing a physician regularly while taking antituberculosis drugs is important. The physician will check to make sure the medicine is working as it should and will watch for unwanted side effects. These visits also will help the physician know if the dosage needs to be changed.

Symptoms should begin to improve within a few weeks after treatment begins with antituberculosis drugs. If they do not, or if they become worse, check with a physician.

Some people feel drowsy, dizzy, confused, or less alert when using these drugs. Some may also cause vision changes, clumsiness, or unsteadiness. Because of these possible problems, anyone who takes antituberculosis drugs should not drive, use machines, or do anything else that might be dangerous until they have found out how the medicine affects them.

Daily doses of pyridoxine (vitamin B_6) may lessen or prevent some side effects of ethionamide or isoniazid. If the physician who prescribed the medicine recommends this, be sure to take the pyridoxine every day.

Certain kinds of cheese (such as Swiss and Cheshire) and fish (such as tuna and skipjack) may cause an unusual reaction in people taking isoniazid. Symptoms of this reaction include fast or pounding heartbeat, sweating or a hot feeling, chills or a clammy feeling, **headache**, lightheadedness, and red or itchy skin. This reaction is very

rare. However, if any of these symptoms occur, check with a physician as soon as possible.

Rifabutin and rifampin will make saliva, sweat, tears, urine, feces, and skin turn reddish orange to reddish brown. This is nothing to worry about. However, the discolored tears may permanently stain soft contact lenses (but not hard contact lenses). To avoid ruining contact lenses, do not wear soft contacts while taking these medicines.

Rifampin may temporarily lower the number of white blood cells. Because the white blood cells are important in fighting infection, this effect increases the chance of getting an infection. This drug also may lower the number of platelets that play an important role in clotting. To reduce the risk of bleeding and infection in the mouth while taking this medicine, be especially careful when brushing and flossing the teeth. Check with a physician or dentist for suggestions on how to keep the teeth and mouth clean without causing injuries. Put off any dental work until blood counts return to normal.

Rifampin may affect the results of some medical tests. Before having medical tests, anyone taking this medicine should alert the health care professional in charge.

People who have certain medical conditions may have problems if they take antituberculosis drugs. For example:

- cycloserine or isoniazid may increase the risk of seizures (convulsions) in people with a history of seizures.
- the dosage of cycloserine may need to be adjusted for people with kidney disease.
- ethambutol or pyrazinamide may cause or worsen attacks of **gout** in people who are prone to having them.
- ethambutol may cause or worsen eye damage.
- diabetes may be harder to control in patients who take ethionamide.
- isoniazid may cause false results on some urine sugar tests, and pyrazinamide may cause false results on urine ketone tests. Diabetic patients who either of these medicines should discuss the possibility of false test results with their physicians.
- people with liver disease or a history of alcohol abuse may be more likely to develop hepatitis when taking isoniazid and are more likely to have side effects that affect the liver when taking rifampin.
- in people with kidney disease, ethambutol, ethionamide, or isoniazid may be more likely to cause side effects.
- side effects are also more likely in people with liver disease who take pyrazinamide.

Before taking antituberculosis drugs, be sure to let the physician know about these or any other medical problems.

In laboratory tests of pregnant animals, high doses of some antituberculosis drugs have caused **birth defects** and other problems in the fetus or newborn. However, pregnant women with tuberculosis need to take antituberculosis drugs to clear up their disease. Knowing that many women have had healthy babies after taking these drugs during **pregnancy** may be reassuring. Pregnant women who need to take this medicine and are worried about birth defects or other problems should talk to their physicians.

Anyone who has had unusual reactions to antituberculosis drugs or to niacin should let his or her physician know before taking any antituberculosis drug. The physician should also be told about any **allergies** to foods, dyes, preservatives, or other substances.

Patients who are on special **diets**, such as low-sodium or low-sugar diets, should make sure their physicians know. Some antituberculosis medicines may contain sodium, sugar, or alcohol.

Side effects

Cycloserine

In some people, this medicine causes depression and thoughts of suicide. If this happens, check with a physician immediately. Switching to another medicine will usually stop these troubling thoughts and feelings. Also let the physician know immediately about any other mood or mental changes; such as nervousness, nightmares, **anxiety**, confusion, or irritability; and about symptoms such as muscle twitches, convulsions, or speech problems.

Headache is a common side effect that usually goes away as the body adjusts to this medicine. This problem does not need medical attention unless it continues or it interferes with everyday life.

Ethambutol

This medicine may cause eye **pain** or vision changes, including loss of vision or changes in color vision. Check with a physician immediately if any of these problems develop.

In addition, anyone who has any of these symptoms while taking ethambutol should check with a physician immediately:

- painful or swollen joints, especially in the knee, ankle, or big toe
- a tight, hot sensation in the skin over painful or swollen joints

• chills

Other side effects may occur but do not need medical attention unless they are bothersome or they do not go away as the body adjusts to the medicine. These include: headache, confusion, **nausea and vomiting**, stomach pain, and loss of appetite.

Ethionamide

Check with a physician immediately if eye pain, blurred vision, or other vision changes occur while taking this medicine.

Symptoms such as unsteadiness, clumsiness and pain, numbness, tingling, or burning in the hands or feet could be the first signs of nerve problems that may become more serious. If any of these symptoms occur, check with a physician immediately. Other side effects that should be brought to a physician's attention immediately include yellow eyes or skin and mood or mental changes such as depression or confusion.

Less serious side effects such as **dizziness**, nausea or vomiting, appetite loss, sore mouth, or metallic taste may also occur. These problems usually go away as the body adjusts to the medicine. They do not need medical attention unless they continue or they interfere with normal activities.

Isoniazid

This medicine may cause serious liver damage, especially in people over 40 years of age. However, taking medicine for tuberculosis is very important for people with the disease. Anyone who has tuberculosis and has been advised to take this drug should thoroughly discuss treatment options with his or her physician.

Recognizing the early signs of liver and nerve damage can help prevent the problems from getting worse. If any of these symptoms occur, check with a physician immediately:

• unusual tiredness or weakness

• clumsiness or unsteadiness

• pain, numbness, tingling, or burning in the hands and feet

• loss of appetite

• vomiting

This medicine may also cause less serious side effects such as **diarrhea** and stomach pain. These usually go away as the body adjusts to the medicine and do not need medical attention unless they continue.

If eye pain, blurred vision, or other vision changes occur while taking this medicine, check with a physician immediately.

Pyrazinamide

Check with a physician immediately if pain in the joints occurs.

Rifabutin

Check with a physician immediately if a skin rash occurs.

Nausea and vomiting are other possible side effects of this medicine. These problems usually go away as the body adjusts to the medicine. If they do not, check with a physician.

Rifampin

Stop taking rifampin and check with a physician immediately if any of the following symptoms occur. These symptoms could be early signs of problems that may become more serious. Getting prompt medical attention could prevent them from getting worse.

• unusual tiredness or weakness

• nausea or vomiting

• loss of appetite

In addition, anyone who has any of these symptoms while taking rifampin should check with a physician immediately:

• breathing problems

• fever

• chills

• shivering

• headache

• dizziness

• itching

• skin rash or redness

• muscle and bone pain

Other side effects, such as diarrhea and stomach pain, may occur with this medicine, but should go away as the body adjusts to the drug. Medical treatment is not necessary unless these problems continue.

Other side effects may occur with any antituberculosis drug. Anyone who has unusual symptoms while taking an antituberculosis drug should get in touch with his or her physician.

Interactions

Taking cycloserine and ethionamide together may increase the risk of seizures and other nervous system problems. These and other side effects also are more

KEY TERMS

Bacteria—Tiny, one-celled forms of life that cause many diseases and infections.

Feces—(Also called stool.) The solid waste that is left after food is digested. Feces form in the intestines and pass out of the body through the anus.

Fetus—A developing baby inside the womb.

Gout—A disease in which uric acid, a waste product that normally passes out of the body in urine, collects in the joints and the kidneys. This causes arthritis and kidney stones.

Immune system—The body's natural defenses against disease and infection.

Microorganism—An organism (life form) that is too small to be seen with the naked eye.

Platelets—Disk-shaped bodies in the blood that are important in clotting.

Seizure—A sudden attack, spasm, or convulsion.

likely in people who drink alcohol while taking cycloserine. To avoid these problems, *do not drink alcohol while taking cycloserine* and check with a physician before combining cycloserine and ethionamide.

Drinking alcohol regularly may prevent isoniazid from working properly and may increase the chance of liver damage. Anyone taking this medicine should strictly limit the use of alcohol. Check with a health care professional for advice on the amount of alcohol that may safely be used.

Many drugs may interact with isoniazid or rifampin, increasing the chance of liver damage or other side effects. Among these drugs are **acetaminophen** (Tylenol), birth control pills and other drugs that contain female hormones, and the antiseizure drugs divalproex (Depakote) and valproic acid (Depakene). For a complete list of drugs that may have this effect, check with a pharmacist.

Isoniazid may also decrease the effects of the antifungal drug ketoconazole (Nizoral) and the antituberculosis drug rifampin (Rifadin).

Rifampin may make many drugs less effective. Among the drugs that may be affected are diabetes medicines taken by mouth (oral hypoglycemics), digitalis heart drugs, many antifungal drugs, and birth control pills. Because it makes birth control pills less effective, taking rifampin may increase the chance of becoming pregnant. Women who take this medicine along with birth control pills should use an additional form of birth control. For a complete list of drugs that may be affected by rifampin, check with a pharmacist.

Using rifabutin with the antiretroviral drug zidovudine (AZT, Retrovir) may make the zidovudine less effective. Consult with a physician if both drugs are prescribed.

Not every drug that may interact with an antituberculosis drug is listed here. Be sure to check with a physician or pharmacist before combining an antituberculosis drug with any other prescription or nonprescription (over-the-counter) medicine.

Resources

PERIODICALS

Cornwall, Janet. "Tuberculosis: A Clinical Problem of International Importance." *The Lancet* (August 30, 1997): 660.

Nancy Ross-Flanigan

Antiulcer drugs

Definition

Antiulcer drugs are a class of drugs, exclusive of the antibacterial agents, used to treat ulcers in the stomach and the upper part of the small intestine.

Purpose

Recurrent gastric and duodenal ulcers are caused by *Helicobacter pylori* infections, and are treated with combination treatments that incorporate antibiotic therapy with gastric acid suppression. Additionally, bismuth compounds have been used. The primary class of drugs used for gastric acid suppression are the proton pump inhibitors, omeprazole, lansoprazole, pantoprazole and rabeprazole. The H-2 receptor blocking agents, cimetidine, famotidine, nizatidine, and ranitidine have been used for this purpose, but are now more widely used for maintenance therapy after treatment with the proton pump inhibitors. Sucralfate, which acts by forming a protective coating over the ulcerate lesion, is also used in ulcer treatment and may be appropriate for patients in whom other classes of drugs are not indicated, or those whose gastric ulcers are caused by non-steroidal anti-inflammatory drugs (NSAIDs) rather than *H. pylori* infections.

Description

The proton pump inhibitors block the secretion of gastric acid by the gastric parietal cells. The extent of inhi-

Antiulcer Drugs

Brand Name (Generic Name)	Possible Common Side Effects Include:
Axid (nitzatidine)	Diarrhea, headache, nausea and vomiting, sore throat
Carafate (sucralfate)	Constipation, insomnia, hives, upset stomach, vomiting
Cytotec (misoprostol)	Cramps, diarrhea, nausea, gas, headache, menstrual disorders (including heavy bleeding and severe cramping)
Pepcid (famotidine)	Constipation or diarrhea, dizziness, fatigue, fever
Prilosec (omeprazole)	Nausea and vomiting, headache, diarrhea, abdominal pain
Tagamet (cimetidine)	Headache, breast development in men, depression and disorientation
Zantac (ranitidine hydrochloride)	Headache, constipation or diarrhea, joint pain

bition of acid secretion is dose related. In some cases, gastric acid secretion is completely blocked for over 24 hours on a single dose. In addition to their role in treatment of gastric ulcers, the proton pump inhibitors are used to treat syndromes of excessive acid secretion (Zollinger-Ellison Syndrome) and gastroesophageal reflux disease (GERD).

Histamine H-2 receptor blockers stop the action of histamine on the gastric parietal cells, inhibiting the secretion of gastric acid. These drugs are less effective than the proton pump inhibitors, but may achieve a 75–79% reduction in acid secretion. Higher rates of acid inhibition may be achieved when the drug is administered by the intravenous route. The H-2 receptor blockers may also be used to treat **heartburn** and hypersecretory syndromes. When given before surgery, the H-2 receptor blockers are useful in prevention of aspiration **pneumonia**.

Sucralfate (Carafate), a substituted sugar molecule with no nutritional value, does not inhibit gastric acid, but rather, reacts with existing stomach acid to form a thick coating that covers the surface of an ulcer, protecting the open area from further damage. A secondary effect is to act as an inhibitor of the digestive enzyme pepsin. Sucralfate does not bind to the normal stomach lining. The drug has been used for prevention of **stress** ulcers, the type seen in patients exposed to physical stress such as **burns** and surgery. It has no systemic effects.

Recommended dosage

The doses of the proton pump inhibitors and H-2 receptor blockers vary depending on the drug and condition being treated. Consult individual references.

The dose of sucralfate for acute ulcer therapy is 1 gram four times a day. After the ulcer has healed, maintenance treatment may continue at 1 gram two times daily.

Precautions

The proton pump inhibitors are generally well tolerated, and the most common adverse effects are **diarrhea**, **itching**, skin rash, **dizziness** and **headache**. Muscle aches and a higher than normal rate of respiratory infections are among the other adverse reactions reported. Omeprazole has an increased rate of fetal deaths in animal studies. It is not known if these drugs are excreted in human milk, but because of reported adverse effects to infants in animal studies, it is recommended that proton pump inhibitors not be used by nursing mothers.

The H-2 receptor blockers vary widely in their adverse effects. Although they are generally well tolerated, cimetidine may cause confusion in elderly patients, and has an antiandrogenic effect that may cause **sexual dysfunction** in males. Famotidine has been reported to cause headache in 4.7% of patients. It is advisable that mothers not take H-2 receptor blockers while nursing.

Sucralfate is well tolerated. It is poorly absorbed, and its most common side effect is **constipation** in 2% of patients. Diarrhea, nausea, vomiting, gastric discomfort, **indigestion**, flatulence, **dry mouth**, rash, pruritus (itching), back **pain**, headache, dizziness, sleepiness, and vertigo have been reported, as well as rare allergic responses. Because sucralfate releases small amounts of aluminum into the system, it should be used with caution in patients with renal insufficiency. There is no information available about sucralfate's safety in breastfeeding.

Interactions

Proton pump inhibitors may increase the pH of the stomach. This will inactivate some antifungal drugs that require an acid medium for effectiveness, notable itraconazole and ketoconazole.

H-2 receptor blocking agents have a large number of drug interactions. Consult individualized references.

Sucralfate should not be used with aluminum containing **antacids**, because of the risk of increased aluminum absorption. Sucralfate may inhibit absorption and reduce blood levels of anticoagulants, digoxin, quinidine, ketoconazole, quinolones and phenytoin.

KEY TERMS

Antibiotic—Medicine used to treat infections.

Enzyme—A type of protein, produced in the body, that brings about or speeds up chemical reactions.

Gastrointestinal tract—The stomach, small intestine and large intestine.

Hypersecretory—Excessive production of a bodily secretion. The most common hypersecretory syndrome of the stomach is Zollinger-Ellison Syndrome, a syndrome consisting of fulminating intractable peptic ulcers, gastric hypersecretion and hyperacidity, and the occurrence of gastrinomas of the pancreatic cells of the islets of Langerhans.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

Mucous—Thick fluid produced by the moist membranes that line many body cavities and structures.

Nonsteroidal anti-inflammatory drug (NSAID)—A type of medicine used to relieve pain, swelling, and other symptoms of inflammation, such as ibuprofen or ketoprofen.

Resources

ORGANIZATIONS

Digestive Disease National Coalition. 507 Capitol Court NE, Suite 200, Washington, DC 20003. (202) 544-7497.

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Antiviral drugs

Definition

Antiviral drugs are medicines that cure or control virus infections.

Purpose

Antivirals are used to treat infections caused by viruses. Unlike antibacterial drugs, which may cover a wide range of pathogens, antiviral agents tend to be narrow in spectrum, and have limited efficacy.

Description

Exclusive of the antiretroviral agents used in HIV (**AIDS**) therapy, there are currently only 11 antiviral drugs available, covering four types of virus. Acyclovir (Zovirax), famciclovir (Famvir), and valacyclovir (Valtrex) are effective against herpesvirus, including herpes zoster and herpes genitalis. They may also be of value in either conditions caused by herpes, such as **chickenpox** and **shingles**. These drugs are not curative, but may reduce the **pain** of a herpes outbreak and shorten the period of viral shedding.

Amantadine (Symmetrel), oseltamivir (Tamiflu), rimantidine (Flumadine), and zanamivir (Relenza) are useful in treatment of **influenza** virus. Amantadine, rimantadine, and oseltamivir may be administered throughout the flu season as preventatives for patients who cannot take influenza virus vaccine.

Cidofovir (Vistide), foscarnet (Foscavir), and ganciclovir (Cytovene) have been beneficial in treatment of cytomegalovirus in immunosupressed patients, primarily HIV-positive patients and transplant recipients. Ribavirin (Virazole) is used to treat respiratory syncytial virus. In combination with interferons, ribavirin has shown some efficacy against **hepatitis C**, and there have been anecdotal reports of utility against other types of viral infections.

As a class, the antivirals are not curative, and must be used either prophylactically or early in the development of an infection. Their mechanism of action is typically to inactivate the enzymes needed for viral replication. This will reduce the rate of viral growth, but will not inactive the virus already present. Antiviral therapy must normally be initiated within 48 hours of the onset of an infection to provide any benefit. Drugs used for influenza may be used throughout the influenza season in high risk patients, or within 48 hours of exposure to a known carrier. Antiherpetic agents should be used at the first signs of an outbreak. Anti-cytomegaloviral drugs must routinely be used as part of a program of secondary **prophylaxis** (mainte-

nance therapy following an initial response) in order to prevent reinfection in immunocompromised patients.

Recommended dosage

Dosage varies with the drug, patient age and condition, route of administration, and other factors. See specific references.

Precautions

Ganciclovir is available in intravenous injection, oral capsules, and intraoccular inserts. The capsules should be reserved for prophylactic use in organ transplant patients, or for HIV infected patients who cannot be treated with the intravenous drug. The toxicity profile of this drug when administered systemically includes granulocytopenia, anemia and **thrombocytopenia**. The drug is in **pregnancy** category C, but has caused significant fetal abnormalities in animal studies including cleft palate and organ defects. Breast feeding is not recommended.

Cidofovir causes renal toxicity in 53% of patients. Patients should be well hydrated, and renal function should be checked regularly. Other common adverse effects are **nausea and vomiting** in 65% or patients, asthenia in 46% and **headache** and **diarrhea**, both reported in 27% of cases. The drug is category C in pregnancy, due to fetal abnormalities in animal studies. Breast feeding is not recommended.

Foscarnet is used in treatment of immunocompromised patients with cytomegalovirus infections and in acyclovir-resistant herpes simples virus. The primary hazard is renal toxicity. Alterations in electrolyte levels may cause seizures. Foscarnet is category C during pregnancy. The drug has caused skeletal abnormailities in developing fetuses. It is not known whether foscarnet is excreted in breast milk, however the drug does appear in breast milk in animal studies.

Valaciclovir is metabolized to acyclovir, so that the hazards of the two drugs are very similar. They are generally well tolerated, but nausea and headache are common adverse effects. They are both pregnancy category B. Although there have been no reports of fetal abnormalities attributable to either drug, the small number of reported cases makes it impossible to draw conclusions regarding safety in pregnancy. Acyclovir is found in breast milk, but no adverse effects have been reported in the newborn. Famciclovir is similar in actions and adverse effects.

Ribavirin is used by aerosol for treatment of hospitalized infants and young children with severe lower respiratory tract infections due to respiratory syncytial virus (RSV). When administered orally, the drug has been used in adultys to treat other viral diseases including acute and chronic hepatitis, herpes genitalis, **measles**, and Lassa **fever**, however there is relatively little information about these uses. In rare cases, initiation of ribavirin therapy has led to deterioration of respiratory function in infants. Careful monitoring is essential for safe use.

The anti-influenza drugs are generally well tolerated. Amantadine, which is also used for treatment of

KEY TERMS

Asthenia—Muscle weakness.

Cytomegalovirus (CMV)—A type of virus that attacks and enlarges certain cells in the body. The virus also causes a disease in infants.

Herpes simplex—A virus that causes sores on the lips (cold sores) or on the genitals (genital herpes).

HIV—Acronym for human immunodeficiency virus, the virus that causes AIDS.

Parkinsonism—A group of conditions that all have these typical symptoms in common: tremor, rigidity, slow movement, and poor balance and coordination.

Pregnancy category—A system of classifying drugs according to their established risks for use during pregnancy. Category A: Controlled human studies have demonstrated no fetal risk. Category B: Animal studies indicate no fetal risk, but no human studies, or adverse effects in animals, but not in well-controlled human studies. Category C: No adequate human or animal studies, or adverse fetal effects in animal studies, but no available human data. Category D: Evidence of fetal risk, but benefits outweigh risks. Category X: Evidence of fetal risk. Risks outweigh any benefits.

Prophylactic—Guarding from or preventing the spread or occurrence of disease or infection.

Retrovirus—A group of viruses that contain RNA and the enzyme reverse transcriptase. Many viruses in this family cause tumors. The virus that causes AIDS is a retrovirus.

Shingles—An disease caused by an infection with the Herpes zoster virus, the same virus that causes chickenpox. Symptoms of shingles include pain and blisters along one nerve, usually on the face, chest, stomach, or back.

Virus—A tiny, disease-causing structure that can reproduce only in living cells and causes a variety of infectious diseases.

Parkinsonism, may show more frequent CNS effects, including **sedation** and **dizziness**. Rapid discontinuation of amantidine may cause an increase in Parkinsonian symptoms in patients using the drug for that purpose. All are schedule C for pregnancy. In animal studies, they have caused fetal malformations in doses several times higher than the normal human dose. Use caution in breast feeding.

Interactions

Consult specific references for information on drug interactions.

Use particular caution in HIV-positive patients, since these patients are commonly on multi-drug regimens with a high frequency of interactions. Ganciclovir should not be used with other drugs which cause hematologic toxicity, and cidofovir should not be used with other drugs that may cause kidney damage.

Resources

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Anxiety

Definition

Anxiety is a multisystem response to a perceived threat or danger. It reflects a combination of biochemical changes in the body, the patient's personal history and memory, and the social situation. As far as we know, anxiety is a uniquely human experience. Other animals clearly know fear, but human anxiety involves an ability, to use memory and imagination to move backward and forward in time, that animals do not appear to have. The anxiety that occurs in post-traumatic syndromes indicates that human memory is a much more complicated mental function than animal memory. Moreover, a large portion of human anxiety is produced by anticipation of future events. Without a sense of personal continuity over time, people would not have the "raw materials" of anxiety.

It is important to distinguish between anxiety as a feeling or experience, and an anxiety disorder as a psychiatric diagnosis. A person may feel anxious without having an anxiety disorder. Also a person facing a clear and present danger or a realistic fear is not usually considered to be in a state of anxiety. In addition, anxiety frequently occurs as a symptom in other categories of psychiatric disturbance.

Description

Although anxiety is a commonplace experience that everyone has from time to time, it is difficult to describe concretely because it has so many different potential causes and degrees of intensity. Doctors sometimes categorize anxiety as an emotion or an affect depending on whether it is being described by the person having it (emotion) or by an outside observer (affect). The word *emotion* is generally used for the biochemical changes and feeling state that underlie a person's internal sense of anxiety. *Affect* is used to describe the person's emotional state from an observer's perspective. If a doctor says that a patient has an anxious affect, he or she means that the patient appears nervous or anxious, or responds to others in an anxious way (for example, the individual is shaky, tremulous, etc.).

Although anxiety is related to fear, it is not the same thing. Fear is a direct, focused response to a specific event or object, and the person is consciously aware of it. Most people will feel fear if someone points a loaded gun at them or if they see a tornado forming on the horizon. They also will recognize that they are afraid. Anxiety, on the other hand, is often unfocused, vague, and hard to pin down to a specific cause. In this form it is called free-floating anxiety. Sometimes anxiety being experienced in the present may stem from an event or person that produced **pain** and fear in the past, but the anxious individual is not consciously aware of the original source of the feeling. It is anxiety's aspect of remoteness that makes it hard for people to compare their experiences of it. Whereas most people will be fearful in physically dangerous situations, and can agree that fear is an appropriate response in the presence of danger, anxiety is often triggered by objects or events that are unique and specific to an individual. An individual might be anxious because of a unique meaning or memory being stimulated by present circumstances, not because of some immediate danger. Another individual looking at the anxious person from the outside may be truly puzzled as to the reason for the person's anxiety.

Causes and symptoms

Anxiety can have a number of different causes. It is a multidimensional response to stimuli in the person's environment, or a response to an internal stimulus (for example, a hypochondriac's reaction to a stomach rumbling) resulting from a combination of general biological and individual psychological processes.

Physical

In some cases, anxiety is produced by physical responses to **stress**, or by certain disease processes or medications.

THE AUTONOMIC NERVOUS SYSTEM (ANS). The nervous system of human beings is "hard-wired" to respond to dangers or threats. These responses are not subject to conscious control, and are the same in humans as in lower animals. They represent an evolutionary adaptation to the animal predators and other dangers with which all animals, including primitive humans, had to cope. The most familiar reaction of this type is the so-called "fight-or-flight" reaction. This response is the human organism's automatic "red alert" in a life-threatening situation. It is a state of physiological and emotional hyperarousal marked by high muscle tension and strong feelings of fear or anger. When a person has a fight-or-flight reaction, the level of stress hormones in their blood rises. They become more alert and attentive, their eyes dilate, their heartbeat increases, their breathing rate increases, and their digestion slows down, allowing more energy to be available to the muscles.

This emergency reaction is regulated by a part of the nervous system called the autonomic nervous system, or ANS. The ANS is controlled by the hypothalamus, a specialized part of the brainstem that is among a group of structures called the limbic system. The limbic system controls human emotions through its connections to glands and muscles; it also connects to the ANS and "higher" brain centers, such as parts of the cerebral cortex. One problem with this arrangement is that the limbic system cannot tell the difference between a realistic physical threat and an anxiety-producing thought or idea. The hypothalamus may trigger the release of stress hormones by the pituitary gland, even when there is no external and objective danger. A second problem is caused by the biochemical side effects of too many "false alarms" in the ANS. When a person responds to a real danger, his or her body gets rid of the stress hormones by running away or by fighting. In modern life, however, people often have fight-or-flight reactions in situations in which they can neither run away nor lash out physically. As a result, their bodies have to absorb all the biochemical changes of hyperarousal, rather than release them. These biochemical changes can produce anxious feelings, as well as muscle tension and other physical symptoms associated with anxiety. They may even produce permanent changes in the brain, if the process occurs repeatedly. Moreover, chronic physical disorders, such as **coronary artery disease**, may be worsened by anxiety, as chronic hyperarousal puts undue stress on the heart, stomach, and other organs.

DISEASES AND DISORDERS. Anxiety can be a symptom of certain medical conditions. Some of these diseases are disorders of the endocrine system, such as **Cushing's syndrome** (overproduction of cortisol by the adrenal cortex), and include over- or underactivity of the thyroid gland. Other medical conditions that can produce anxiety include **respiratory distress syndrome**, **mitral valve prolapse**, porphyria, and chest pain caused by inadequate blood supply to the heart (**angina** pectoris).

MEDICATIONS AND SUBSTANCE USE. Numerous medications may cause anxiety-like symptoms as a side effect. They include birth control pills; some thyroid or **asthma** drugs; some psychotropic agents; occasionally, local anesthetics; **corticosteroids**; **antihypertensive drugs**; and **nonsteroidal anti-inflammatory drugs** (like flurbiprofen and ibuprofen).

Although people do not usually think of **caffeine** as a drug, it can cause anxiety-like symptoms when consumed in sufficient quantity. Patients who consume caffeine rich foods and beverages, such as chocolate, cocoa, coffee, tea, or carbonated soft drinks (especially cola beverages), can sometimes lower their anxiety symptoms simply by reducing their intake of these substances.

Withdrawal from certain prescription drugs, primarily **beta blockers** and corticosteroids, can cause anxiety. Withdrawal from drugs of abuse, including **LSD**, **cocaine**, alcohol, and opiates, can also cause anxiety.

Learned associations

Some aspects of anxiety appear to be unavoidable byproducts of the human developmental process. Humans are unique among animals in that they spend an unusually long period of early life in a relatively helpless condition, and a sense of helplessness can lead to anxiety. The extended period of human dependency on adults means that people may remember, and learn to anticipate, frightening or upsetting experiences long before they are capable enough to feel a sense of mastery over their environment. In addition, the fact that **anxiety disorders** often run in families indicates that children can learn unhealthy attitudes and behaviors from parents, as well as healthy ones. Also, recurrent disorders in families may indicate that there is a genetic or inherited component in some anxiety disorders. For example, there has been found to be a higher rate of anxiety disorders (panic) in identical twins than in fraternal twins.

CHILDHOOD DEVELOPMENT AND ANXIETY. Researchers in early childhood development regard anxiety in adult life as a residue of childhood memories of dependency. Humans learn during the first year of life that they are not self-sufficient and that their basic survival depends on the care of others. It is thought that this early experience of helplessness underlies the most common anxieties of adult life, including fear of powerlessness and fear of being unloved. Thus, adults can be made anxious by symbolic threats to their sense of competence

and/or significant relationships, even though they are no longer helpless children.

SYMBOLIZATION. The psychoanalytic model gives considerable weight to the symbolic aspect of human anxiety; examples include phobic disorders, obsessions, compulsions, and other forms of anxiety that are highly individualized. The length of the human maturation process allows many opportunities for children and adolescents to connect their experiences with certain objects or events that can bring back feelings in later life. For example, a person who was frightened as a child by a tall man wearing glasses may feel panicky years later by something that reminds him of that person or experience without consciously knowing why.

Freud thought that anxiety results from a person's internal conflicts. According to his theory, people feel anxious when they feel torn between desires or urges toward certain actions, on the one hand, and moral restrictions, on the other. In some cases, the person's anxiety may attach itself to an object that represents the inner conflict. For example, someone who feels anxious around money may be pulled between a desire to steal and the belief that stealing is wrong. Money becomes a symbol for the inner conflict between doing what is considered right and doing what one wants.

PHOBIAS. **Phobias** are a special type of anxiety reaction in which the person's anxiety is concentrated on a specific object or situation that the person then tries to avoid. In most cases, the person's fear is out of all proportion to its "cause." Prior to the *Diagnostic and Statistical Manual of Mental Disorders,* 4th edition *(DSM-IV),* these specific phobias were called simple phobias. It is estimated that 10-11% of the population will develop a phobia in the course of their lives. Some phobias, such as **agoraphobia** (fear of open spaces), claustrophobia (fear of small or confined spaces), and social phobia, are shared by large numbers of people. Others are less common or unique to the patient.

Social and environmental stressors

Anxiety often has a social dimension because humans are social creatures. People frequently report feelings of high anxiety when they anticipate and, therefore, fear the loss of social approval or love. Social phobia is a specific anxiety disorder that is marked by high levels of anxiety or fear of embarrassment in social situations.

Another social stressor is prejudice. People who belong to groups that are targets of bias are at higher risk for developing anxiety disorders. Some experts think, for example, that the higher rates of phobias and **panic disorder** among women reflects their greater social and economic vulnerability.

Some controversial studies indicate that the increase in violent or upsetting pictures and stories in news reports and entertainment may raise the anxiety level of many people. Stress and anxiety management programs often suggest that patients cut down their exposure to upsetting stimuli.

Anxiety may also be caused by environmental or occupational factors. People who must live or work around sudden or loud noises, bright or flashing lights, chemical vapors, or similar nuisances, which they cannot avoid or control, may develop heightened anxiety levels.

Existential anxiety

Another factor that shapes human experiences of anxiety is knowledge of personal mortality. Humans are the only animals that appear to be aware of their limited life span. Some researchers think that awareness of **death** influences experiences of anxiety from the time that a person is old enough to understand death.

Symptoms of anxiety

In order to understand the diagnosis and treatment of anxiety, it is helpful to have a basic understanding of its symptoms.

SOMATIC. The somatic or physical symptoms of anxiety include headaches, **dizziness** or lightheadedness, nausea and/or vomiting, **diarrhea**, tingling, pale complexion, sweating, numbness, difficulty in breathing, and sensations of tightness in the chest, neck, shoulders, or hands. These symptoms are produced by the hormonal, muscular, and cardiovascular reactions involved in the fight-or-flight reaction.

BEHAVIORAL. Behavioral symptoms of anxiety include pacing, trembling, general restlessness, hyperventilation, pressured speech, hand wringing, or finger tapping.

COGNITIVE. Cognitive symptoms of anxiety include recurrent or obsessive thoughts, feelings of doom, morbid or fear-inducing thoughts or ideas, and confusion, or inability to concentrate.

EMOTIONAL. Feeling states associated with anxiety include tension or nervousness, feeling "hyper" or "keyed up," and feelings of unreality, panic, or terror.

DEFENSE MECHANISMS. In psychoanalytic theory, the symptoms of anxiety in humans may arise from or activate a number of unconscious defense mechanisms. Because of these defenses, it is possible for a person to be anxious without being consciously aware of it or appearing anxious to others. These psychological defenses include:

- Repression. The person pushes anxious thoughts or ideas out of conscious awareness.
- Displacement. Anxiety from one source is attached to a different object or event. Phobias are an example of the mechanism of displacement in psychoanalytic theory.
- Rationalization. The person justifies the anxious feelings by saying that any normal person would feel anxious in their situation.
- Somatization. The anxiety emerges in the form of physical complaints and illnesses, such as recurrent headaches, stomach upsets, or muscle and joint pain.
- Delusion formation. The person converts anxious feelings into conspiracy theories or similar ideas without reality testing. Delusion formation can involve groups as well as individuals.

Other theorists attribute some drug **addiction** to the desire to relieve symptoms of anxiety. Most addictions, they argue, originate in the use of mood-altering substances or behaviors to "medicate" anxious feelings.

Diagnosis

The diagnosis of anxiety is difficult and complex because of the variety of its causes and the highly personalized and individualized nature of its symptom formation. There are no medical tests that can be used to diagnose anxiety by itself. When a doctor examines an anxious patient, he or she will first rule out physical conditions and diseases that have anxiety as a symptom. Apart from these exclusions, the **physical examination** is usually inconclusive. Some anxious patients may have their blood pressure or pulse rate affected by anxiety, or may look pale or perspire heavily, but others may appear physically completely normal. The doctor will then take the patient's medication, dietary, and occupational history to see if they are taking prescription drugs that might cause anxiety, if they are abusing alcohol or mood-altering drugs, if they are consuming large amounts of caffeine, or if their workplace is noisy or dangerous. In most cases, the most important source of diagnostic information is the patient's psychological and social history. The doctor may administer a brief psychological test to help evaluate the intensity of the patient's anxiety and some of its features. Some tests that are often given include the Hamilton Anxiety Scale and the Anxiety Disorders Interview Schedule (ADIS). Many doctors will check a number of chemical factors in the blood, such as the level of thyroid hormone and blood sugar.

Treatment

Not all patients with anxiety require treatment, but for more severe cases, treatment is recommended. Because anxiety often has more than one cause and is experienced in highly individual ways, its treatment usually requires more than one type of therapy. In addition, there is no way to tell in advance how patients will respond to a specific drug or therapy. Sometimes the doctor will need to try different medications or methods of treatment before finding the best combination for the particular patient. It usually takes about six to eight weeks for the doctor to evaluate the effectiveness of a treatment regimen.

Medications

Medications are often prescribed to relieve the physical and psychological symptoms of anxiety. Most agents work by counteracting the biochemical and muscular changes involved in the fight-or-flight reaction. Some work directly on the chemicals in the brain that are thought to underlie the anxiety.

ANXIOLYTICS. Anxiolytics are sometimes called tranquilizers. Most anxiolytic drugs are either **benzodiazepines** or **barbiturates**. Barbiturates, once commonly used, are now rarely used in clinical practice. Barbiturates work by slowing down the transmission of nerve impulses from the brain to other parts of the body. They include such drugs as phenobarbital (Luminal) and pentobarbital (Nembutal). Benzodiazepines work by relaxing the skeletal muscles and calming the limbic system. They include such drugs as chlordiazepoxide (Librium) and diazepam (Valium). Both barbiturates and benzodiazepines are potentially habit-forming and may cause withdrawal symptoms, but benzodiazepines are far less likely than barbiturates to cause physical dependency. Both drugs also increase the effects of alcohol and should never be taken in combination with it.

Two other types of anxiolytic medications include meprobamate (Equanil), which is now rarely used, and buspirone (BuSpar), a new type of anxiolytic that appears to work by increasing the efficiency of the body's own emotion-regulating brain chemicals. Buspirone has several advantages over other anxiolytics. It does not cause dependence problems, does not interact with alcohol, and does not affect the patient's ability to drive or operate machinery. However, buspirone is not effective against certain types of anxiety, such as panic disorder.

ANTIDEPRESSANTS AND BETA-BLOCKERS. For some anxiety disorders, such as **obsessive-compulsive disorder** and panic type anxiety, a type of drugs used to treat depression, **selective serotonin reuptake inhibitors** (SSRIs; such as Prozac and Paxil), are the treatment of choice. Because anxiety often coexists with symptoms of depression, many doctors prescribe antidepressant medications for anxious/depressed patients. While SSRIs are

more common, antidepressants are sometimes prescribed, including tricyclic antidepressants such as imipramine (Tofranil) or **monoamine oxidase inhibitors** (MAO inhibitors) such as phenelzine (Nardil).

Beta-blockers are medications that work by blocking the body's reaction to the stress hormones that are released during the fight-or-flight reaction. They include drugs like propranolol (Inderal) or atenolol (Tenormin). Beta-blockers are sometimes given to patients with post-traumatic anxiety symptoms. More commonly, the beta-blockers are given to patients with a mild form of social phobic anxiety, such as fear of public speaking.

Psychotherapy

Most patients with anxiety will be given some form of psychotherapy along with medications. Many patients benefit from insight-oriented therapies, which are designed to help them uncover unconscious conflicts and defense mechanisms in order to understand how their symptoms developed. Patients who are extremely anxious may benefit from supportive psychotherapy, which aims at symptom reduction rather than personality restructuring.

Two newer approaches that work well with anxious patients are **cognitive-behavioral therapy** (CBT), and relaxation training. In CBT, the patient is taught to identify the thoughts and situations that stimulate his or her anxiety, and to view them more realistically. In the behavioral part of the program, the patient is exposed to the anxiety-provoking object, situation, or internal stimulus (like a rapid heart beat) in gradual stages until he or she is desensitized to it. Relaxation training, which is sometimes called anxiety management training, includes breathing exercises and similar techniques intended to help the patient prevent hyperventilation and relieve the muscle tension associated with the fight-or-flight reaction. Both CBT and relaxation training can be used in **group therapy** as well as individual treatment. In addition to CBT, support groups are often helpful to anxious patients, because they provide a social network and lessen the embarrassment that often accompanies anxiety symptoms.

Psychosurgery

Surgery on the brain is very rarely recommended for patients with anxiety; however, some patients with severe cases of obsessive- compulsive disorder (OCD) have been helped by an operation on a part of the brain that is involved in OCD. Normally, this operation is attempted after all other treatments have failed.

Alternative treatment

Alternative treatments for anxiety cover a variety of approaches. **Meditation** and mindfulness training are thought beneficial to patients with phobias and panic disorder. **Hydrotherapy** is useful to some anxious patients because it promotes general relaxation of the nervous system. **Yoga**, aikido, **t'ai chi**, and dance therapy help patients work with the physical, as well as the emotional, tensions that either promote anxiety or are created by the anxiety.

Homeopathy and **traditional Chinese medicine** approach anxiety as a symptom of a systemic disorder. Homeopathic practitioners select a remedy based on other associated symptoms and the patient's general constitution. Chinese medicine regards anxiety as a blockage of *qi*, or vital force, inside the patient's body that is most likely to affect the lung and large intestine meridian flow. The practitioner of Chinese medicine chooses **acupuncture** point locations and/or herbal therapy to move the qi and rebalance the entire system in relation to the lung and large intestine.

Aromatherapy using essential oils can also be beneficial in treating patients with anxiety. The oils go directly to the brain via the olfactory nerve (which controls smell) and can have direct affect on calming the nervous system.

Prognosis

The prognosis for resolution of anxiety depends on the specific disorder and a wide variety of factors, including the patient's age, sex, general health, living situation, belief system, social support network, and responses to different anxiolytic medications and forms of therapy.

Prevention

Humans have significant control over thoughts, and, therefore, may learn ways of preventing anxiety by changing irrational ideas and beliefs. Humans also have some power over anxiety arising from social and environmental conditions. Other forms of anxiety, however, are built into the human organism and its life cycle, and cannot be prevented or eliminated.

Resources

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KEY TERMS

Affect—An observed emotional expression or response. In some situations, anxiety would be considered an inappropriate affect.

Anxiolytic—A type of medication that helps to relieve anxiety.

Autonomic nervous system (ANS)—The part of the nervous system that supplies nerve endings in the blood vessels, heart, intestines, glands, and smooth muscles, and governs their involuntary functioning. The autonomic nervous system is responsible for the biochemical changes involved in experiences of anxiety.

Endocrine gland—A ductless gland, such as the pituitary, thyroid, or adrenal gland, that secretes its products directly into the blood or lymph.

Free-floating anxiety—Anxiety that lacks a definite focus or content.

Hyperarousal—A state or condition of muscular and emotional tension produced by hormones released during the fight-or-flight reaction.

Hypothalamus—A portion of the brain that regulates the autonomic nervous system, the release of hormones from the pituitary gland, sleep cycles, and body temperature.

Limbic system—A group of structures in the brain that includes the hypothalamus, amygdala, and hippocampus. The limbic system plays an important part in regulation of human moods and emotions. Many psychiatric disorders are related to malfunctioning of the limbic system.

Phobia—In psychoanalytic theory, a psychological defense against anxiety in which the patient displaces anxious feelings onto an external object, activity, or situation.

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Anxiety disorders

Definition

The **anxiety** disorders are a group of mental disturbances characterized by anxiety as a central or core symptom. Although anxiety is a commonplace experience, not everyone who experiences it has an anxiety disorder. Anxiety is associated with a wide range of physical illnesses, medication side effects, and other psychiatric disorders.

The revisions of the *Diagnostic and Statistical Manual of Mental Disorders (DSM)* that took place after 1980 brought major changes in the classification of the anxiety disorders. Prior to 1980, psychiatrists classified patients on the basis of a theory of causality that defined anxiety as the outcome of unconscious conflicts in the patient's mind. *DSM-III* (1980), *DSM-III-R* (1987), and *DSM-IV* (1994) introduced and refined a new classification that took into consideration recent discoveries about the biochemical and post-traumatic origins of some types of anxiety. The present definitions are based on the external and reported symptom patterns of the disorders rather than on theories about their origins.

Description

Anxiety disorders are the most common form of mental disturbance in the United States population. It is estimated that 28 million persons suffer from an anxiety disorder every year. These disorders are a serious problem for the entire society because of their interference with patients' work, schooling, and family life. They also contribute to the high rates of alcohol and substance abuse in the United States. Anxiety disorders are an additional problem for health professionals because the physical symptoms of anxiety frequently bring people to primary care doctors or emergency rooms.

DSM-IV defines twelve types of anxiety disorders in the adult population. They can be grouped under seven headings:

- Panic disorders with or without **agoraphobia**. The chief characteristic of **panic disorder** is the occurrence of panic attacks coupled with fear of their recurrence. In clinical settings, agoraphobia is usually not a disorder by itself, but is typically associated with some form of panic disorder. Patients with agoraphobia are afraid of places or situations in which they might have a panic attack and be unable to leave or to find help. About 25% of patients with panic disorder develop **obsessive-compulsive disorder** (OCD).
- **Phobias**. These include specific phobias and social phobia. A phobia is an intense irrational fear of a spe-

cific object or situation that compels the patient to avoid it. Some phobias concern activities or objects that involve some risk (for example, flying or driving) but many are focused on harmless animals or other objects. Social phobia involves a fear of being humiliated, judged, or scrutinized. It manifests itself as a fear of performing certain functions in the presence of others, such as public speaking or using public lavatories.

- Obsessive-compulsive disorder (OCD). This disorder is marked by unwanted, intrusive, persistent thoughts or repetitive behaviors that reflect the patient's anxiety or attempts to control it. It affects between 2-3% of the population and is much more common than was previously thought.
- **Stress** disorders. These include **post-traumatic stress disorder** (PTSD) and **acute stress disorder**. Stress disorders are symptomatic reactions to traumatic events in the patient's life.
- **Generalized anxiety disorder** (GAD). GAD is the most commonly diagnosed anxiety disorder and occurs most frequently in young adults.
- Anxiety disorders due to known physical causes. These include general medical conditions or substance abuse.
- Anxiety disorder not otherwise specified. This last category is not a separate type of disorder, but is included to cover symptoms that do not meet the specific *DSM-IV* criteria for other anxiety disorders.

All *DSM-IV* anxiety disorder diagnoses include a criterion of severity. The anxiety must be severe enough to interfere significantly with the patient's occupational or educational functioning, social activities or close relationships, and other customary activities.

The anxiety disorders vary widely in their frequency of occurrence in the general population, age of onset, family patterns, and gender distribution. The stress disorders and anxiety disorders caused by medical conditions or substance abuse are less age- and gender-specific. Whereas OCD affects males and females equally, GAD, panic disorder, and specific phobias all affect women more frequently than men. GAD and panic disorders are more likely to develop in young adults, while phobias and OCD can begin in childhood.

Anxiety disorders in children and adolescents

DSM-IV defines one anxiety disorder as specific to children, namely, separation anxiety disorder. This disorder is defined as anxiety regarding separation from home or family that is excessive or inappropriate for the child's age. In some children, separation anxiety takes the form of school avoidance.

Children and adolescents can also be diagnosed with panic disorder, phobias, generalized anxiety disorder, and the post- traumatic stress syndromes.

Causes and symptoms

The causes of anxiety include a variety of individual and general social factors, and may produce physical, cognitive, emotional, or behavioral symptoms. The patient's ethnic or cultural background may also influence his or her vulnerability to certain forms of anxiety. Genetic factors that lead to biochemical abnormalities may also play a role.

Anxiety in children may be caused by suffering from abuse, as well as by the factors that cause anxiety in adults.

Diagnosis

The diagnosis of anxiety disorders is complicated by the variety of causes of anxiety and the range of disorders that may include anxiety as a symptom. Many patients who suffer from anxiety disorders have features or symptoms of more than one disorder. Patients whose anxiety is accounted for by another psychic disorder, such as **schizophrenia** or major depression, are not diagnosed with an anxiety disorder. A doctor examining an anxious patient will usually begin by ruling out diseases that are known to cause anxiety and then proceed to take the patient's medication history, in order to exclude side effects of prescription drugs. Most doctors will ask about **caffeine** consumption to see if the patient's dietary habits are a factor. The patient's work and family situation will also be discussed. Laboratory tests for blood sugar and thyroid function are also common

Diagnostic testing for anxiety

There are no laboratory tests that can diagnose anxiety, although the doctor may order some specific tests to rule out disease conditions. Although there is no psychiatric test that can provide definite diagnoses of anxiety disorders, there are several short-answer interviews or symptom inventories that doctors can use to evaluate the intensity of a patient's anxiety and some of its associated features. These measures include the Hamilton Anxiety Scale and the Anxiety Disorders Interview Schedule (ADIS).

Treatment

For relatively mild anxiety disorders, psychotherapy alone may suffice. In general, doctors prefer to use a combination of medications and psychotherapy with more severely anxious patients. Most patients respond better to a combination of treatment methods than to either med-

ications or psychotherapy in **isolation**. Because of the variety of medications and treatment approaches that are used to treat anxiety disorders, the doctor cannot predict in advance which combination will be most helpful to a specific patient. In many cases the doctor will need to try a new medication or treatment over a six- to eight-week period in order to assess its effectiveness. Treatment trials do not necessarily mean that the patient cannot be helped or that the doctor is incompetent.

Although anxiety disorders are not always easy to diagnose, there are several reasons why it is important for patients with severe anxiety symptoms to get help. Anxiety doesn't always go away by itself; it often progresses to panic attacks, phobias, and episodes of depression. Untreated anxiety disorders may eventually lead to a diagnosis of major depression, or interfere with the patient's education or ability to keep a job. In addition, many anxious patients develop addictions to drugs or alcohol when they try to "medicate" their symptoms. Moreover, since children learn ways of coping with anxiety from their parents, adults who get help for anxiety disorders are in a better position to help their families cope with factors that lead to anxiety than those who remain untreated.

Alternative treatment

Alternative treatments for anxiety cover a variety of approaches. **Meditation** and mindfulness training are thought beneficial to patients with phobias and panic disorder. **Hydrotherapy** is useful to some anxious patients because it promotes general relaxation of the nervous system. **Yoga**, aikido, **t'ai chi**, and dance therapy help patients work with the physical, as well as the emotional, tensions that either promote anxiety or are created by the anxiety.

Homeopathy and **traditional Chinese medicine** approach anxiety as a symptom of a systemic disorder. Homeopathic practitioners select a remedy based on other associated symptoms and the patient's general constitution. Chinese medicine regards anxiety as a blockage of *qi*, or vital force, inside the patient's body that is most likely to affect the lung and large intestine meridian flow. The practitioner of Chinese medicine chooses **acupuncture** point locations and/or herbal therapy to move the qi and rebalance the entire system in relation to the lung and large intestine.

Aromatherapy using essential oils can also be beneficial in treating patients with anxiety. The oils go directly to the brain via the olfactory nerve (which controls smell) and can have direct affect on calming the nervous system.

Prognosis

The prognosis for recovery depends on the specific disorder, the severity of the patient's symptoms, the specific causes of the anxiety, and the patient's degree of control over these causes.

KEY TERMS

Agoraphobia—Abnormal anxiety regarding public places or situations from which the patient may wish to flee or in which he or she would be helpless in the event of a panic attack.

Compulsion—A repetitive or ritualistic behavior that a person performs to reduce anxiety. Compulsions often develop as a way of controlling or "undoing" obsessive thoughts.

Obsession—A repetitive or persistent thought, idea, or impulse that is perceived as inappropriate and distressing.

Panic attack—A time-limited period of intense fear accompanied by physical and cognitive symptoms. Panic attacks may be unexpected or triggered by specific cues.

Prevention

Anxiety is an unavoidable feature of human existence. However, humans do have some power over their reactions to anxiety- provoking events and situations. Cognitive therapy and meditation or mindfulness training appear to be beneficial in helping people lower their long-term anxiety levels.

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Rebecca J. Frey

Anxiolytics *see* **Antianxiety drugs**

Aortic aneurysm

Definition

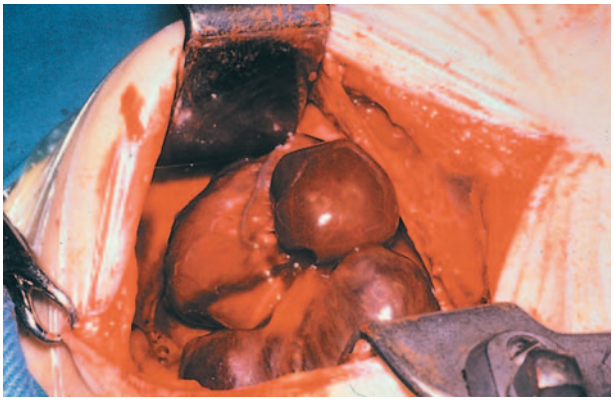
An aneurysm is an abnormal bulging or swelling of a portion of a blood vessel. The aorta, which can develop these abnormal bulges, is the large blood vessel that carries oxygen-rich blood away from the heart to the rest of the body.

Description

The aorta carries oxygen-rich blood to the body, and is therefore called an artery. Because the aorta is an artery, its walls are made of up three layers; a thin inner layer, a muscular middle layer (that gives the vessel its flexibility under pressure from the filling blood), and a fiber-like outer layer that gives the vessel strength to not burst when the heart pumps blood to the body.

Aortic aneurysms occur when a weakness develops in part of the wall of the aorta; three basic types are usually found. If all three layers of the vessel are affected and weakness develops along an extended area of the vessel, the weakened area will appear as a large, bulging region of blood vessel; this is called a fusiform aneurysm. If weakness develops between the inner and outer layers of the aortic wall, a bulge results as blood from the interior of the vessel is pushed around the damaged region in the wall and collects between these layers. This is called a dissecting aneurysm because one layer is "dissected" or separated from another. If damage occurs to only the middle (muscular) layer of the vessel, a sack-like bulge can form; therefore, this is a saccular aneurysm.

An aneurysm in progress. An aneurysm is an abnormal bulging or swelling of a portion of a blood vessel. *(Custom Medical Stock Photo. Reproduced by permission.)*



Surgery being performed to correct aortic aneurysm. *(Custom Medical Stock Photo. Reproduced by permission.)*

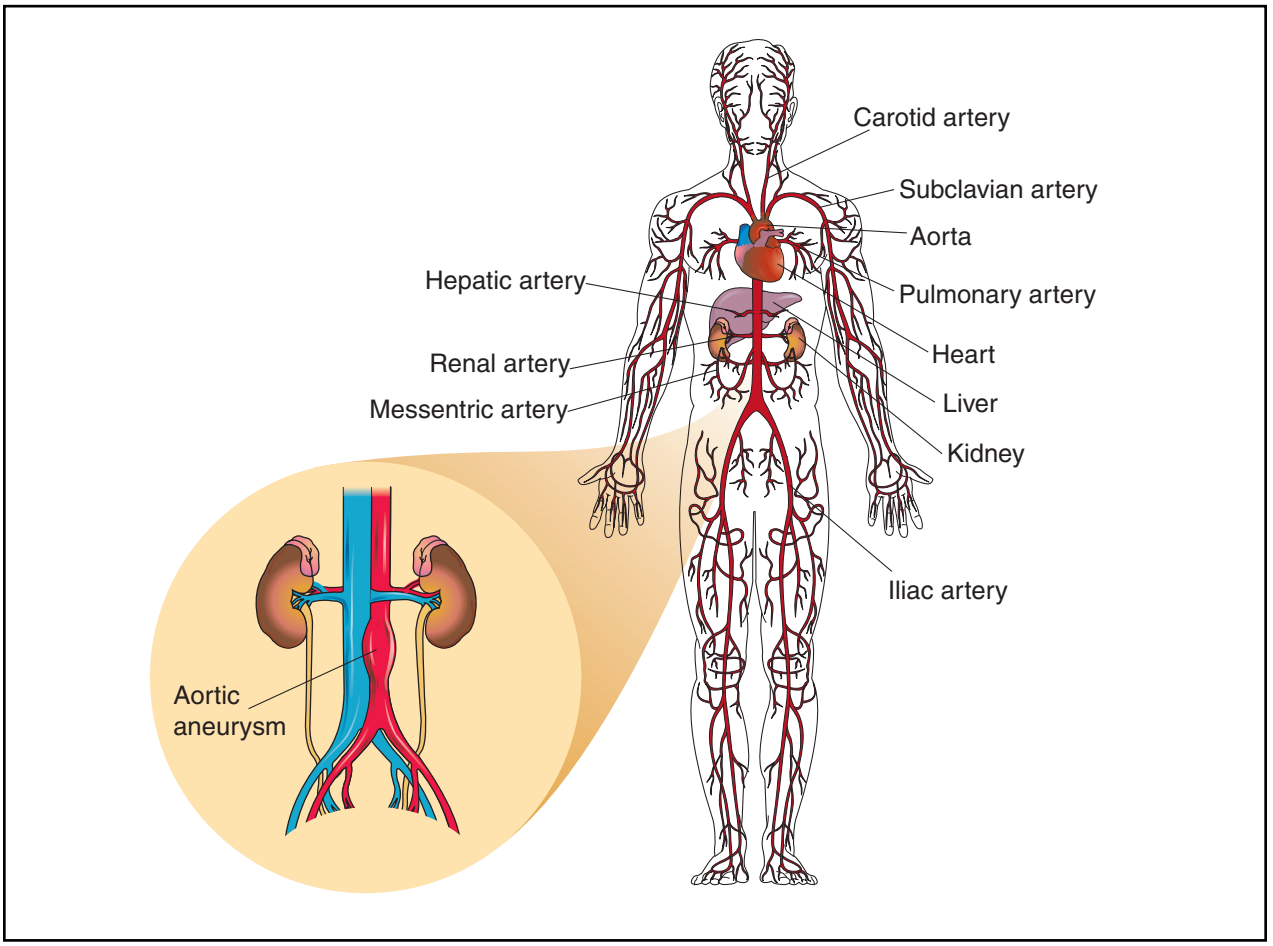
Causes and symptoms

Aortic aneurysms occur in different portions of the aorta, which begins in the chest (at the heart) and travels downward through the abdomen. Aneurysms found in the region of the aorta within the chest are called thoracic aortic aneurysms. Aneurysms that occur in the part of the aorta within the abdomen are called abdominal aortic aneurysms.

Thoracic aortic aneurysms do not usually produce any noticeable symptoms. However, as the aneurysm becomes larger, chest, shoulder, neck, lower back, or abdominal **pain** can result. Abdominal aortic aneurysms occur more often in men, and these aneurysms can cause pain in the lower back, hips, and abdomen. A painful abdominal aortic aneurysm usually means that the aneurysm could burst very soon.

Most abdominal aortic aneurysms are caused by **atherosclerosis**, a condition caused when fat (mostly cholesterol) carried in the blood builds up in the inner wall of the aorta. As more and more fat attaches to the aortic wall, the wall itself becomes abnormally weak and often results in an aneurysm or bulge.

Aortic aneurysms are also caused by a breakdown of the muscular middle layer of the artery wall, by high blood pressure, by direct injury to the chest, and although rare, by bacteria that can infect the aorta.



Aortic aneurysms occur when a weakness develops in a part of the wall of the aorta. The aorta is the large blood vessel that carries oxygen-rich blood away from the heart to the rest of the body. *(Illustration by Electronic Illustrators Group.)*

Diagnosis

Silent, stable aneurysms are often detected when a person has an x ray as part of a routine examination or for other medical reasons. Otherwise, when chest, abdominal, or back pain is severe, aortic aneurysm is suspected and x-ray (radiographic) studies can confirm or rule out that condition.

Treatment

Aortic aneurysms are potentially life-threatening conditions. Small aneurysms should be monitored for their rate of growth and large aneurysms require consideration for a surgical repair. The most common method of surgical repair is to cut out the bulging section of artery wall and sew a Dacron fiber material into its place in the vessel wall.

Prognosis

Only 1-2% of people die from having surgical repair of an aortic aneurysm. However, if the aneurysm is untreated and eventually ruptures, less than half of the people with ruptured aneurysms will survive. The challenge for the physician is to decide when or if to do the preventive surgery.

Prevention

Aneuryms can develop in people with atherosclerosis. High blood pressure can also lead to this condition. Although no definite prevention exists, lifestyle and dietary changes that help lower blood pressure and the amount of fat in the blood stream may slow the development of aneurysms.

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KEY TERMS

Atherosclerosis—The accumulation of fat on the inner wall of an artery. This fat is largely made up of cholesterol being carried in the blood.

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

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

Dominic De Bellis, PhD

Aortic dissection

Definition

Aortic dissection is a rare, but potentially fatal, condition in which blood passes through the inner lining and between the layers of the aorta. The dissecting aorta usually does not burst, but has an abnormal second channel within it.

Description

A defect in the inner lining of the aorta allows an opening or tear to develop. The aorta is the main artery of the body and is an area of high blood pressure. When a defect develops, blood pressure can force the tear to open and allow blood to pass through. Since the blood is under pressure, it eventually splits (dissecting) the middle layer of the blood vessel, creating a new channel for blood. The length of the channel grows over time and can result in the closing off of connection points to other arteries. This can lead to **heart attack**, strokes, abdominal **pain**, and nerve damage. Blood may leak from the dissection and collect in the chest an around the heart.

A second mechanism leading to aortic dissection is medial hemorrhage. A medial hemorrhage occurs in the middle layer of the blood vessel and spills through the inner lining of the aorta wall. This opening then allows blood from the aorta to enter the vessel wall and begin a dissection. Approximately 2,000 cases of aortic dissection occur yearly in the United States.

Causes and symptoms

Aortic dissection is caused by a deterioration of the inner lining of the aorta. There are a number of conditions that predispose a person to develop defects of the inner lining, including high blood pressure, Marfan's disease, **Ehlers-Danlos syndrome**, connective tissue diseases, and defects of heart development which begin during fetal development. A dissection can also occur accidentally following insertion of a catheter, trauma, or surgery. The main symptom is sudden, intense pain. The pain can be so intense as to immobilize the patient and cause him to fall to the ground. The pain is frequently felt in both the chest and in the back, between the shoulder blades. The extent of the pain is proportional to the length of the dissection.

Diagnosis

The pain experienced by the patient is the first symptom of aortic dissection and is unique. The pain is usually described by the patient as "tearing, ripping, or stabbing." This is in contrast to the pain associated with heart attacks. The patient frequently has a reduced or absent pulse in the extremities. A murmur may be heard if the dissection is close to the heart. An enlarged aorta will usually appear in the chest x rays and ultrasound exams of most patients. The use of a blood dye in angiograms and/or CT scans (**computed tomography scans**) will aid in diagnosing and visualizing the dissection.

Treatment

Because of the potentially fatal nature of aortic dissection, patients are treated immediately. Drugs are administered to reduce the blood pressure and heart rate. If the dissection is small, drug therapy alone may be used. In other cases, surgery is performed. In surgery, damaged sections of the aorta are removed and a synthetic graft is often used to reconstruct the damaged vessel.

Prognosis

Depending on the nature and extent of the dissection, **death** can occur within a few hours of the start of a dissection. Approximately 75% of untreated people die with-

KEY TERMS

Dissection—A cut or divide.

Hemorrhage—A large discharge of blood, profuse bleeding.

in two weeks of the start of a dissection. Of those who are treated, 40% survive more than 10 years. Patients are usually given long term treatment with drugs to reduce their blood pressure, even if they have had surgery.

Resources

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John T. Lohr, PhD

Aortic incompetence *see* **Aortic valve insufficiency**

Aortic regurgitation *see* **Aortic valve insufficiency**

Aortic stenosis *see* **Aortic valve stenosis**

Aortic valve insufficiency

Definition

The aortic valve separates the left ventricle of the heart (the heart's largest pumping chamber) from the aorta, the large artery that carries oxygen-rich blood out of the left ventricle to the rest of the body. In aortic valve insufficiency, the aortic valve becomes leaky, causing blood to flow backwards into the left ventricle.

Description

Aortic valve insufficiency occurs when this valve cannot properly close after blood that is leaving the heart's left ventricle enters the aorta. With each contraction of the heart more and more blood flows back into the left ventricle, causing the ventricle to become overfilled. This larger-than-normal amount of blood that collects in the left ventricle puts pressure on the walls of the heart, causing the heart muscle to increase in thickness (hypertrophy). If this thickening continues, the heart can be permanently damaged.

Aortic valve insufficiency is also know as aortic valve regurgitation because of the abnormal reversed flow of blood leaking through the poorly functioning valve.

Causes and symptoms

The faulty working of the aortic valve can be caused by a birth defect; by abnormal widening of the aorta (which can be caused by very high blood pressure and a variety of other less common conditions); by various diseases that cause large amounts of swelling (inflammation) in different areas of the body, like **rheumatic fever**; and, although rarely, by the sexually transmitted disease, **syphilis**.

About 75% of people with aortic valve insufficiency are men. Rheumatic (inflammatory) diseases have been the main cause of this condition in both men and women.

Aortic valve insufficiency can remain unnoticed for 10 to 15 years. In cases of severe insufficiency a person may notice a variety of symptoms, including an uncomfortable pounding of the heart when lying down, a very rapid or hard heart beat (**palpitations**), **shortness of breath**, chest **pain**, and if untreated for very long times, swelling of the liver, ankles, and belly.

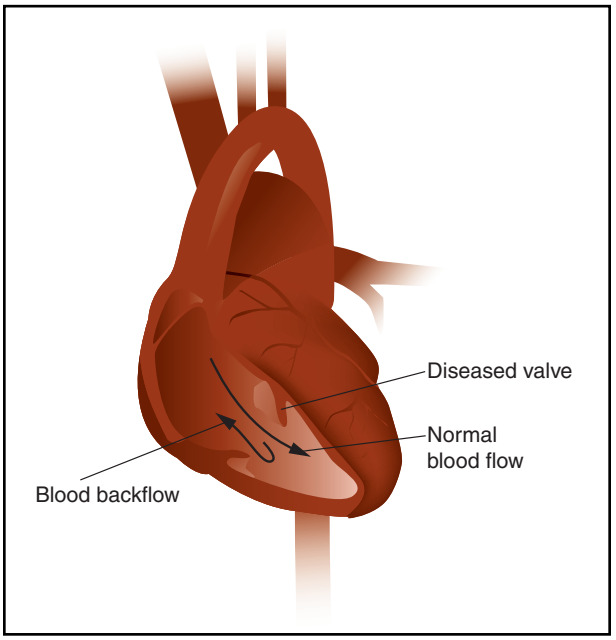
Diagnosis

A poorly functioning or insufficient aortic valve can be identified when a doctor listens to the heart during a **physical examination**. A **chest x ray**, an electrocardiogram (ECG, an electrical printout of the heart beats), as well as an echocardiogram (a test that uses sound waves to create an image of the heart and its valves), can further evaluate or confirm the condition.

Treatment

Aortic insufficiency is usually corrected by having the defective valve surgically replaced. However, such an operation is done in severe cases. Before the condition worsens, certain drugs can be used to help manage this condition.

Drugs that remove water from the body, drugs that lower blood pressure, and drugs that help the heart beat more effectively can each be used for this condition. Reducing the amount of salt in the diet also helps lower the amount of fluid the body holds and can help the heart to work more efficiently as well.



A human heart with a diseased valve that doesn't open and close properly, allowing blood to backflow to the heart. *(Illustration by Argosy, Inc.)*

In cases of a severely malfunctioning valve that has been untreated for a long time, surgery is the treatment of choice, especially if the heart is not functioning normally. Human heart valves can be replaced with man-made valves or with valves taken from pig hearts.

Prognosis

Although drug treatment can help put off the need for surgical valve replacement, it is important to replace the faulty valve before the heart muscle itself is damaged beyond recovery.

Resources

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KEY TERMS

Rheumatic fever—A disease believed to be caused by a bacterium named group A streptococcus. This bacterium causes a sore "strep throat" and can also result in fever. Infection by this bacterium can also damage the heart and its valves, but how this takes place is not clearly understood.

ORGANIZATIONS

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

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

Dominic De Bellis, PhD

Aortic valve stenosis

Definition

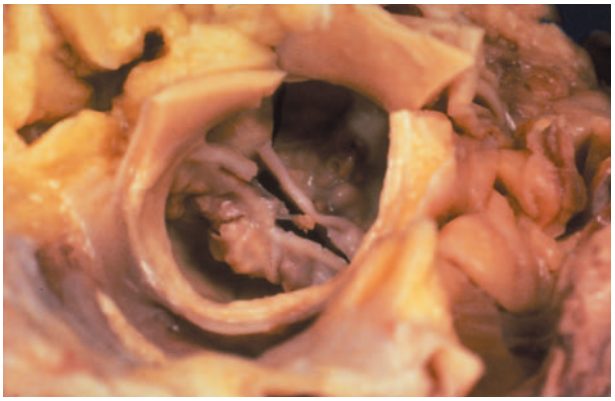
When aortic valve stenosis occurs, the aortic valve, located between the aorta and left ventricle of the heart, is narrower than normal size.

Description

A normal aortic valve, when open, allows the free flow of blood from the left ventricle to the aorta. When the valve narrows, as it does with stenosis, blood flow is impeded. Because it is more difficult for blood to flow through the valve, there is increased strain on the heart. This can cause the left ventricle to enlarge and malfunction, resulting in reduced blood supply to the heart muscle and body, as well as fluid build up in the lungs.

Cause and symptoms

Aortic valve stenosis can occur because of a birth defect in the formation of the valve. Calcium deposits may form on the valve with **aging**, causing the valve to become stiff and narrow. Stenosis can also occur as a result of **rheumatic fever**. Mild aortic stenosis may produce no symptoms at all. The most common symptoms, depending on the severity of the disease, are chest **pain**, blackouts, and difficulty breathing.



A close-up view of a calcified stenosis of the aortic valve. *(Custom Medical Stock Photo. Reproduced by permission.)*

KEY TERMS

Aorta—The largest artery in the body, which moves blood from the left ventricle to the rest of the body.

ECG—Also called an electrocardiogram, it records the electrical activity of the heart.

Echocardiogram—A procedure in which high frequency sound waves harmlessly bounce off organs in the body providing an image so one can determine their structure and function.

Cardiac catheterization—A procedure in which dye is injected through a tube or catheter into an artery to more easily observe valves or blood vessels seen on an x ray.

Left ventricle—One of the lower chambers of the heart, which pumps blood to the aorta.

Murmur—An abnormal heart sound that can reflect a valve dysfunction.

Rheumatic fever—A bacterial infection that often causes heart inflammation.

Pulmonary valve—The valve located between the pulmonary artery and the right ventricle, which brings blood to the lungs.

Diagnosis

Using a stethoscope, a physician may hear a murmur and other abnormal heart sounds. An ECG, also called an electrocardiogram, records the electrical activity of the heart. This technique and **chest x ray** can show evidence that the left ventricle is enlarged. An x ray can also reveal calcium deposits on the valve, as well as congestion in the lungs. **Echocardiography** can pick up thickening of the valve, heart size, and whether or not the valve is working properly. This is a procedure in which high frequency sound waves harmlessly bounce off organs in the body. **Cardiac catheterization**, in which a contrast dye is injected in an artery using a catheter, is the key tool to confirm stenosis and gauge its severity.

Treatment

Treatment depends on the symptoms and how the heart's function is affected. The valve can be opened without surgery by using a balloon catheter, but this is often a temporary solution. The procedure involves inserting a deflated balloon at the end of a catheter through the arteries to the valve. Inflating the balloon should widen the valve. In severe stenosis, **heart valve replacement** is recommended, most often involving open-heart surgery. The valve can be replaced with a mechanical valve, a valve from a pig, or by moving the patient's other heart valve (pulmonary) into the position of the aortic valve and then replacing the pulmonary valve with an mechanical one. Anyone with aortic stenosis needs to take **antibiotics** (amoxicillin, erythromycin, or clindamycin) before dental and some other surgical procedures, to prevent a heart valve infection.

Prognosis

The prognosis for aortic valve stenosis depends on the severity of the disease. With surgical repair, the disease is curable. Patients suffering mild stenosis can usually lead a normal life; a minority of the patients progress to severe disease. Anyone with moderate stenosis should avoid vigorous physical activity. Most of these patients end up suffering some kind of coronary heart disease over a 10 year period. Because it is a progressive disease, moderate and severe stenosis will be treated ultimately with surgery. Severe disease, if left untreated, leads to **death** within 2 to 4 years once the symptoms start.

Prevention

There is no way to prevent aortic stenosis.

Resources

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Jeanine Barone, Physiologist

KEY TERMS

Acrocyanosis—A slight cyanosis, or blueness of the hands and feet of the neonate is considered normal. This impaired ability to fully oxygenate the extremities is due to an immature circulatory system which is still in flux.

Amniotic fluid—The protective bag of fluid that surrounds the fetus while growing in the uterus.

Neonate—A term referring to the newborn infant, from birth until one month of age.

Neonatologist—A physician who specializes in problems of newborn infants.

Pallor—Extreme paleness in the color of the skin.

Apgar testing

Definition

Apgar testing is the assessment of the newborn rating color, heart rate, stimulus response, muscle tone, and respirations on a scale of zero to two, for a maximum possible score of 10. It is performed twice, first at one minute and then again at five minutes after birth.

Purpose

Apgar scoring was originally developed in the 1950s by the anesthesiologist Virginia Apgar to assist practitioners attending a birth in deciding whether or not a newborn was in need of resuscitation. Using a scoring method fosters consistency and standardization among different practitioners. A February 2001 study published in the *New England Journal of Medicine* investigated whether Apgar scoring continues to be relevant. Researchers concluded that "The Apgar scoring system remains as relevant for the prediction of neonatal survival today as it was almost 50 years ago".

Description

The five areas are scored as follows:

- Appearance, or color: 2 if the skin is pink all over; 1 for **acrocyanosis**, where the trunk and head are pink, but the arms and legs are blue; and 0 if the whole body is blue. Newborns with naturally darker skin color will not be pink. However, pallor is still noticeable, especially in the soles and palms. Color is related to the neonate's ability to oxygenate its body and extremities, and is dependent on heart rate and respirations. A perfectly healthy newborn will often receive a score of 9 because of some blueness in the hands and feet.
- Pulse (heart rate): 2 for a pulse of 100+ beats per minute (bpm); 1 for a pulse below 100 bpm; 0 for no pulse. Heart rate is assessed by listening with a stethoscope to the newborn's heart and counting the number of beats.
- Grimace, or reflex irritability: 2 if the neonate coughs, sneezes, or vigorously cries in response to a stimulus (such as the use of nasal suctioning, stroking the back to assess for spinal abnormalities, or having the foot tapped); 1 for a slight cry or grimace in response to the stimulus; 0 for no response.
- Activity, or muscle tone: 2 for vigorous movements of arms and legs; 1 for some movement; 0 for no movement, limpness.
- Respirations: 2 for visible breathing and crying; 1 for slow, weak, irregular breathing; 0 for apnea, or no breathing. A crying newborn can adequately oxygenate its lungs. Respirations are best assessed by watching the rise and fall of the neonate's abdomen, as infants are diaphragmatic breathers.

The combined first letters in these five areas spell Apgar.

Preparation

No preparation is needed to perform the test. However, while being born the neonate may receive nasal and oral suctioning to remove mucus and amniotic fluid. This may be done when the head of the newborn is safely out, while the mother rests before she continues to push.

Aftercare

Since the test is primarily observational in nature, no aftercare is needed. However, the test may flag the need for immediate intervention or prolonged observation.

Normal results

The maximum possible score is 10, the minimum is zero. It is rare to receive a true 10, as some acrocyanosis in

DR. VIRGINIA APGAR (1909–1974)

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

As one of very few female medical students at Columbia University College of Physicians and Surgeons in New York during the early 1930s and one of the first women to graduate from its medical school, Apgar knew that her goal of becoming a surgeon would not be achieved easily in a male-dominated profession. Reluctantly, she switched her medical specialty to anesthesiology, she embraced her new field with typical intelligence and energy. At this time, anesthesiology was a relatively new field, having been left by the doctors mostly to the attention of nurses. Apgar realized immediately how much in need of scientifically trained personnel was this significant part of surgery, and she set out to make anesthesiology a separate medical discipline. By 1937, she had become the fiftieth physician to be certified as an anesthesiologist in the United States. The following year she was appointed director of anesthesiology at the Columbia-Presbyterian Medical Center, becoming the first woman to head a department at that institution.

As the attending anesthesiologist who assisted in the delivery of thousands of babies during these years, Apgar realized that infants had died from respiratory or circulatory complications that early treatment could have prevented. Apgar decided to bring her considerable research skills to this childbirth dilemma, and her careful study resulted in her publication of the Apgar Score System in 1952.

the newborn is considered normal, and therefore not a cause for concern. Most infants score between 7 and 10. These infants are expected to have an excellent outcome. A score of 4, 5, or 6 requires immediate intervention, usually in the form of oxygen and respiratory assistance, or perhaps just suctioning if breathing has been obstructed by mucus. While suctioning is being done, a source of oxygen may be placed near, but not over the newborn's nose and mouth. This form of oxygen is referred to as *blow-by*. A score in the 4-6 range indicates that the neonate is having some difficulty adapting to extrauterine life. This may be due to medications given to the mother during a difficult labor, or at the very end of labor, when these medications have an exaggerated effect on the neonate.

Abnormal results

With a score of 0-3, the newborn is unresponsive, apneic, pale, limp and may not have a pulse. Interventions to resuscitate will begin immediately. The test is repeated at five minutes after birth and both scores are documented. Should the resuscitation effort continue into the five-minute time period, interventions will not stop in order to perform the test. The one-minute score indicates the need for intervention at birth. It addresses survival and prevention of birth-related complications resulting from inadequate oxygen supply. Poor oxygenation may be due to inadequate neurological and/or chemical control of respiration. The five-minute score appears to have a more predictive value for morbidity and normal development, although research studies on this are inconsistent in their conclusions.

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Esther Csapo Rastegari, RN, BSN, EdM

Aphasia

Definition

Aphasia is condition characterized by either partial or total loss of the ability to communicate verbally or using written words. A person with aphasia may have difficulty speaking, reading, writing, recognizing the names of objects, or understanding what other people have said. Aphasia is caused by a brain injury, as may occur during a traumatic accident or when the brain is deprived of oxygen during a **stroke**. It may also be caused by a **brain tumor**, a disease such as Alzheimer's, or an infection, like **encephalitis**. Aphasia may be temporary or permanent. Aphasia does not include speech impediments caused by loss of muscle control.

Description

To understand and use language effectively, an individual draws upon word memory—stored information on what certain words mean, how to put them together, and how and when to use them properly. For a majority of people, these and other language functions are located in the left side (hemisphere) of the brain. Damage to this side of the brain is most commonly linked to the development of aphasia. Interestingly, however, left-handed people appear to have language areas in both the left and right hemispheres of the brain and, as a result, may develop aphasia from damage to either side of the brain.

Stroke is the most common cause of aphasia in the United States. Approximately 500,000 individuals suffer strokes each year, and 20% of these individuals develop some type of aphasia. Other causes of brain damage include head injuries, brain tumors, and infection. About half of the people who show signs of aphasia have what is called temporary or transient aphasia and recover completely within a few days. An estimated one million Americans suffer from some form of permanent aphasia. As yet, no connection between aphasia and age, gender, or race has been found.

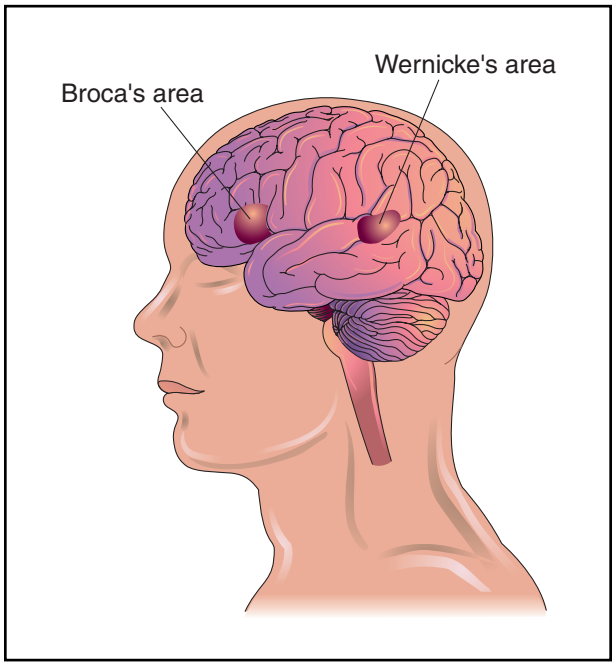
Aphasia is sometimes confused with other conditions that affect speech, such as dysarthria and apraxia. These condition affect the muscles used in speaking rather than language function itself. Dysarthria is a speech disturbance caused by lack of control over the muscles used in speaking, perhaps due to nerve damage. Speech apraxia is a speech disturbance in which language comprehension and muscle control are retained, but the memory of how to use the muscles to form words is not.

Causes and symptoms

Aphasia can develop after an individual sustains a brain injury from a stroke, head trauma, tumor, or infection, such as herpes encephalitis. As a result of this injury, the pathways for language comprehension or production are disrupted or destroyed. For most people, this means damage to the left hemisphere of the brain. (In 95 to 99% of right-handed people, language centers are in the left hemisphere, and up to 70% of left-handed people also have left-hemisphere language dominance.) According to the traditional classification scheme, each form of aphasia is caused by damage to a different part of the left hemisphere of the brain. This damage affects one or more of the basic language functions: speech, naming (the ability to identify an object, color, or other item with an appropriate word or term), repetition (the ability to repeat words, phrases, and sentences), hearing comprehension (the ability to understand spoken language), reading (the ability to understand written words and their meaning), and writing (the ability to communicate and record events with text).

The traditional classification scheme includes eight types of aphasia:

- Broca's aphasia, also called motor aphasia, results from damage to the front portion or frontal lobe of the language-dominant area of the brain. Individuals with Broca's aphasia may be completely unable to use speech (**mutism**) or may be able to use single-word statements or even full sentences, though these sentences may require a great deal of effort to construct. Small words, such as conjunctions (and, or, but) and articles (the, an, a), may be omitted, leading to a "telegraph" quality in their speech. Hearing comprehension is usually not affected, so they are able to understand other people's speech and conversation and can follow commands. Often, they may experience weakness on the right side of their bodies, which can make it difficult to write. Reading ability is impaired, and they may have difficulty finding the right word when speaking. Individuals with Broca's aphasia may become frustrated and depressed because they are aware of their language difficulties.
- Wernicke's aphasia is caused by damage to the side portion or temporal lobe of the language-dominant area



Broca's aphasia results from damage to the frontal lobe of the language-dominant area of the brain. Individuals with Broca's aphasia may become mute or may be able to use single-word statements or full sentences, although it may require great effort. Wernicke's aphasia is caused by damage to the temporal lobe of the language-dominant area of the brain. People with this condition speak in long, uninterrupted sentences, but the words used are often unnecessary and unintelligible. *(Illustration by Electronic Illustrators Group.)*

of the brain. Individuals with Wernicke's aphasia speak in long, uninterrupted sentences; however, the words used are frequently unnecessary or even made-up. They have a great deal of difficulty understanding other people's speech, sometimes to the point of being unable to understand spoken language at all. Reading ability is diminished, and although writing ability is retained, what is written may be abnormal. No physical symptoms, such as the right-sided weakness seen with Broca's aphasia, are typically observed. Also, in contrast to Broca's aphasia, individuals with Wernicke's aphasia are not aware of their language errors.

- Global aphasia is caused by widespread damage to the language areas of the left hemisphere. As a result, all basic language functions are affected, but some areas may be more affected than others. For example, an individual may have difficulty speaking but may be able to write well. The individual may experience weakness and loss of feeling on the right side of their body.
- Conduction aphasia, also called associative aphasia, is rather uncommon. Individuals with conduction aphasia are unable to repeat words, sentences, and phrases. Speech is fairly unbroken, although individuals may frequently correct themselves and words may be skipped or repeated. Although able to understand spoken language, it may also be difficult for the individual with conduction aphasia to find the right word to describe a person or object. The impact of this condition on reading and writing ability varies. As with other types of aphasia, right-sided weakness or sensory loss may be present.
- Anomic or nominal aphasia primarily influences an individual's ability to find the right name for a person or object. As a result, an object may be described rather than named. Hearing comprehension, repetition, reading, and writing are not affected, other than by this inability to find the right name. Speech is fluent, except for pauses as the individual tries to recall the right name. Physical symptoms are variable, and some individuals have no symptoms of one-sided weakness or sensory loss.
- Transcortical aphasia is caused by damage to the language areas of the left hemisphere outside the primary language areas. There are three types of aphasia: transcortical motor aphasia, transcortical sensory aphasia, and mixed transcortical aphasia. All of the transcortical aphasias are distinguished from other types by the individual's ability to repeat words, phrases, or sentences. Other language functions may also be impaired to varying degrees, depending on the extent and particular location of brain damage.

As researchers continue to learn more about the brain's structure and function, new types of aphasia are being recognized. One newly recognized type of aphasia, subcortical aphasia, mimics the symptoms of other traditional types of aphasia but involves language disorders that are not typical. This type of aphasia is associated with injuries to areas of the brain typically not identified with language and language processing.

Diagnosis

Following brain injury, an initial bedside assessment is made to determine whether language function has been affected. If the individual experiences difficulty communicating, attempts are made to determine whether this difficulty arises from impaired language comprehension or an impaired ability to speak. A typical examination involves listening to spontaneous speech and evaluating the individual's ability to recognize and name objects, comprehend what is heard, and repeat sample words and phrases. The individual may also be asked to read text aloud and explain what the passage means. In addition, writing ability is evaluated by having the individual copy text, transcribe dictated text, and write something without prompting.

KEY TERMS

Anomic aphasia—A condition characterized by either partial or total loss of the ability to recall the names of persons or things as a result of a stroke, head injury, brain tumor, or infection.

Broca's aphasia—A condition characterized by either partial or total loss of the ability to express oneself, either through speech or writing. Hearing comprehension is not affected. This condition may result from a stroke, head injury, brain tumor, or infection.

Computed tomography (CT)—An imaging technique that uses cross-sectional x rays of the body to create a three-dimensional image of the body's internal structures.

Conduction aphasia—A condition characterized by the inability to repeat words, sentences, or phrases as a result of a stroke, head injury, brain tumor, or infection.

Frontal lobe—The largest, most forward-facing part of each side or hemisphere of the brain.

Global aphasia—A condition characterized by either partial or total loss of the ability to communicate verbally or using written words as a result of widespread injury to the language areas of the brain. This condition may be caused by a stroke, head injury, brain tumor, or infection. The exact language abilities affected vary depending on the location and extent of injury.

Hemisphere—One of the two halves or sides-the left and the right-of the brain.

Magnetic resonance imaging (MRI)—An imaging technique that uses a large circular magnet and radio waves to generate signals from atoms in the body. These signals are used to construct images of internal structures.

Subcortical aphasia—A condition characterized by either partial or total loss of the ability to communicate verbally or using written words as a result of damage to non language-dominated areas of the brain. This condition may be caused by a stroke, head injury, brain tumor, or infection.

Temporal lobe—The part of each side or hemisphere of the brain that is on the side of the head, nearest the ears.

Transcortical aphasia—A condition characterized by either partial or total loss of the ability to communicate verbally or using written words that does not affect an individual's ability to repeat words, phrases, and sentences.

Wernicke's aphasia—A condition characterized by either partial or total loss of the ability to understand what is being said or read. The individual maintains the ability to speak, but speech may contain unnecessary or made-up words.

A speech pathologist or neuropsychologist may be asked to conduct more extensive examinations using in-depth, standardized tests. Commonly used tests include the Boston Diagnostic Aphasia Examination, the Western Aphasia Battery, and possibly, the Porch Index of Speech Ability.

The results of these tests indicate the severity of the aphasia and may also provide information regarding the exact location of the brain damage. This more extensive testing is also designed to provide the information necessary to design an individualized speech therapy program. Further information about the location of the damage is gained through the use of imaging technology, such as **magnetic resonance imaging** (MRI) and **computed tomography scans** (CT).

Treatment

Initially, the underlying cause of aphasia must be treated or stabilized. To regain language function, therapy must begin as soon as possible following the injury. Although there are no medical or surgical procedures currently available to treat this condition, aphasia resulting from stroke or **head injury** may improve through the use of speech therapy. For most individuals, however, the primary emphasis is placed on making the most of retained language abilities and learning to use other means of communication to compensate for lost language abilities.

Speech therapy is tailored to meet individual needs, but activities and tools that are frequently used include the following:

- **Exercise** and practice. Weakened muscles are exercised by repetitively speaking certain words or making facial expressions, such as smiling.
- Picture cards. Pictures of everyday objects are used to improve word recall and increase vocabulary. The

names of the objects may also be repetitively spoken aloud as part of an exercise and practice routine.

- Picture boards. Pictures of everyday objects and activities are placed together, and the individual points to certain pictures to convey ideas and communicate with others.
- Workbooks. Reading and writing exercises are used to sharpen word recall and regain reading and writing abilities. Hearing comprehension is also redeveloped using these exercises.
- Computers. Computer software can be used to improve speech, reading, recall, and hearing comprehension by, for example, displaying pictures and having the individual find the right word.

Prognosis

The degree to which an individual can recover language abilities is highly dependent on how much brain damage occurred and the location and cause of the original brain injury. Other factors include the individual's age, general health, motivation and willingness to participate in speech therapy, and whether the individual is left or right handed. Language areas may be located in both the left and right hemispheres in left-handed individuals. Left-handed individuals are, therefore, more likely to develop aphasia following brain injury, but because they have two language centers, may recover more fully because language abilities can be recovered from either side of the brain. The intensity of therapy and the time between diagnosis and the start of therapy may also affect the eventual outcome.

Prevention

Because there is no way of knowing when a stroke, traumatic head injury, or disease will occur, very little can be done to prevent aphasia. The extent of recovery, however, in some cases, can be affected by an individual's willingness to cooperate and participate in speech therapy directly following the injury.

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National Institute on Deafness and Other Communication Disorders. National Institutes of Health, 31 Center Drive, MSC 2320, Bethesda, MD USA 20892-2320. (800) 241-1044. <http://www.nidcd.nih.gov>.

Julia Barrett

Apheres *see* **Transfusion**

Aplastic anemia

Definition

Aplastic anemia is a disorder in which the bone marrow greatly decreases or stops production of blood cells.

Description

The bone marrow (soft tissue which is located within the hard outer shell of the bones) is responsible for the production of all the types of blood cells. The mature forms of these cells include red blood cells, which carry oxygen throughout the body; white blood cells, which fight infection; and platelets, which are involved in clotting. In aplastic anemia, the basic structure of the marrow becomes abnormal, and those cells responsible for generating blood cells (hematopoietic cells) are greatly decreased in number or absent. These hematopoietic cells are replaced by large quantities of fat.

Yearly, aplastic anemia strikes about 5-10 people in every one million. Although aplastic anemia strikes both males and females of all ages, there are two age groups that have an increased risk. Both young adults (between 15-30 years of age) and the elderly (over the age of 60) have higher rates of aplastic anemia than the general population. While the disorder occurs worldwide, young adults in Asia have a higher disease rate than do populations in North America and Europe.

Causes and symptoms

Aplastic anemia falls into three basic categories, based on the origin of its cause: idiopathic, acquired, and hereditary.

In about 60% of cases, aplastic anemia is considered to be idiopathic, meaning that the cause of the disorder is unknown.

Acquired aplastic anemia refers to those cases where certain environmental factors and physical conditions seem to be associated with development of the disease. Acquired aplastic anemia can be associated with:

- exposure to drugs, especially anti-cancer agents, **antibiotics**, anti-inflammatory agents, seizure medications, and antithyroid drugs (drugs given to stop the functioning of an overactive thyroid)
- exposure to radiation
- chemical exposure (especially to the organic solvent benzene and certain insecticides)
- infection with certain viruses (especially those causing viral hepatitis, as well as Epstein-Barr virus, parvovirus, and HIV, the virus which can cause **AIDS**)
- pregnancy
- certain other disorders, including a disease called paroxysmal nocturnal hemoglobinuria, an autoimmune reaction called graft-vs-host disease (which occurs when the body's immune system attacks and destroys the body's own cells), and certain connective tissue diseases

Hereditary aplastic anemia is relatively rare, but does occur in Fanconi's anemia, Shwachman-Diamond syndrome, and dyskeratosis congenita.

Symptoms of aplastic anemia tend to be those of other **anemias**, including **fatigue**, weakness, tiny reddish-purple marks (petechiae) on the skin (evidence of pinpoint hemorrhages into the skin), evidence of abnormal bruising, and bleeding from the gums, nose, intestine, or vagina. The patient is likely to appear pale. If the anemia progresses, decreased oxygen circulating in the blood may lead to an increase in heart rate and the sudden appearance of a new heart murmur.

Diagnosis

The **blood count** in aplastic anemia will reveal low numbers of all formed blood cells. Red blood cells will appear normal in size and coloration, but greatly decreased in number. Cells called reticulocytes (very young red blood cells, which are usually produced in great numbers by the bone marrow in order to compensate for a severe anemia) will be very low in number. Platelets and white blood cells will also be decreased in number, though normal in structure.

A sample of the patient's bone marrow will need to be removed by needle (usually from the hip bone) and examined under a microscope. If aplastic anemia is present, this examination will reveal very few or no hematopoietic cells, and replacement with fat.

Treatment

The first step in the treatment of aplastic anemia involves discontinuing exposure to any substance that may be causing the disorder. Although it would seem that blood transfusions would be helpful in this disease, in fact, they only serve as a temporary help, and may complicate future attempts at **bone marrow transplantation**.

The most successful treatment for aplastic anemia is bone marrow transplantation. To do this, a marrow donor (often a sibling) must be identified. There are a number of tissue markers which must be examined to determine whether a bone marrow donation is likely to be compatible with the patient's immune system. Compatibility is necessary to avoid complications, including the destruction of the donor marrow by the patient's own immune system.

Patients who cannot undergo bone marrow transplant can be treated with a number of agents, including antithymocyte globulin (ATG), cyclophosphamide, steroids, and cyclosporine. These agents all have the potential to cause a number of troublesome side-effects. Furthermore, not all patients respond fully to these agents. Still, even among those patients who do have a good response, many later suffer a relapse (return) of aplastic anemia.

Prognosis

Aplastic anemia is a life-threatening illness. Without treatment, it will almost surely progress to **death**. Survival depends on how severe the disease is at diagnosis, which type of treatment a patient is eligible for, and what kind of response their body has to that treatment. The worst-prognosis type of aplastic anemia is one associated with very low numbers of a particular type of white blood cell. These patients have a high chance of dying from overwhelming bacterial infections. In fact, 80% of all patients treated with blood transfusions alone die within 18 months to two years. Patients who undergo bone marrow transplantation have a 60-90% chance of being cured of the disease.

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KEY TERMS

Bone marrow—A substance found in the cavities of bones, especially the long bones and the sternum (breast bone). The bone marrow contains those cells which are responsible for the production of the blood cells (red blood cells, white blood cells, and platelets).

Bone marrow transplant—A procedure in which a quantity of bone marrow is extracted through a needle from a donor, and then passed into a patient to replace the patient's diseased or absent bone marrow.

Hematopoietic cells—Those cells which are lodged within the bone marrow, and which are responsible for producing the cells which circulate in the blood (red blood cells, white blood cells, and platelets).

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ORGANIZATIONS

Aplastic Anemia Foundation of America. P.O. Box 613, Annapolis, MD 21404. (800) 747-2820. <http://www.aplastic.org>.

Rosalyn Carson-DeWitt, MD

Aplastic crisis *see* **Fifth disease**

Appendectomy

Definition

Appendectomy is the surgical removal of the appendix. The appendix is a worm-shaped hollow pouch attached to the cecum, the beginning of the large intestine.

Purpose

Appendectomies are performed to treat **appendicitis**, an inflamed and infected appendix.

Precautions

Since appendicitis occurs most commonly in males between the ages of 10-14 and in females between the ages of 15-19, appendectomy is most often performed during this time. The diagnosis of appendicitis is most difficult in the very young (less than two years of age) and in the elderly.

Description

Appendectomy is considered a major surgical operation. Therefore, a general surgeon must perform this operation in the operating room of a hospital. An anesthesiologist is also present during the operation to administer an anesthetic. Most often the anesthesiologist uses a general anesthetic technique whereby patients are put to sleep and made **pain** free by administering drugs in the vein or by agents inhaled through a tube placed in the windpipe. Occasionally a spinal anesthetic may be used.

After the patient is anesthetized, the general surgeon can remove the appendix either by using the traditional open procedure (in which a 2-3 [5-7.6 cm] in incision is made in the abdomen) or via **laparoscopy** (in which four 1 in [2.5 cm] incisions are made in the abdomen).

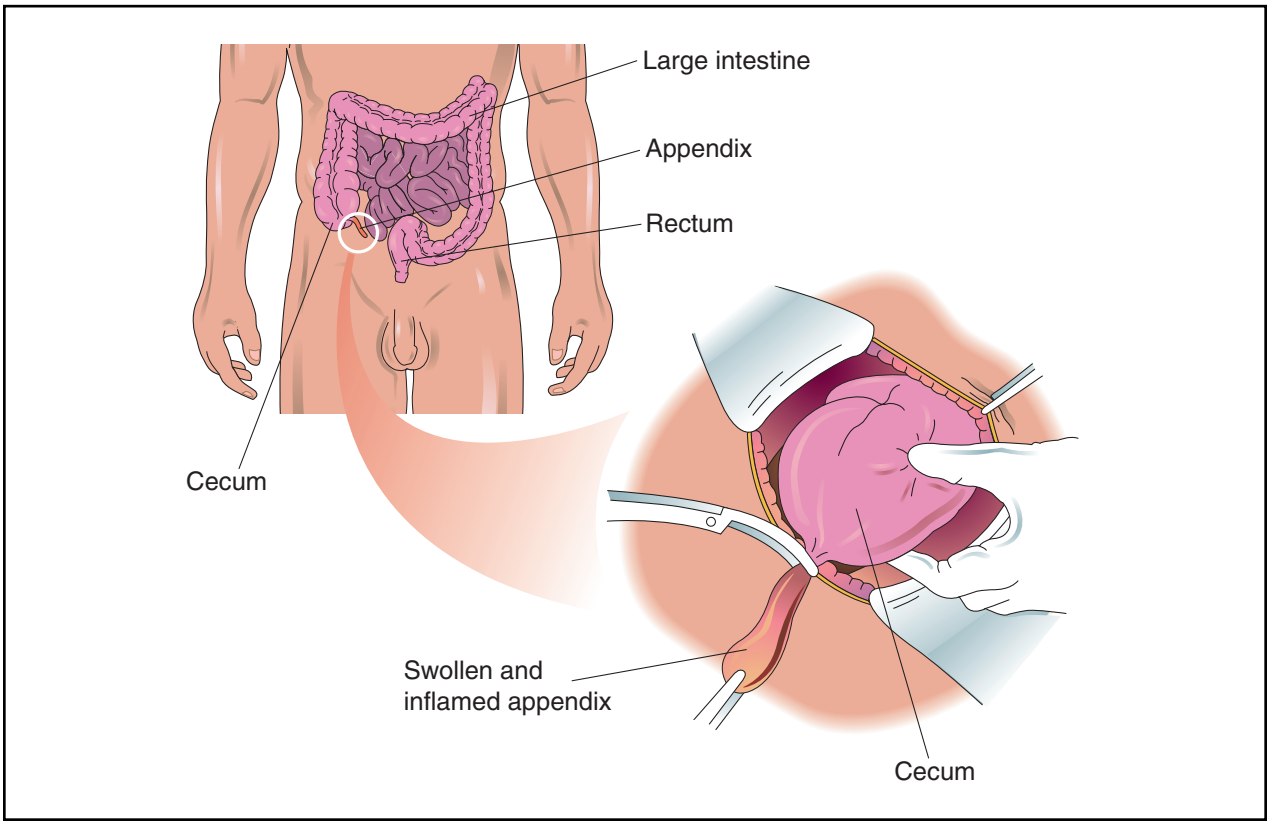
Traditional open appendectomy

When the surgeon uses the open approach, he makes an incision in the lower right section of the abdomen. Most incisions are less than 3 in (7.6 cm) in length. The surgeon then identifies all of the organs in the abdomen and examines them for other disease or abnormalities. The appendix is located and brought up into the **wounds**. The surgeon separates the appendix from all the surrounding tissue and its attachment to the cecum and then removes it. The site where the appendix was previously attached, the cecum, is closed and returned to the abdomen. The muscle layers and then the skin are sewn together.

Laproscopic appendectomy

When the surgeon conducts a laproscopic appendectomy, four incisions, each about 1 in (2.5 cm) in length, are made. One incision is near the umbilicus, or navel, and one is between the umbilicus and the pubis. Two other incisions are smaller and are in the right side of the lower abdomen. The surgeon then passes a camera and special instruments through these incisions. With the aid of this equipment, the surgeon visually examines the abdominal organs and identifies the appendix. Similarly, the appendix is freed from all of its attachments and removed. The place where the appendix was formerly attached, the cecum, is stitched. The appendix is removed through one of the incisions. The instruments are removed and then all of the incisions are closed.

Studies and opinions about the relative advantages and disadvantages of each method are divided. A skilled surgeon can perform either one of these procedures in



A traditional open appendectomy. After the surgeon makes an incision in the lower right section of the abdomen, he/she pulls the appendix up, separates it from the surrounding tissue and its attachment to the cecum, and then removes it. *(Illustration by Electronic Illustrators Group.)*

less than one hour. However, laproscopic appendectomy (LA) always takes longer than traditional appendectomy (TA). The increased time required to do a LA increases the patient's exposure to anesthetics, which increases the risk of complications. The increased time requirement also escalates fees charged by the hospital for operating room time and by the anesthesiologist. Since LA also requires specialized equipment, the fees for its use also increases the hospital charges. Patients with either operation have similar pain medication needs, begin eating **diets** at comparable times, and stay in the hospital equivalent amounts of time. LA is of special benefit in women in whom the diagnosis is difficult and gynecological disease (such as **endometriosis**, **pelvic inflammatory disease**, ruptured ovarian follicles, ruptured **ovarian cysts**, and tubal pregnancies) may be the source of pain and not appendicitis. If LA is done in these patients, the pelvic organs can be more thoroughly examined and a definitive diagnosis made prior to removal of the appendix. Most surgeons select either TA or LA based on the individual needs and circumstances of the patient.

Insurance plans do cover the costs of appendectomy. Fees are charged independently by the hospital and the physicians. Hospital charges include fees for operating and recovery room use, diagnostic and laboratory testing, as well as the normal hospital room charges. Surgical fees vary from region to region and range between $250-$750. The anesthesiologist's fee depends upon the health of the patient and the length of the operation.

Preparation

Once the diagnosis of appendicitis is made and the decision has been made to perform an appendectomy, the patient undergoes the standard preparation for an operation. This usually takes only one to two hours and includes signing the operative consents, patient identification procedures, evaluation by the anesthesiologist, and moving the patient to the operating suites of the hospital. Occasionally, if the patient has been ill for a prolonged period of time or has had protracted vomiting, a delay of few to several hours may be necessary to give the patient fluids and **antibiotics**.

Aftercare

Recovery from an appendectomy is similar to other operations. Patients are allowed to eat when the stomach

and intestines begin to function again. Usually the first meal is a clear liquid diet—broth, juice, soda pop, and gelatin. If patients tolerate this meal, the next meal usually is a regular diet. Patients are asked to walk and resume their normal physical activities as soon as possible. If TA was done, work and physical education classes may be restricted for a full three weeks after the operation. If a LA was done, most patients are able to return to work and strenuous activity within one to three weeks after the operation.

Risks

Certain risks are present when any operation requires a general anesthetic and the abdominal cavity is opened. **Pneumonia** and collapse of the small airways (**atelectasis**) often occurs. Patients who smoke are at a greater risk for developing these complications. **Thrombophlebitis**, or inflammation of the veins, is rare but can occur if the patient requires prolonged bed rest. Bleeding can occur but rarely is a blood **transfusion** required. Adhesions (abnormal connections to abdominal organs by thin fibrous tissue) is a known complication of any abdominal procedure such as appendectomy. These adhesions can lead to intestinal obstruction which prevents the normal flow of intestinal contents. **Hernia** is a complication of any incision, However, they are rarely seen after appendectomy because the abdominal wall is very strong in the area of the standard appendectomy incision.

The overall complication rate of appendectomy depends upon the status of the appendix at the time it is removed. If the appendix has not ruptured the complication rate is only about 3%. However, if the appendix has ruptured the complication rate rises to almost 59%. Wound infections do occur and are more common if the appendicitis was severe, far advanced, or ruptured. An **abscess** may form in the abdomen as a complication of appendicitis.

Occasionally, an appendix will rupture prior to its removal, spilling its contents into the abdominal cavity. **Peritonitis** or a generalized infection in the abdomen will occur. Treatment of peritonitis as a result of a ruptured appendix includes removal of what remains of the appendix, insertion of drains (rubber tubes that promote the flow of infection inside the abdomen to outside of the body), and antibiotics. Fistula formation (an abnormal connection between the cecum and the skin) rarely occurs. It is only seen if the appendix has a broad attachment to the cecum and the appendicitis is far advanced causing destruction of the cecum itself.

Normal results

Most patients feel better immediately after an operation for appendicitis. Many patients are discharged from the hospital within 24 hours after the appendectomy. Others may require a longer stay—three to five days. Almost all patients are back to their normal activities within three weeks.

The mortality rate of appendicitis has dramatically decreased over time. Currently, the mortality rate is estimated at one to two per 1,000,000 cases of appendicitis. **Death** is usually due to peritonitis, intra abdominal abscess or severe infection following rupture.

The complications associated with undiagnosed, misdiagnosised, or delayed diagnosis of appendectomy are very significant. The diagnosis is of appendicitis is difficult and never certain. This has led surgeons to perform an appendectomy any time that they feel appendicitis is the diagnosis. Most surgeons feel that in approximately 20% of their patients, a normal appendix will be removed. Rates much lower than this would seem to indicate that the diagnosis of appendicitis was being frequently missed.

KEY TERMS

Abscess—A collection of pus buried deep in the tissues or in a body cavity.

Anesthesiologist—A physician who has special training and expertise in the delivery of anesthetics.

Anesthetics—Drugs or methodologies used to make a body area free of sensation or pain.

Cecum—The beginning of the large intestine and the place where the appendix attaches to the intestinal tract.

General surgeon—A physician who has special training and expertise in performing a variety of operations.

Pelvic organs—The organs inside of the body that are located within the confines of the pelvis. This includes the bladder and rectum in both sexes and the uterus, ovaries, and fallopian tubes in females.

Pubis—The anterior portion of the pelvis located in the anterior abdomen.

Thrombophlebitis—Inflammation of the veins, usually in the legs, which causes swelling and tenderness in the affected area.

Umbilicus—The navel.

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Mary Jeanne Krob, MD, FACS

Appendicitis

Definition

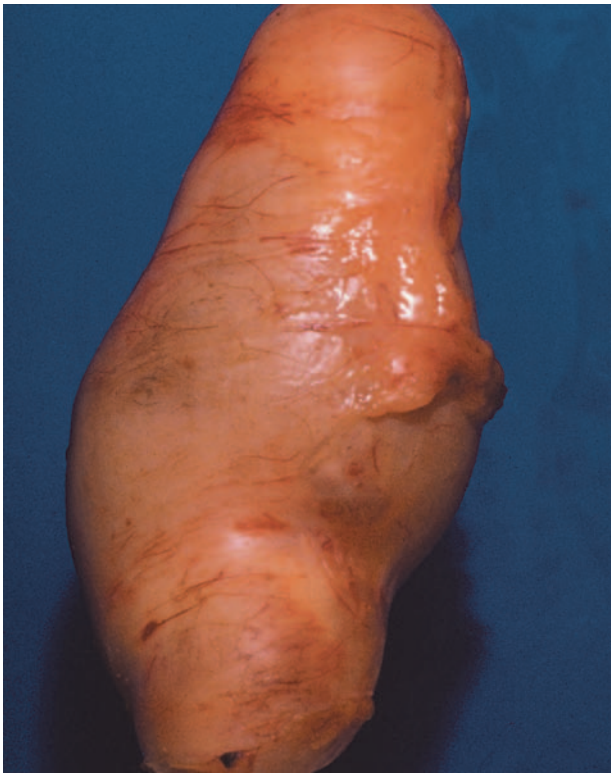
Appendicitis is an inflammation of the appendix, which is the worm-shaped pouch attached to the cecum, the beginning of the large intestine. The appendix has no known function in the body, but it can become diseased. Appendicitis is a medical emergency, and if it is left untreated the appendix may rupture and cause a potentially fatal infection.

Description

Appendicitis is the most common abdominal emergency found in children and young adults. One person in 15 develops appendicitis in his or her lifetime. The incidence is highest among males aged 10-14, and among females aged 15-19. More males than females develop appendicitis between **puberty** and age 25. It is rare in the elderly and in children under the age of two.

The hallmark symptom of appendicitis is increasingly severe abdominal **pain**. Since many different conditions can cause abdominal pain, an accurate diagnosis of appendicitis can be difficult. A timely diagnosis is important, however, because a delay can result in perforation, or rupture, of the appendix. When this happens, the infected contents of the appendix spill into the abdomen, potentially causing a serious infection of the abdomen called **peritonitis**.

Other conditions can have similar symptoms, especially in women. These include **pelvic inflammatory disease**, ruptured ovarian follicles, ruptured **ovarian cysts**, tubal pregnancies, and **endometriosis**. Various forms of stomach upset and bowel inflammation may also mimic appendicitis.



An extracted appendix. *(Photograph by Lester V. Bergman, Corbis Images. Reproduced by permission.)*

The treatment for acute (sudden, severe) appendicitis is an **appendectomy**, surgery to remove the appendix. Because of the potential for a life-threatening ruptured appendix, persons suspected of having appendicitis are often taken to surgery before the diagnosis is certain.

Causes and symptoms

The causes of appendicitis are not well understood, but it is believed to occur as a result of one or more of these factors: an obstruction within the appendix, the development of an ulceration (an abnormal change in tissue accompanied by the **death** of cells) within the appendix, and the invasion of bacteria.

Under these conditions, bacteria may multiply within the appendix. The appendix may become swollen and filled with pus (a fluid formed in infected tissue, consisting of while blood cells and cellular debris), and may eventually rupture. Signs of rupture include the presence of symptoms for more than 24 hours, a **fever**, a high white blood cell count, and a fast heart rate. Very rarely,

the inflammation and symptoms of appendicitis may disappear but recur again later.

The distinguishing symptom of appendicitis is pain beginning around or above the navel. The pain, which may be severe or only achy and uncomfortable, eventually moves into the right lower corner of the abdomen. There, it becomes more steady and more severe, and often increases with movement, coughing, and so forth. The abdomen often becomes rigid and tender to the touch. Increasing rigidity and tenderness indicates an increased likelihood of perforation and peritonitis.

Loss of appetite is very common. **Nausea and vomiting** may occur in about half of the cases and occasionally there may be **constipation** or **diarrhea**. The temperature may be normal or slightly elevated. The presence of a fever may indicate that the appendix has ruptured.

Diagnosis

A careful examination is the best way to diagnose appendicitis. It is often difficult even for experienced physicians to distinguish the symptoms of appendicitis from those of other abdominal disorders. Therefore, very specific questioning and a thorough **physical examination** are crucial. The physician should ask questions, such as where the pain is centered, whether the pain has shifted, and where the pain began. The physician should press on the abdomen to judge the location of the pain and the degree of tenderness.

The typical sequence of symptoms is present in about 50% of cases. In the other half of cases, less typical patterns may be seen, especially in pregnant women, older patients, and infants. In pregnant women, appendicitis is easily masked by the frequent occurrence of mild abdominal pain and nausea from other causes. Elderly patients may feel less pain and tenderness than most patients, thereby delaying diagnosis and treatment, and leading to rupture in 30% of cases. Infants and young children often have diarrhea, vomiting, and fever in addition to pain.

While laboratory tests cannot establish the diagnosis, an increased white cell count may point to appendicitis. **Urinalysis** may help to rule out a urinary tract infection that can mimic appendicitis.

Patients whose symptoms and physical examination are compatible with a diagnosis of appendicitis are usually taken immediately to surgery, where a laparotomy (surgical exploration of the abdomen) is done to confirm the diagnosis. In cases with a questionable diagnosis, other tests, such as a computed tomography scan (CT) may be performed to avoid unnecessary surgery. An ultrasound examination of the abdomen may help to identify an inflamed appendix or other condition that would explain the symptoms. Abdominal x-rays are not of much value except when the appendix has ruptured.

Often, the diagnosis is not certain until an operation is done. To avoid a ruptured appendix, surgery may be recommended without delay if the symptoms point clearly to appendicitis. If the symptoms are not clear, surgery may be postponed until they progress enough to confirm a diagnosis.

When appendicitis is strongly suspected in a woman of child-bearing age, a diagnostic **laparoscopy** (an examination of the interior of the abdomen) is sometimes recommended before the appendectomy in order to be sure that a gynecological problem, such as a ruptured ovarian cyst, is not causing the pain. In this procedure, a lighted viewing tube is inserted into the abdomen through a small incision around the navel.

A normal appendix is discovered in about 10-20% of patients who undergo laparotomy, because of suspected appendicitis. Sometimes the surgeon will remove a normal appendix as a safeguard against appendicitis in the future. During the surgery, another specific cause for the pain and symptoms of appendicitis is found for about 30% of these patients.

Treatment

The treatment of appendicitis is an immediate appendectomy. This may be done by opening the abdomen in the standard open appendectomy technique, or through laparoscopy. In laparoscopy, a smaller incision is made through the navel. Both methods can successfully accomplish the removal of the appendix. It is not certain that laparoscopy holds any advantage over open appendectomy. When the appendix has ruptured, patients undergoing a laparoscopic appendectomy may have to be switched to the open appendectomy procedure for the successful management of the rupture. If a ruptured appendix is left untreated, the condition is fatal.

Prognosis

Appendicitis is usually treated successfully by appendectomy. Unless there are complications, the patient should recover without further problems. The mortality rate in cases without complications is less than 0.1%. When an appendix has ruptured, or a severe infection has developed, the likelihood is higher for complications, with slower recovery, or death from disease. There are higher rates of perforation and mortality among children and the elderly.

Prevention

Appendicitis is probably not preventable, although there is some indication that a diet high in green vegetables and tomatoes may help prevent appendicitis.

KEY TERMS

Appendectomy (or appendicectomy)—Surgical removal of the appendix.

Appendix—The worm-shaped pouch attached to the cecum, the beginning of the large intestine.

Laparotomy—Surgical incision into the loin, between the ribs and the pelvis, which offers surgeons a view inside the abdominal cavity.

Peritonitis—Inflammation of the peritoneum, membranes lining the abdominal pelvic wall.

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Caroline Andrews Helwick

Appendix removal *see* **Appendectomy**

Applied kinesiology

Definition

Applied kinesiology (AK) is the study of muscles and the relationship of muscle strength to health. It incorporates a system of manual muscle testing and therapy. AK is based on the theory that an organ dysfunction is accompanied by a specific muscle weakness. Diseases are diagnosed through muscle-testing procedures and then treated. AK is not the same as kinesiology, or biomechanics, which is the scientific study of movement.

Purpose

AK is not designed for crisis medicine. For example, an AK practitioner cannot cure **cancer**, arthritis, diabetes, heart disease, or infections. This therapy is designed to be a part of a holistic approach to preventive medicine. The goals of AK are to (1) restore normal nerve function, (2) achieve normal endocrine, immune, digestive, and other internal organ functions, (3) intervene early in degenerative processes to prevent or delay pathological conditions, and to (4) restore postural balance, correct gait (walking) impairment, and improve range of motion.

Description

Origins

AK is based on principles of functional neurology, anatomy, physiology, biomechanics, and biochemistry as well as principles from Chinese medicine, **acupuncture**, and massage. It was developed from traditional kinesiology in 1964 by George G. Goodheart, a chiropractor from Detroit, Michigan. He observed that each large muscle relates to a body organ. A weakness in a muscle may mean that there is a problem in the associated organ. Goodheart found that by treating the muscle and making it strong again, he was able to improve the function of the organ as well. For example, if a particular nutritional supplement was given to a patient, and the muscle tested strong, it was the correct supplement for the patient. If the muscle remained weak, it was not. Other methods of treatment can be evaluated in a similar manner. Goodheart also found that painful nodules (small bumps) may be associated with a weak muscle. By deeply massaging the muscle, he was able to improve its strength. Goodheart's findings in 1964 led to the origin and insertion treatment, the first method developed in AK. Other diagnostic and therapeutic procedures were developed for various reflexes described by other chiropractors and doctors. Goodheart incorporated acupuncture meridian therapy into AK after reading the writings of Felix Mann, M.D.

Goodheart considered AK to be a therapeutic tool that incorporates feedback from the body. He said that "applied kinesiology is based on the fact that the body language never lies." He felt that the body's muscles were indicators of disharmony. Once muscle weakness has been ascertained, the problem may be solved in a variety of ways. If a practitioner approaches the problem correctly, he believed, making the proper and adequate diagnosis and treatment, the outcome is satisfactory both to the doctor and to the patient.

According to AK, each muscle in the body relates to a specific meridian or energy pathway (acupuncture

GEORGE GOODHEART (1918–)

Dr. George Goodheart was born in Detroit, Michigan, in 1918 and became a second-generation doctor of chiropractic. He graduated from the National College of Chiropractic in 1939 and is recognized as the founder and developer of Applied Kinesiology. After he joined the U.S. Air Force as an aviation cadet in World War II, he received a promotion to major at the age of 22. He was the youngest ever to attain that rank. He served in active duty from 1941-1946 and continued as a member of the Air Force Reserve until the mid-1950s.

Dr. Goodheart held numerous positions of distinction during his career, including director of the National Chiropractic Mutual Insurance Company and director for the International College of Applied Kinesiology-U.S.A. He also lectured and taught throughout the United States, Japan, Europe, and Australia; and he was the official doctor of chiropractic for the Lake Placed Winter Olympic Games in 1980. He contributes to a variety of trade publications on a regular basis.

In 1998 Dr. Goodheart received a Lifetime Achievement Award from the International College of Kinesiology. Earlier, in 1987 he was honored with the Leonardo da Vinci Award from the Institute for the Achievement of Human Potential, and he was cited for his research by Logan and Palmer Colleges of Chiropractic. He represented the State of Michigan as a delegate to the American Chiropractic Association and was a fellow at the International College of Chiropractic. He resides with his wife, JoAnn in Grosse Pointe Woods, Michigan, where he enjoys skiing and tennis.

lines) in the body. These meridians also relate to organs or glands, allowing the muscles to provide information about organ or gland function and energy. The five areas of diagnosis and therapy for the applied kinesiologist are (1) the nervous system, (2) the lymphatic system, (3) the vascular (blood vessel) system, (4) the cerebrospinal system, and (5) the meridian system.

The first part of AK is muscle testing, which is used to help diagnose what part of the body is functioning abnormally. Muscle testing involves putting the body into a position that requires a certain muscle to remain contracted, and then applying pressure against the muscle. The testing does not measure strength but is meant to reveal stresses and imbalances in the body through the tension in the muscle. The test evaluates the ability of a controlling system (like the nervous system) to adapt the muscle to meet the changing pressure of the examiner's test. AK practitioners also examine structural factors such as posture, gait, and range of motion. Some chiropractors use AK to help them evaluate the success of spinal adjustment. A leg muscle is tested for strength or weakness to determine whether the adjustments made are appropriate.

According to AK, common internal causes of muscle weakness include:

- dysfunction of nerve supply (nerve interference between spine and muscles)
- impairment of lymphatic drainage
- reduction of blood supply
- abnormal pressure in cerebral fluid affecting nerve-to-muscle relationships
- blockage of an acupuncture meridian
- imbalance of chemicals
- dysfunction of organs or glands
- excesses or deficiencies in **nutrition**

Physiological reactions to chemicals, including those associated with nutrition and **allergies**, may also be evaluated using AK. The AK protocol for testing chemical compounds is to place the substance on the patient's tongue so that he tastes the material, and the normal chemical reactions of ingestion begin. In some cases, the substances are inhaled through the nose. The AK practitioner then tests the associated muscle-organ pattern to determine where or if there is a strength or weakness. The patient does not need to swallow the substance for a change in strength or weakness to be identified. David S. Walther, a diplomate of the International College of Applied Kinesiology, has indicated that "it is possible that the central nervous system, recognizing the compound being ingested, relays information to the organs and glands preparing for use of the compound. If the compound is recognized as beneficial, the energy pattern is immediately enhanced, influencing not only the organ or gland, but also the associated muscle."

AK has been used as a diagnostic health tool for a variety of conditions.

Bone health

- neck/low back **pain** and sciatica
- whiplash
- frozen shoulder

Joint health

- carpal tunnel syndrome
- arthritis (including rheumatoid arthritis)
- sports injuries

Muscle health

- tennis elbow

- heel spurs
- wound healing
- intermittent claudication (pain on walking)
- restless legs
- cramps

Vascular system health

- aching varicose veins
- palpitations
- high blood pressure

Nervous system health

- migraine and other headaches
- trigeminal **neuralgia** and other face pains
- Bell's palsy
- anxiety
- depression
- fears
- addictions (like smoking)
- claustrophobia
- Meniere's disorder
- neuralgia (severe, throbbing pain)
- travel sickness
- fatigue
- phantom limb pain
- paralysis of leg or arm after a stroke

Respiratory system health

- hay fever
- rhinitis (inflammed nasal passages)
- **asthma**
- bronchitis
- emphysema (lung disease)

Urinary system health

- cystitis (bladder inflammation), especially in the elderly
- early prostate enlargement
- non-specific **urethritis** (inflammation of tube from the bladder)
- bedwetting

Reproductive organ health

- menstrual pains
- irregular or excessive menstrual activity
- pelvic pains and endometriosis
- menopausal flushes
- painful, nodular breasts
- preparation for childbirth
- vaginal pain
- post herpetic (**shingles**) pain
- impotence and infertility

Skin health

- pain after operations
- painful, prominent scars
- wrinkles or bagginess of face
- acne
- psoriasis and eczema (skin diseases)
- boils
- excessive perspiration
- hemorrhoids
- canker sores
- itching

Immune system health

- recurring **tonsillitis** (inflammed tonsils)
- persisting weakness after a severe illness

Sensory organ health

- tinnitus (ringing ears)
- tired eyes
- retinitis pigmentosa and pterygium retinitis (diseases of the retina)

Digestive system health

- constipation
- colitis or other bowel inflammations
- ulcers
- diarrhea
- obesity

The second part of AK involves the treatment phase. Goodheart and other practitioners of AK have adapted many treatment methods for the problems that are diagnosed with muscle testing. Examples of treatment methods include special **diets**, dietary supplements, **chiropractic** manipulation, osteopathic cranial techniques, acupuncture/meridian therapies, **acupressure**, deep muscle massage, and nervous system coordination procedures. For example, an AK practitioner might treat asthma by looking for weaknesses in specific lower back and leg muscles that share a connection with the adrenal glands. The practitioner will strengthen these muscles and help the adrenal gland produce **bronchodilators**, chemicals that relax or open air passages in the lungs.

The practice of kinesiology requires that it be used in conjunction with other standard diagnostic methods by professionals trained in clinical diagnosis. Most practitioners of AK are chiropractors, but naturopaths, medical doctors, dentists, osteopaths, nutritionists, physical therapists, massage therapists, podiatrists, psychiatrists, and nurse practitioners are also involved. In 1991, 37.2% of 4,835 full-time chiropractors in the United States who responded to a survey by the National Board of Chiropractic Examiners (NBCE) said they used AK in their practice. Subsequent NBCE surveys indicated that 31% of chiropractors in Canada, 60% in Australia, and 72% in New Zealand use AK.

Most practitioners of AK utilize a holistic approach and evaluate a person from a triad-based health perspective. Generally, chiropractors approach health and healing from a structural basis, medical doctors generally from a chemical basis, and psychiatrists and psychologists from a mental or emotional basis. Applied kinesiologists attempt to work with all three areas of health, and in some cases, include a spiritual dimension.

The use of AK is often included in insurance coverage if the policy covers chiropractor benefits. The cost of the AK examination is similar to the costs of other chiropractic practices.

Precautions

AK should only by used by trained professionals with the necessary expertise to perform specific and accurate tests. The AK examination should be combined with a standard physical diagnosis, which often includes laboratory tests, x rays, health and dietary history, and other special tests. An AK examination should enhance a standard diagnosis, not replace it. The total diagnostic work-up should be used to determine the final diagnosis.

The use of manual muscle testing to evaluate nutrition is particularly a problem if it is done by a lay nutrition sales person as a tool to sell his/her product. The person should have the educational background to evaluate nutritional needs as well as have a high level of knowledge in the use of proper muscle testing techniques.

Side effects

If AK is performed by a trained practitioner with the appropriate educational background, side effects from the muscle-testing procedures should be minimal.

Research and general acceptance

AK is a tool that is used by many health care professionals, and especially by chiropractors. A literature review published in 1999 by researchers from the School of Medicine at the University of North Carolina at Chapel Hill and the Foundation for Allied Conservative Therapies Research in Chapel Hill stated that, although AK appears to be a promising methodology, there is a lack of research results relevant to clinical practice and outcomes of AK care. They found this lack of results surprising, since cost, satisfaction, utilization, and changes in symptoms are the important results of clinical practice. In addition, they determined that some studies that were supposed to be an evaluation of AK procedures did not actually use clinical practices and principles of AK. However, from studies adhering to AK principles and employing standardized training by well-trained practitioners, they did state there was some evidence that AK is an objectively verifiable phenomenon. They suggested that "future studies of AK should focus on outcomes of care, including symptoms, function, costs, and safety. Only well-designed studies that account for the individual nature of AK diagnosis and treatment and preserve the proper clinical context of AK treatment will be informative. Understanding the individual components of the process of AK treatment remains important. Studies addressing validation of isolated AK procedures need to meet the methodological challenges of studying appropriate subjects that reflects the current recognized practice and understanding of AK. Further evaluation of the basic physiologic phenomena involved and correlation of AK manual muscle test results will also advance understanding of this diagnostic and therapeutic system."

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ORGANIZATIONS

International College of Applied Kinesiology. 6405 Metcalf Ave., Suite 503, Shawnee Mission, KS 66202. 913-384-5336. <http://www.icakusa.com and <http://www.icak.com>.

Judith Sims

APSGN *see* **Acute poststreptococcal glomerulonephritis**

APTT *see* **Partial thromboplastin time**

Arachnodactyly *see* **Marfan syndrome**

Arbovirus encephalitis

Definition

Encephalitis is a serious inflammation of the brain. Arbovirus encephalitis is caused by a virus from the Arbovirus group. The term *arbovirus* stands for *Arthropod-borne virus* because these viruses are passed to humans by members of the phylum Arthropoda (which includes insects and spiders).

Description

Of the huge number of arboviruses known to exist, about 80 types are responsible for human disease. In addition to the virus, there are usually two other types of living creatures involved in the cycle leading to human disease. When large quantities of virus are present in an arthropod (often a tick or mosquito), the viruses are passed to a bird or small mammal when the arthropod attempts to feed on the blood of that creature. The virus thrives within the new host, sometimes causing illness, sometimes not. More ticks or mosquitoes are infected with the virus when they feed on the host's blood. Eventually, a tick or mosquito bites a human, and the virus is passed along. Just a few types of arboviruses cycle only between arthropods and humans, with no intermediate stop in a bird or small mammal.

Because the arboviruses require an arthropod to pass them along to humans, the most common times of year for these illnesses include summer and fall, when mosquitoes and ticks are most prevalent. Damp environments favor large populations of mosquitoes, and thus also increase the risk of arbovirus infections.

The major causes of arbovirus encephalitis include the members of the viral families alphavirus (causing Eastern equine encephalitis, Western equine encephalitis, and Venezuelan equine encephalitis), flavivirus (responsible for St. Louis encephalitis, **Japanese encephalitis**, Tick-borne encephalitis, Murray Valley encephalitis, Russian spring-summer encephalitis, and Powassan), and bunyavirus (causing California encephalitis).

In the United States, the most important types of arbovirus encephalitis include Western equine encephalitis (WEE), Eastern equine encephalitis (EEE), St. Louis encephalitis, and California encephalitis. WEE strikes young infants in particular, with a 5% chance of **death** from the illness. Of those who survive, about 60% suffer permanent brain damage. EEE strikes infants and children, with a 20% chance of death, and a high rate of permanent brain damage among survivors. St. Louis encephalitis tends to strike adults older than 40 years of age, and older patients tend to have higher rates of death and long-term disability from the infection. California virus primarily strikes 5-18 year olds, with a lower degree of permanent brain damage.

Causes and symptoms

Encephalitis occurs because specific arboviruses have biochemical characteristics which cause them to be particularly attracted to the cells of the brain and the nerves. The virus causes cell death and inflammation, with **fever** and swelling within the brain and nerves. The membranous coverings of the brain and spinal cord (the meninges) may also become inflamed, a condition called **meningitis**. The brain is swollen, and patches of bleeding occur throughout the brain and spinal cord.

Patients with encephalitis suffer from headaches, fever, **nausea and vomiting**, stiff neck, and sleepiness. As the disease progresses, more severe symptoms develop, including **tremors**, confusion, seizures, **coma**, and **paralysis**. Loss of function occurs when specific nerve areas are damaged and/or killed.

Diagnosis

Early in the disease, laboratory testing of blood may reveal the presence of the arbovirus. The usual technique used to verify the presence of arbovirus involves injecting the patient's blood into the brain of a newborn mouse, then waiting to see if the mouse develops encephalitis. Diagnosis is usually based on the patient's symptoms, history of tick or mosquito bites, and knowledge that the patient has been in an area known to harbor the arbovirus.

Treatment

Treatment is mostly supportive, meaning it is directed at improving the symptoms, but does not shorten the course of the illness. The main concerns of treatment involve lowering fever, treating **pain**, avoiding **dehydration** or other chemical imbalances, and decreasing swelling in the brain with steroids.

Prognosis

Prognosis depends on the particular type of arbovirus causing disease, and on the age and prior health status of the patient. Death rates range all the way up to 20% for arbovirus encephalitis, and the rates of lifelong effects due to brain damage reach 60% for some types of arboviruses.

Prevention

Prevention involves avoiding contact with arthropods which carry these viruses. This means wearing

KEY TERMS

Arthropods—A phylum name referring to certain insects (including mosquitoes and ticks) and spiders.

Encephalitis—A condition in which the brain swells.

appropriate insect repellents, and dressing properly in areas known to be infested. Insecticides and the avoidance of collections of standing water (which are good breeding ground for arthropods) is also effective at decreasing arthropod populations.

There are immunizations available against EEE and WEE. These have primarily been used to safeguard laboratory workers who have regular exposure to these viruses.

Resources

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Rosalyn Carson-DeWitt, MD

ARDS *see* **Adult respiratory distress syndrome**

Aromatherapy

Definition

Aromatherapy is the therapeutic use of plant-derived, aromatic essential oils to promote physical and psychological well-being. It is sometimes used in combination with massage and other therapeutic techniques as part of a holistic treatment approach.

Purpose

Aromatherapy offers diverse physical and psychological benefits, depending on the essential oil or oil combination and method of application used. Some common medicinal properties of essential oils used in aromatherapy include: analgesic, antimicrobial, antiseptic, anti-inflammatory, astringent, sedative, antispasmodic, expectorant, diuretic, and sedative. Essential oils are used to treat a wide range of symptoms and conditions, including, but not limited to, gastrointestinal discomfort, skin conditions, menstrual **pain** and irregularities, stress-related conditions, **mood disorders**, circulatory problems, respiratory infections, and **wounds**.

Description

Origins

Aromatic plants have been employed for their healing, preservative, and pleasurable qualities throughout recorded history in both the East and West. As early as 1500 B.C. the ancient Egyptians used waters, oils, incense, resins, and ointments scented with botanicals for their religious ceremonies.

There is evidence that the Chinese may have recognized the benefits of herbal and aromatic remedies much earlier than this. The oldest known herbal text, Shen Nung's *Pen Ts'ao* (c. 2700-3000 B.C.) catalogs over 200 botanicals. Ayurveda, a practice of traditional Indian medicine that dates back over 2,500 years, also used aromatic herbs for treatment.

The Romans were well-known for their use of fragrances. They bathed with botanicals and integrated them into their state and religious rituals. So did the Greeks, with a growing awareness of the medicinal properties of herbs, as well. Greek physician and surgeon Pedanios Dioscorides, whose renown herbal text *De Materia Medica* (60 A.D.) was the standard textbook for Western medicine for 1,500 years, wrote extensively on the medicinal value of botanical aromatics. The *Medica* contained detailed information on over 500 plants and 4,740 separate medicinal uses for them, including an entire section on aromatics.

Written records of herbal distillation are found as early as the first century A.D., and around 1000 A.D., the noted Arab physician and naturalist Avicenna described the distillation of rose oil from rose petals, and the medicinal properties of essential oils in his writings. However, it wasn't until 1937, when French chemist René-Maurice Gattefossé published *Aromatherapie: Les Huiles essentielles, hormones végé tales*, that aromatherapie, or aromatherapy, was introduced in Europe as a medical discipline. Gattefossé, who was employed by a French perfumeur, discovered the healing properties of lavender oil quite by accident when he suffered a severe burn while working and used the closest available liquid, lavender oil, to soak it in.

In the late 20th century, French physician Jean Valnet used botanical aromatics as a front line treatment for wounded soldiers in World War II. He wrote about his use

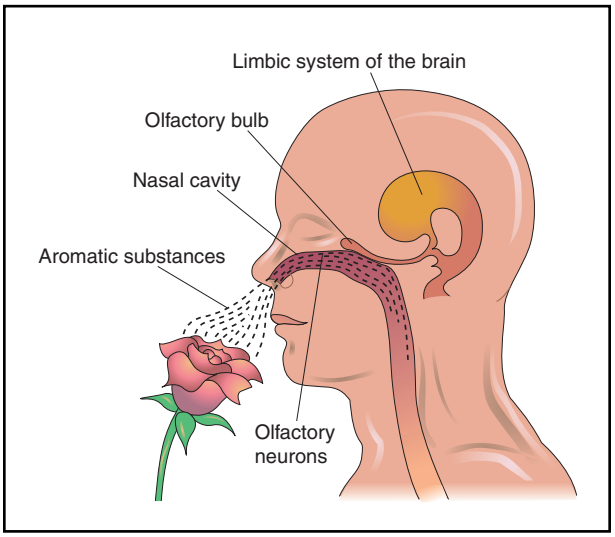
of essential oils and their healing and antiseptic properties, in his 1964 book *Aromatherapie, traitement des maladies par les essences des plantes*, which popularized the use of essential oils for medical and psychiatric treatment throughout France. Later, French biochemist Mauguerite Maury popularized the cosmetic benefits of essential oils, and in 1977 Robert Tisserand wrote the first English language book on the subject, *The Art of Aromatherapy*, which introduced massage as an adjunct treatment to aromatherapy and sparked its popularity in the United Kingdom.

In aromatherapy, essential oils are carefully selected for their medicinal properties. As essential oils are absorbed into the bloodstream through application to the skin or inhalation, their active components trigger certain pharmalogical effects (e.g., pain relief).

In addition to physical benefits, aromatherapy has strong psychological benefits. The volatility of an oil, or the speed at which it evaporates in open air, is thought to be linked to the specific psychological effect of an oil. As a rule of thumb, oils that evaporate quickly are considered emotionally uplifting, while slowly-evaporating oils are thought to have a calming effect.

Essential oils commonly used in aromatherapy treatment include:

- Roman chamomile (*Chamaemelum nobilis*). An anti-inflammatory and analgesic. Useful in treating **otitis media** (earache), skin conditions, menstrual pains, and depression.
- Clary sage (*Salvia sclarea*). This natural astringent is not only used to treat oily hair and skin, but is also said to be useful in regulating the menstrual cycle, improving mood, and controlling high blood pressure. Clary sage should not be used by pregnant women.
- Lavender (*Lavandula officinalis*). A popular aromatherapy oil which mixes well with most essential oils, lavender has a wide range of medicinal and cosmetic applications, including treatment of insect bites, **burns**, respiratory infections, intestinal discomfort, nausea, migraine, **insomnia**, depression, and **stress**.
- Myrtle (*Myrtus communis*). Myrtle is a fungicide, disinfectant, and antibacterial. It is often used in steam aromatherapy treatments to alleviate the symptoms of **whooping cough**, **bronchitis**, and other respiratory infections.
- Neroli (bitter orange), (*Citrus aurantium*). Citrus oil extracted from bitter orange flower and peel and used to treat **sore throat**, insomnia, and stress and anxiety-related conditions.
- Sweet orange (*Citrus sinensis*). An essential oil used to treat stomach complaints and known for its reported ability to lift the mood while relieving stress.



As a holistic therapy, aromatherapy is believed to benefit both the mind and body. Here, the aromatic substances from a flower stimulates the olfactory bulb and neurons. The desired emotional response (such as relaxation) is activated from the limbic system of the brain. *(Illustration by Electronic Illustrators Group.)*

- Peppermint (*Mentha piperita*). Relaxes and soothes the stomach muscles and gastrointestinal tract. Peppermint's actions as an anti-inflammatory, antiseptic, and antimicrobial also make it an effective skin treatment, and useful in fighting cold and flu symptoms.
- Rosemary (*Rosmarinus officinalis*). Stimulating essential oil used to treat muscular and rheumatic complaints, as well as low blood pressure, gastrointestinal problems, and headaches.
- Tea tree (*Melaleuca alternifolia*). Has bactericidal, virucidal, fungicidal, and anti-inflammatory properties that make it a good choice for fighting infection. Recommended for treating sore throat and respiratory infections, vaginal and bladder infections, wounds, and a variety of skin conditions.
- Ylang ylang (*Cananga odorata*). A sedative essential oil sometimes used to treat **hypertension** and tachycardia.

Essential oils contain active agents that can have potent physical effects. While some basic aromatherapy home treatments can be self-administered, medical aromatherapy should always be performed under the guidance of an aromatherapist, herbalist, massage therapist, nurse, or physician.

Inhalation

The most basic method of administering aromatherapy is direct or indirect inhalation of essential oils. Several drops of an essential oil can be applied to a tissue or

Aromatherapy Oils

Name	Description	Conditions treated
Bay laurel	Antiseptic, diuretic,sedative, etc.	Digestive problems, bronchitis, common cold, influenza, and scabies and lice. CAUTION: Don't use if pregnant.
Clary sage	Relaxant, anticonvulsive, antiinflammatory, and antiseptic	Menstrual and menopausal symptoms, burns, eczema, and anxiety. CAUTION: Don't use if pregnant.
Eucalyptus	Antiseptic, antibacterial, astringent, expectorant, and analgesic	Boils, breakouts, cough, common cold, influenza, and sinusitis. CAUTION: Not to be taken orally.
Chamomile	Sedative, antiinflammatory, antiseptic, and pain reliever	Hay fever, burns, acne, arthritis, digestive problems, sunburn, and menstrual an menopausal symptoms.
Lavender	Analgesic, antiseptic, calming/soothing	Headache, depression, insomnia, stress, sprains, and nausea.
Peppermint	Pain reliever	Indigestion, nausea, headache, motion sickness, and muscle pain.
Rosemary	Antiseptic, stimulant, and diuretic	Indigestion, gas, bronchitis, fluid retention, and influenza. CAUTION: Don't use if pregnant or have epilepsy or hypertension.
Tarragon	Diuretic, laxative, antispasmodic, and stimulant	Menstrual and menopausal symptoms, gas, and indigestion. CAUTION: Don't use if pregnant.
Tea tree	Antiseptic and soothing	Common cold, bronchitis, abscesses, acne, vaginitis, and burns.
Thyme	Stimulant, antiseptic, antibacterial, and antispasmodic	Cough, laryngitis, diarrhea, gas, and intestinal worms. CAUTION: Don't use if pregnant or have hypertension.

handkerchief and gently inhaled. A small amount of essential oil can also be added to a bowl of hot water and used as a steam treatment. This technique is recommended when aromatherapy is used to treat respiratory and/or skin conditions. Aromatherapy steam devices are also available commercially. A warm bath containing essential oils can have the same effect as steam aromatherapy, with the added benefit of promoting relaxation. When used in a bath, water should be lukewarm rather than hot to slow the evaporation of the oil.

Essential oil diffusers, vaporizers, and light bulb rings can be used to disperse essential oils over a large area. These devices can be particularly effective in aromatherapy that uses essential oils to promote a healthier home environment. For example, eucalyptus and tea tree oil are known for their antiseptic qualities and are frequently used to disinfect sickrooms, and citronella and geranium can be useful in repelling insects.

Direct application

Because of their potency, essential oils are diluted in a carrier oil or lotion before being applied to the skin to prevent an allergic skin reaction. The carrier oil can be a vegetable or olive based one, such as wheat germ or avocado. Light oils, such as safflower, sweet almond, grapeseed, hazelnut, apricot seed, or peach kernel, may be absorbed more easily by the skin. Standard dilutions of essential oils in carrier oils range from 2–10%. However, some oils can be used at higher concentrations, and others should be diluted further for safe and effective use. The type of carrier oil used and the therapeutic use of the application may also influence how the essential oil is mixed. Individuals should seek guidance from a healthcare professional and/or aromatherapist when diluting essential oils.

Massage is a common therapeutic technique used in conjunction with aromatherapy to both relax the body and thoroughly administer the essential oil treatment. Essential oils can also be used in hot or cold compresses and soaks to treat muscle aches and pains (e.g., lavender and ginger). As a sore throat remedy, antiseptic and soothing essential oils (e.g., tea tree and sage) can be thoroughly mixed with water and used as a gargle or mouthwash.

Internal use

Some essential oils can be administered internally in tincture, infusion, or suppository form to treat certain symptoms or conditions; however, this treatment should never be self-administered. Essential oils should only be taken internally under the supervision of a qualified healthcare professional.

As non-prescription botanical preparations, the essential oils used in aromatherapy are typically not paid for by health insurance. The self-administered nature of the therapy controls costs to some degree. Aromatherapy treatment sessions from a professional aromatherapist are not covered by health insurance in most cases, although aromatherapy performed in conjunction with physical therapy, nursing, therapeutic massage, or other covered medical services may be. Individuals should check with their insurance provider to find out about their specific coverage.

The adage "You get what you pay for" usually applies when purchasing essential oils, as bargain oils are

KEY TERMS

Antiseptic—Inhibits the growth of microorganisms.

Bactericidal—An agent that destroys bacteria (e.g., Staphylococci aureus, Streptococci pneumoniae, Escherichia coli, Salmonella enteritidis).

Carrier oil—An oil used to dilute essential oils for use in massage and other skin care applications.

Contact dermatitis—Skin irritation as a result of contact with a foreign substance.

Essential oil—A volatile oil extracted from the leaves, fruit, flowers, roots, or other components of a plant and used in aromatherapy, perfumes, and foods and beverages.

Holistic—A practice of medicine that focuses on the whole patient, and addresses the social, emotional, and spiritual needs of a patient as well as their physical treatment.

Phototoxic—Causes a harmful skin reaction when exposed to sunlight.

Remedy antidote—Certain foods, beverages, prescription medications, aromatic compounds, and other environmental elements that counteract the efficacy of homeopathic remedies.

Steam distillation—A process of extracting essential oils from plant products through a heating and evaporation process.

Volatile—Something that vaporizes or evaporates quickly when exposed to air.

often adulterated, diluted, or synthetic. Pure essential oils can be expensive; and the cost of an oil will vary depending on its quality and availability.

Preparations

The method of extracting an essential oil varies by plant type. Common methods include water or steam distillation and cold pressing. Quality essential oils should be unadulterated and extracted from pure botanicals. Many aromatherapy oils on the market are synthetic and/or diluted, contain solvents, or are extracted from botanicals grown with pesticides or herbicides. To ensure best results, essential oils should be made from pure organic botanicals and labeled by their full botanical name. Oils should always be stored dark bottles out of direct light.

Before using essential oils on the skin, individuals should perform a skin patch test by applying a small amount of the diluted oil behind the wrist and covering it with a bandage or cloth for up to 12 hours. If redness or irritation occurs, the oil should be diluted further and a second skin test performed, or it should be avoided altogether. Individuals should never apply undiluted essential oils to the skin unless advised to do so by a trained healthcare professional.

Precautions

Individuals should only take essential oils internally under the guidance and close supervision of a health-care professional. Some oils, such as eucalyptus, wormwood, and sage, should never be taken internally. Many essential oils are highly toxic and should never be used at all in aromatherapy. These include (but are not limited to) bitter almond, pennyroyal, mustard, sassafras, rue, and mugwort.

Citrus-based essential oils, including bitter and sweet orange, lime, lemon, grapefruit, and tangerine, are phototoxic, and exposure to direct sunlight should be avoided for at least four hours after their application.

Other essential oils, such as cinnamon leaf, black pepper, juniper, lemon, white camphor, eucalyptus blue gum, ginger, peppermint, pine needle, and thyme can be extremely irritating to the skin if applied in high enough concentration or without a carrier oil or lotion. Caution should always be exercised when applying essential oils topically. Individuals should never apply undiluted essential oils to the skin unless directed to do so by a trained healthcare professional and/or aromatherapist.

Individuals taking homeopathic remedies should avoid black pepper, camphor, eucalyptus, and peppermint essential oils. These oils may act as a remedy antidote to the homeopathic treatment.

Children should only receive aromatherapy treatment under the guidance of a trained aromatherapist or healthcare professional. Some essential oils may not be appropriate for treating children, or may require additional dilution before use on children.

Certain essential oils should not be used by pregnant or nursing women or by people with specific illnesses or physical conditions. Individuals suffering from any

chronic or acute health condition should inform their healthcare provider before starting treatment with any essential oil.

Asthmatic individuals should not use steam inhalation for aromatherapy, as it can aggravate their condition.

Essential oils are flammable, and should be kept away from heat sources.

Side effects

Side effects vary by the type of essential oil used. Citrus-based essential oils can cause heightened sensitivity to sunlight. Essential oils may also cause **contact dermatitis**, an allergic reaction characterized by redness and irritation. Anyone experiencing an allergic reaction to an essential oil should discontinue its use and contact their healthcare professional for further guidance. Individuals should do a small skin patch test with new essential oils before using them extensively (see "Preparations" above).

Research and general acceptance

The antiseptic and bactericidal qualities of some essential oils (such as tea tree and peppermint) and their value in fighting infection has been detailed extensively in both ancient and modern medical literature.

Recent research in mainstream medical literature has also shown that aromatherapy has a positive psychological impact on patients, as well. Several clinical studies involving both post-operative and chronically ill subjects showed that massage with essential oils can be helpful in improving emotional well-being, and consequently, promoting the healing process.

Today, the use of holistic aromatherapy is widely accepted in Europe, particularly in Great Britain, where it is commonly used in conjunction with massage as both a psychological and physiological healing tool. In the United States, where aromatherapy is often misunderstood as solely a cosmetic treatment, the mainstream medical community has been slower to accept it.

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Paula Ford-Martin

Arrhythmias

Definition

An arrhythmia is an abnormality in the heart's rhythm, or heartbeat pattern. The heartbeat can be too slow, too fast, have extra beats, skip a beat, or otherwise beat irregularly.

Description

Arrhythmias are deviations from the normal cadence of the heartbeat, which cause the heart to pump improperly. The normal heartbeat starts in the right atrium, where the heart's natural pacemaker (the sinus node) sends an electrical signal to the center of the heart to the atrioventricular node. The atrioventricular node then sends signals into the main pumping chamber to make the ventricle contract. Arrhythmias occur when the heartbeat starts in a part of the heart other than the sinus node, an abnormal rate or rhythm develops in the sinus node, or a heart conduction "block" prevents the electrical signal from traveling down the normal pathway.

More than four million Americans have arrhythmias, most of which are harmless. Middle-aged adults commonly experience arrhythmias. As people age, the probability of experiencing an arrhythmia increases. Arrhythmias often occur in people who do not have heart disease. In people with heart disease, it is usually the heart disease which is dangerous, not the arrhythmia. Arrhythmias often occur during and after heart attacks. Some types of arrhythmias, such as **ventricular tachycardia**, are serious and even life threatening. In the United States, arrhythmias are the primary cause of **sudden cardiac death**, accounting for more than 350,000 deaths each year.

Slow heart rates (less than 60 beats per minute) are called bradycardias, while fast heart rates (more than 100 beats per minute) are called tachycardias. Bradycardia can result in poor circulation of blood, and, hence, a lack of oxygen throughout the body, especially the brain. Tachycardias also can compromise the heart's ability to pump effectively because the ventricles do not have enough time to completely fill.

Arrhythmias are characterized by their site of origin: the atria or the ventricles. Supraventricular arrhythmias occur in the upper areas of the heart and are less serious than ventricular arrhythmias. **Ventricular fibrillation** is the most serious arrhythmia and is fatal unless medical help is immediate.

Causes and symptoms

In many cases, the cause of an arrhythmia is unknown. Known causes of arrhythmias include heart

disease, **stress**, **caffeine**, tobacco, alcohol, diet pills, and **decongestants** in **cough** and cold medicines.

Symptoms of an arrhythmia include a fast heartbeat, pounding or fluttering chest sensations, skipping a heartbeat, "flip-flops," **dizziness**, faintness, **shortness of breath**, and chest pains.

Diagnosis

Examination with a stethoscope, electrocardiograms, and electrophysiologic studies is used to diagnose arrhythmias. Sometimes arrhythmias can be identified by listening to the patient's heart through a stethoscope, but, since arrhythmias are not always present, they may not occur during the physical exam.

An electrocardiogram (ECG) shows the heart's activity and may reveal a lack of oxygen from poor circulation (**ischemia**). Electrodes covered with conducting jelly are placed on the patient's chest, arms, and legs. They send impulses of the heart's activity through an electrical activity monitor (oscilloscope) to a recorder that traces them on paper. The test takes about 10 minutes and is performed in a physician's office. Another type of ECG, commonly known as the **exercisestress test**, measures how the heart and blood vessels respond to exertion while the patient is exercising on a treadmill or a stationary bike. This test is performed in a physician's office or an exercise laboratory and takes 15-30 minutes. Other types of ECGs include 24-hour ECG monitoring and transtelephonic monitoring. In 24-hour ECG (Holter) monitoring, the patient wears a small, portable tape recorder connected to disks on his/her chest that record the heart's rhythm during daily activities. Transtelephonic monitoring can identify arrhythmias that occur infrequently. Similar to **Holter monitoring**, transtelephonic monitoring can continue for days or weeks, and it enables patients to send the ECG via telephone to a monitoring station when an arrhythmia is felt, or the patient can store the information in the recorder and transmit it later.

Electrophysiologic studies are invasive procedures performed in a hospital to identify the origin of serious arrhythmias and responses to various treatments. They involve **cardiac catheterization**, in which catheters tipped with electrodes are passed from a vein in the arm or leg through the blood vessels into the heart. The electrodes record impulses in the heart, highlighting where the arrhythmia starts. During the procedure, physicians can test the effects of various drugs by provoking an arrhythmia through the electrodes and trying different drugs. The procedure takes one to three hours, during which the patient is awake but mildly sedated. Local anesthetic is injected at the catheter insertion sites.

Treatment

Many arrhythmias do not require any treatment. For serious arrhythmias, treating the underlying heart disease sometimes controls the arrhythmia. In some cases, the arrhythmia itself is treated with drugs, electrical shock (**cardioversion**), automatic implantable defibrillators, artificial **pacemakers**, **catheter ablation**, or surgery. Supraventricular arrhythmias often can be treated with drug therapy. Ventricular arrhythmias are more complex to treat.

Drug therapy can manage many arrhythmias, but finding the right drug and dose requires care and can take some time. Common drugs for suppressing arrhythmias include beta-blockers, **calcium channel blockers**, quinidine, digitalis preparations, and procainamide. Because of their potential serious side effects, stronger, desensitizing drugs are used only to treat life-threatening arrhythmias. All of the drugs used to treat arrhythmias have possible side effects, ranging from mild complications with beta-blockers and calcium channel blockers to more serious effects of desensitizing drugs that can, paradoxically, cause arrhythmias or make them worse. Response to drugs is usually measured by ECG, Holter monitor, or electrophysiologic study.

In emergency situations, cardioversion or **defibrillation** (the application of an electrical shock to the chest wall) is used. Cardioversion restores the heart to its normal rhythm. It is followed by drug therapy to prevent recurrence of the arrhythmia.

Artificial pacemakers that send electrical signals to make the heart beat properly can be implanted under the skin during a simple operation. Leads from the pacemaker are anchored to the right side of the heart. Pacemakers are used to correct bradycardia and are sometimes used after surgical or catheter ablation.

Automatic implantable defibrillators correct life-threatening ventricular arrhythmias by recognizing them and then restoring a normal heart rhythm by pacing the heart or giving it an electric shock. They are implanted within the chest wall without major surgery and store information for future evaluation by physicians. Automatic implantable defibrillators have proven to be more effective in saving lives than drugs alone. They often are used in conjunction with drug therapy.

Ablation, a procedure to alter or remove the heart tissue causing the arrhythmia in order to prevent a recurrence, can be performed through a catheter or surgery. Supraventricular tachycardia can be treated successfully with ablation. Catheter ablation is performed in a catheterization laboratory with the patient under **sedation**. A catheter equipped with a device that maps the heart's electrical pathways is inserted into a vein and is

threaded into the heart. High-frequency radio waves are then used to remove the pathway(s) causing the arrhythmia. Surgical ablation is similar in principle but it is performed in a hospital, using a cold probe instead of radio waves to destroy tissue. Ablation treatments are used when medications fail.

Maze surgery treats atrial fibrillation by making multiple incisions through the atrium to allow electrical impulses to move effectively. This is often recommended for patients who have not responded to drugs or cardioversion.

Alternative treatment

Since some arrhythmias can be life threatening, a conventional medical doctor should always be consulted first. **Acupuncture** can correct an insignificant number (1.5%) of atrial fibrillation cases. For new, minor arrhythmias, acupuncture may be effective in up to 70% of cases, but this figure may not differ much from placebo therapy. Both western and Chinese herbal remedies are also used in the treatment of arrhythmias. Since hawthorn (*Crataegus laevigata*) dilates the blood vessels and stimulates the heart muscle, it may help to stabilize arrhythmias. It is gentle and appropriate for home use, unlike foxglove (*Digitalis purpurea*), an herb whose action on the heart is too potent for use without supervision by a qualified practitioner. Homeopathic practitioners may prescribe remedies such as *Lachesis* and aconite or monkshood (*Aconitum napellus*) to treat mild arrhythmias.

Prognosis

Advances in diagnostic techniques, new drugs, and medical technology have extended the lives of many patients with serious arrhythmias. Diagnostic techniques enable physicians to accurately identify arrhythmias, while new drugs, advances in pacemaker technology, the development of implantable defibrillators, and progress in ablative techniques offer effective treatments for many types of arrhythmia.

Prevention

Some arrhythmias can be prevented by managing stress, controlling **anxiety**, and avoiding caffeine, alcohol, decongestants, **cocaine**, and cigarettes.

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Lori De Milto

KEY TERMS

Bradycardia—A slow heart rate. Bradycardia is one of the two types of arrhythmia

Electrocardiogram—A test which uses electric sensors placed on the body to monitor the heartbeat.

Electrophysiology study—A test using cardiac catheterization to stimulate an electrical current to provoke an arrhythmia. The test identifies the origin of arrhythmias and is used to test the effectiveness of antiarrhythmic drugs.

Tachycardia—A fast heart rate. Tachycardia is one of the two types of arrhythmia.

Arterial blood gas analysis *see* **Blood gas analysis**

Arterial embolism

Definition

An embolus is a blood clot, bit of tissue or tumor, gas bubble, or other foreign body that circulates in the blood stream until it becomes stuck in a blood vessel.

Description

When a blood clot develops in an artery and remains in place, it is called a thrombosis. If all or part of the blockage breaks away and lodges in another part of the artery, it is called an **embolism**. Blockage of an artery in this manner can be the result of a blood clot, fat cells, or an air bubble.

When an embolus blocks the flow of blood in an artery, the tissues beyond the plug are deprived of normal blood flow and oxygen. This can cause severe damage and even **death** of the tissues involved.

Emboli can affect any part of the body. The most common sites are the legs and feet. When the brain is affected, it is called a **stroke**. When the heart is involved, it is called a **heart attack** or myocardial infarction (MI).

Causes and symptoms

A common cause of embolus is when an artery whose lining has become thickened or damaged, usually with age, allows cholesterol to build up more easily than normal on the artery wall. If some of the cholesterol breaks off, it forms an embolus. Emboli also commonly form from blood clots in a heart that has been damaged from heart attack or when the heart contracts abnormally from arterial fibrillation.

Other known causes are fat cells that enter the blood after a major bone fracture, infected blood cells, **cancer** cells that enter the blood stream, and small gas bubbles.

Symptoms of an embolus can begin suddenly or build slowly over time, depending on the amount of blocked blood flow.

If the embolus is in an arm or leg, there will be muscle **pain**, numbness or tingling, pale skin color, lower temperature in the limb, and weakness or loss of muscle function. If it occurs in an internal organ, there is usually pain and/or loss of the organ's function.

Diagnosis

The following tests can be used to confirm the presence of an arterial embolism:

- Electrocardiogram, also known as an EKG or ECG. For this test, patches that detect electrical impulses from the heart are attached to the chest and extremities. The information is displayed on a monitor screen or a paper tape in the form of waves. Reduced blood and oxygen supply to the heart shows as a change in the shape of the waves.
- Noninvasive vascular tests. These involve measuring blood pressure in various parts of the body and comparing the results from each location. When there is a decrease in blood pressure beyond what is normal between two points, a blockage is presumed to be present.
- **Angiography**. In this procedure, a colored liquid material (a dye, or contrast material) that can be seen with x rays is injected into the blood stream through a small tube called a catheter. As the dye fills the arteries, they are easily seen on x ray motion pictures. If there is a blockage in the artery, it shows up as a sudden cut off in the movement of contrast material. Angiography is an expensive procedure and does carry some risk. The catheter may cause a blood clot to form, blocking blood flow. There is also the risk of poking the catheter through the artery or heart muscle. Some people may be allergic to the dye. The risk of any of these injuries occurring is small.

KEY TERMS

Arterial fibrillation—An arrhythmia; chaotic quivering of the arteries.

Thrombosis—A blockage in a blood vessel that builds and remains in one place.

Treatment

Arterial embolism can be treated with medication or surgery, depending on the extent and location of the blockage.

Medication to dissolve the clot is usually given through a catheter directly into the affected artery. If the embolus was caused by a blood clot, medications that thin the blood will help reduce the risk of another embolism.

A surgeon can remove an embolus by making an incision in the artery above the blockage and, using a catheter inserted past the embolus, drag it out through the incision.

If the condition is severe, a surgeon may elect to bypass the blocked vessel by grafting a new vessel in its place.

Prognosis

An arterial embolism is serious and should be treated promptly to avoid permanent damage to the affected area. The outcome of any treatment depends on the location and seriousness of the embolism. New arterial emboli can form even after successful treatment of the first event.

Prevention

Prevention may include diet changes to reduce cholesterol levels, medications to thin the blood, and practicing an active, healthy lifestyle.

Resources

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Dorothy Elinor Stonely

Arteriogram *see* **Angiography**

Arteriography *see* **Angiography**

Arteriosclerosis *see* **Atherosclerosis**

Arteriovenous fistula

Definition

An arteriovenous fistula is an abnormal channel or passage between an artery and a vein.

Description

An arteriovenous fistula is a disruption of the normal blood flow pattern. Normally, oxygenated blood flows to the tissue through arteries and capillaries. Following the release of oxygen in the tissues, the blood returns to the heart in veins. An arteriovenous fistula is an abnormal connection of an artery and a vein. The blood bypasses the capillaries and tissues, and returns to the heart. Arterial blood has a higher blood pressure than veins and causes swelling of veins involved in a fistula. Although both the artery and the vein retain their normal connections, the new opening between the two will cause some arterial blood to shunt into the vein because of the blood pressure difference.

Causes and symptoms

There are two types of arteriovenous fistulas, congenital and acquired. A congenital arteriovenous fistula is one that formed during fetal development. It is a birth defect.

KEY TERMS

Congenital—Present at the time of birth.

In congenital fistulas, blood vessels of the lower extremity are more frequently involved than other areas of the body. Congenital fistulas are not common. An acquired arteriovenous fistula is one that develops after a person is born. It usually occurs when an artery and vein that are side-by-side are damaged and the healing process results in the two becoming linked. After catheterizations, arteriovenous fistulas may occur as a complication of the arterial puncture in the leg or arm. Fistulas also form without apparent cause. In the case of patients on hemodialysis, physicians perform surgery to create a fistula. These patients receive many needle sticks to flush their blood through dialysis machines and for routine blood analysis testing. The veins used may scar and become difficult to use. Surgery is used to connect an artery and vein so that arterial blood pressure and flow rate widens the vein and decreases the chance of blood clots forming inside the vein.

The main symptoms of arteriovenous fistulas near the surface of the skin are bulging and discolored veins. In some cases, the bulging veins can be mistaken for **varicose veins**. Other fistulas can cause more serious problems depending on their location and the blood vessels involved.

Diagnosis

Using a stethoscope, a physician can detect the sound of a pulse in the affected vein (bruit). The sound is a distinctive to-and-fro sound. Dye into the blood can be tracked by x ray to confirm the presence of a fistula.

Treatment

Small arteriovenous fistulas can be corrected by surgery. Fistulas in the brain or eye are very difficult to treat. If surgery is not possible or very difficult, injection therapy may be used. Injection therapy is the injection of substances that cause the blood to clot at the site of the injection. In the case of an arteriovenous fistula, the blood clot should stop the passage of blood from the artery to the vein. Surgery is usually used to correct acquired fistulas once they are diagnosed.

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John T. Lohr, PhD

Arteriovenous malformations

Definition

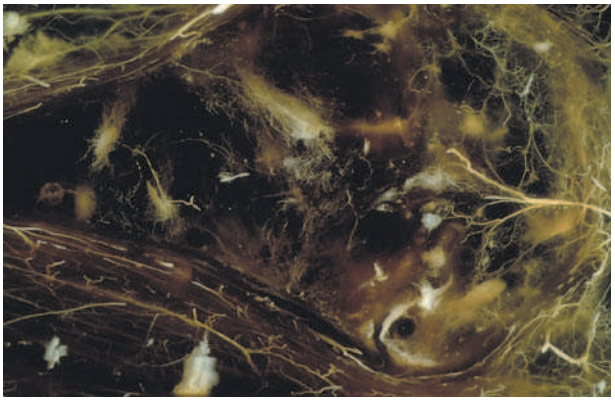
Arteriovenous malformations are blood vessel defects that occur before birth when the fetus is growing in the uterus (prenatal development). The blood vessels appear as a tangled mass of arteries and veins. They do not possess the capillary (very fine blood vessels) bed which normally exists in the common area where the arteries and veins lie in close proximity (artery-vein interface). An arteriovenous malformation (AVM) may hemorrhage, or bleed, leading to serious complications that can be life-threatening.

Description

AVMs represent an abnormal interface between arteries and veins. Normally, arteries carry oxygenated blood to the body's tissues through progressively smaller blood vessels. The smallest are capillaries, which form a web of blood vessels (the capillary bed) through the body's tissues. The arterial blood moves through tissues by these tiny pathways, exchanging its load of oxygen and nutrients for carbon dioxide and other waste products produced by the body cells (cellular wastes). The blood is carried away by progressively larger blood vessels, the veins. AVMs lack a capillary bed and arterial blood is moved (shunted) directly from the arteries into the veins.

AVMs can occur anywhere in the body and have been found in the arms, hands, legs, feet, lungs, heart, liver, and kidneys. However, 50% of these malformations are located in the brain, brainstem, and spinal cord. Owing to the possibility of hemorrhaging, such AVMs carry the risk of **stroke**, **paralysis**, and the loss of speech, memory, or vision. An AVM that hemorrhages can be fatal.

Approximately three of every 100,000 people have a cerebral AVM and roughly 40-80% of them will experience some bleeding from the abnormal blood vessels at some point. The annual risk of an AVM bleeding is estimated at about 1-4%. After age 55, the risk of bleeding decreases. Pre-existing high blood pressure or intense physical activity do not seem to be associated with AVM hemorrhage, but **pregnancy** and labor could cause a rupture or breaking open of a blood vessel. An AVM hemorrhage is not as dangerous as an aneurysmal rupture. (An aneurysm is a swollen, blood filled vessel where the pressure of the blood causes the wall to bulge outward.) There is an approximate 10% fatality rate associated with AVM hemorrhage, compared to a 50% fatality rate for ruptured aneurysms.



Arteriovenous malformations. *(Custom Medical Stock Photo. Reproduced by permission.)*

Although AVMs are congenital defects, meaning a person is born with them, they are rarely discovered before age 20. A genetic link has been proposed for some AVMs, but studies are only suggestive, not positive. The majority of AVMs are discovered in people age 20-40. Medical researchers estimate that the malformations are created during days 45-60 of fetal development. A second theory suggests that AVMs are primitive structures that are left over from the period when fetal blood circulating systems began to develop.

However they form, AVMs have blood vessels that are abnormally fragile. The arteries that feed into the malformation are unusually swollen and thin walled. They lack the usual amount of smooth muscle tissue and elastin, a fibrous connective tissue. These blood vessels commonly accumulate deposits of calcium salts and hyalin. The venous part of the malformation receives blood directly from the artery. Without the intervening capillary bed, the veins receive blood at a higher pressure than they were designed to handle. This part of the malformation is also swollen (dilated) and thin walled. There is a measurable risk of an aneurysm forming near an AVM, increasing the threat of hemorrhage, brain damage, and **death**. Approximately 10-15% of AVMs are accompanied by saccular aneurysms, a type of aneurysm that looks like a small sac attached to the outer wall of the blood vessel.

Although the malformation itself lacks capillaries, there is often an abnormal proliferation of capillaries next to the defect. These blood vessels feed into the malformation, causing it to grow larger in some cases. As the AVM receives more blood through this "steal," adjacent brain tissue does not receive enough. These areas show abnormal nerve cell growth, cell death, and deposits of calcium in that area (calcification). Nerve cells within the malformation may demonstrate abnormal growth and are believed to be nonfunctional.

Causes and symptoms

Most people do not realize that they have an AVM unless it hemorrhages enough to produce symptoms. Small AVMs are more likely to hemorrhage. If a hemorrhage occurs, it produces a sudden, severe **headache**. The headache may be focused in one specific area or it may be more general. It can be mistaken for a migraine in some cases. The headache is accompanied by other symptoms, such as vomiting, a stiff neck, sleepiness, lethargy, confusion, irritability, or weakness anywhere in the body. Seizures occur in about a quarter of AVM cases. A person may experience decreased, double, or blurred vision. Hemorrhaging from an AVM is generally less dangerous than hemorrhaging from an aneurysm, with a survival rate of 80-90%.

Other symptoms occur less frequently, but sometimes appear alongside major symptoms such as the sudden severe headache. Additional warning signs of a bleeding AVM are impaired speech or smell, **fainting**, facial paralysis, a drooping eyelid, **dizziness**, and ringing or buzzing in the ears.

Although large AVMs are less likely to hemorrhage, they can induce symptoms based on their mass alone. Large AVMs exert pressure against brain tissue, cause abnormal development in the surrounding brain tissue, and slow down or block blood flow. **Hydrocephalus**, a swelling of brain tissue caused by accumulated fluids, may develop. The warning signs associated with a large non-bleeding AVM are similar to the symptoms of a small malformation that is bleeding. Unexplained headaches, seizures, dizziness, and neurological symptoms, such as sensory changes, are signals that demand medical attention.

Diagnosis

Based on the clinical symptoms such as severe headache and neurological problems, and after a complete **neurologic exam**, a computed tomography scan (CT) of the head will be done. In some cases, a whooshing sound from arteries in the neck or over the eye or jaw (called a bruit), can be heard with a stethoscope. The CT scan will reveal whether there has been bleeding in the brain and can identify AVMs larger than 1 inch (2.5 cm). **Magnetic resonance imaging** (MRI) is also used to identify an AVM. A lumbar puncture, or spinal tap, may follow the MRI or CT scan. A lumbar puncture involves removing a small amount of cerebrospinal fluid from the lower part of the spine. Blood cells or blood breakdown products in the cerebrospinal fluid indicate bleeding.

To pinpoint where the blood is coming from, a cerebral **angiography** is done. This procedure uses x rays to map out the blood vessels in the brain, including the vessels that feed into the malformation. The information gained from angiography complements the MRI and helps distinguish the precise location of the AVM.

Treatment

Neurosurgeons consider several factors before deciding on a treatment option. There is some debate over whether or not to treat AVMs that have not ruptured and are not causing any symptoms. The risks and benefits of proceeding with treatment need to be measured on an individual basis, taking into account factors such as the person's age and general health, as well as the AVM's size and location. Several treatment options are available, both for symptomatic or asymptomatic AVMs. These treatment options may be used alone or in combination.

Surgery

Removing the AVM is the surest way of preventing it from causing future problems. Both small and large AVMs can be handled in surgery. Surgery is recommended for superficial AVMs, but may be too dangerous for deep or very large AVMs. Unless it is an emergency situation, an AVM that has hemorrhaged is treated conservatively for several weeks. Conservative treatment consists of managing the immediate symptoms and allowing the patient's condition to stabilize. Surgery requires general anesthesia and a longer period of recuperation than any other treatment option.

Radiation

Radiation is particularly useful to treat small (under 1 in) malformations that are deep within the brain. Ionizing radiation is directed at the malformation, destroying the AVM without damaging the surrounding tissue. Radiation treatment is accomplished in a single session and it is not necessary to open the skull. However, success can only be measured over the course of the following two years. A year after the procedure, 50-75% of treated AVMs are completely blocked; two years after radiation treatment, the percentage increases to 85-95%.

KEY TERMS

Aneurysm—A weak point in a blood vessel where the pressure of the blood causes the vessel wall to bulge outwards.

Angiography—A mapping of the brain's blood vessels, using x-ray imaging.

Capillary bed—A dense network of tiny blood vessels that enables blood to fill a tissue or organ.

Hydrocephalus—Swelling of the brain caused by an accumulation of fluid.

Lumbar puncture—A diagnostic procedure in which a needle is inserted into the lower spine to withdraw a small amount of cerebrospinal fluid. This fluid is examined to assess trauma to the brain.

Saccular aneurysm—A type of aneurysm that resembles a small sack of blood attached to the outer surface of a blood vessel by a thin neck.

Embolization

Embolization involves plugging up access to the malformation. This technique does not require opening the skull to expose the brain and can be used to treat deep AVMs. Using x-ray images as a guide, a catheter is threaded through the artery in the thigh (femoral artery) to the affected area. The patient remains awake during the procedure and medications can be administered to prevent discomfort. The blood vessel leading into the AVM is assessed for its importance to the rest of the brain before a balloon or other blocking agent is inserted via the catheter. The block chokes off the blood supply to the malformation. There may be a mild headache or nausea associated with the procedure, but patients may resume normal activities after leaving the hospital. At least two to three embolization procedures are usually necessary at intervals of two to six weeks. At least a three-day hospital stay is associated with each embolization.

Prognosis

Approximately 10% of AVM cases are fatal. Seizures and neurological changes may be permanent in another 10-30% cases of AVM rupture. If an AVM bleeds once, it is about 20% likely to bleed again in the next year. As time passes from the initial hemorrhage, the risk for further bleeding drops to about 3-4%. If the AVM has not bled, it is possible, but not guaranteed, that it never will. Untreated AVMs can grow larger over time and rarely go away by themselves. Once an AVM is removed and a person has recovered from the procedure, there should be no further symptoms associated with that malformation.

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Arteriovenous Malformation Support Group. 168 Six Mile Canyon Road, Dayton, NV 89403. (702) 246-0682.

National Chronic Pain Outreach Association, Inc. P.O. Box 274, Millboro, VA 24460. (540) 997-5004.

Julia Barrett

Arthritis *see* **Juvenile arthritis; Osteoarthritis; Psoriatic arthritis; Rheumatoid arthritis**

Arthrocentesis *see* **Joint fluid analysis**

Arthrogram *see* **Arthrography**

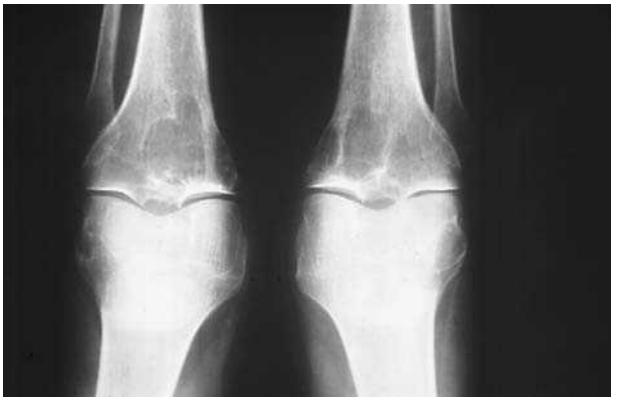
Arthrography

Definition

Arthrograpy is a procedure involving multiple x rays of a joint using a fluoroscope, or a special piece of x-ray equipment which shows an immediate x-ray image. A contrast medium (in this case, a contrast iodine solution) injected into the joint area helps highlight structures of the joint.

Purpose

Frequently, arthrography is ordered to determine the cause of unexplained joint **pain**. This fluoroscopic procedure can show the internal workings of specific joints and outline soft tissue structures. The procedure may also be conducted to identify problems with the ligaments, cartilage, tendons, or the joint capsule of the hip, shoulder, knee, ankle or wrist. An arthrography procedure may locate cysts in the joint area, evaluate problems with the joint's arrangement and function, or indicate the



An x-ray image of the knees of a patient with cysts caused by rheumatoid arthritis. The cysts appear as dark areas just below the knee joints. *(Custom Medical Stock Photo. Reproduced by permission.)*

need for **joint replacement** (prostheses). The most commonly studied joints are the knee and shoulder.

Precautions

Patients who are pregnant or may be pregnant should not have this procedure unless the benefits of the findings outweigh the risk of radiation exposure. Patients who are known to be allergic to iodine need to discuss this complication with their physician. Patients who have a known allergy to shellfish are more likely to be allergic to iodine contrast.

Description

Arthrograpy may be referred to as "joint radiography" or "x rays of the joint." The term arthrogram may be used interchangeably with arthrography. The joint area will be cleaned and a local anesthetic will be injected into the tissues around the joint to reduce pain. Next, if fluids are present in the joint, the physician may suction them out (aspirate) with a needle. These fluids may be sent to a laboratory for further study. Contrast agents are then injected into the joint through the same location by attaching the aspirating needle to a syringe containing the contrast medium. The purpose of contrast agents in x-ray procedures is to help highlight details of areas under study by making them opaque. Agents for arthrography are generally air and water-soluble dyes, the most common containing iodine. Air and iodine may be used together or independently. After the contrast agent is administered, the site of injection will be sealed and the patient may be asked to move the joint around to distribute the contrast.

Before the contrast medium can be absorbed by the joint itself, several films will be quickly taken under the guidance of the fluoroscope. The patient will be asked to move the joint into a series of positions, keeping still between positioning. Sometimes, the patient will experience some tingling or discomfort during the procedure, which is normal and due to the contrast. Following fluoroscopic tracking of the contrast, standard x rays of the area may also be taken. The entire procedure will last about one hour.

Preparation

It is important to discuss any known sensitivity to local anesthetics or iodine prior to this procedure. A physician should explain the procedure and the risks associated with contrast agents and ask the patient to sign an informed consent. If iodine contrast will be administered, the patient may be instructed not to eat before the exam. The timeframe of **fasting** may extend from only 90 minutes prior to the exam up to the night before. There is no other preparation necessary.

Aftercare

The affected joint should be rested for approximately 12 hours following the procedure. The joint may be wrapped in an elastic bandage and the patient should receive instructions on the care and changing of the bandage. Noises in the joint such as cracking or clicking are normal for a few days following arthrography. These noises are the result of liquid in the joints. Swelling may also occur and can be treated with application of ice or cold packs. A mild pain reliever can be used to lessen pain in the first few days. However, if any of these symptoms persist for more than a few days, patients are advised to contact their physician.

Risks

In some patients iodine can cause allergic reactions, ranging from mild nausea to severe cardiovascular or nervous system complications. Since the contrast dye is put into a joint, rather than into a vein, allergic reactions are rare. Facilities licensed to perform contrast exams should meet requirements for equipment, supplies and staff training to handle a possible severe reaction. Infection or joint damage are possible, although not frequent, complications of arthrography.

Normal results

A normal arthrography exam will show proper placement of the dye or contrast medium throughout the joint structures, joint space, cartilage and ligaments.

Abnormal results

The abnormal placement of dye may indicate **rheumatoid arthritis**, cysts, joint dislocation, rupture of

KEY TERMS

Aspirate—Remove fluids by suction, often through a needle.

Contrast (agent, medium)—A substance injected into the body that illuminates certain structures that would otherwise be hard to see on the radiograph(film).

Fluoroscope—A device used in some radiology procedures that provides immediate images and motion on a screen much like those seen at airport baggage security stations.

Radiologist—A medical doctor specially trained in radiology (x ray) interpretation and its use in the diagnosis of diseases and injuries.

X ray—A form of electromagnetic radiation with shorter wavelengths than normal light. X rays can penetrate most structures.

the rotator cuff, tears in the ligament and other conditions. The entire lining of the joint becomes opaque from the technique, which allows the radiologist to see abnormalities in the intricate workings of the joint. In the case of recurrent shoulder dislocations, arthrography results can be used to evaluate damage. Patients with hip prostheses may receive arthrography to evaluate proper placement or function of their prostheses.

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Arthritis Foundation.1300 W. Peachtree St., Atlanta, GA 30309. (800) 283-7800. <http://www.arthritis.org>.

Teresa Norris, RN

Arthroplasty

Definition

Arthroplasty is surgery to relieve **pain** and restore range of motion by realigning or reconstructing a joint.

Purpose

The goal of arthroplasty is to restore the function of a stiffened joint and relieve pain. Two types of arthroplastic surgery exist. Joint resection involves removing a portion of the bone from a stiffened joint, creating a gap between the bone and the socket, to improve the range of motion. Scar tissue eventually fills the gap. Pain is relieved and motion is restored, but the joint is less stable.

Interpositional reconstruction is surgery to reshape the joint and add a prosthetic disk between the two bones forming the joint. The prosthesis can be made of plastic and metal or from body tissue such as fascia and skin. When interpositional reconstruction fails, total **joint replacement** may be necessary. Joint replacement is also called total joint arthroplasty.

In recent years, joint replacement has become the operation of choice for most knee and hip problems. Elbow, shoulder, ankle, and finger joints are more likely to be treated with joint resection or interpositional reconstruction.

Arthroplasty is performed on people suffering from severe pain and disabling joint stiffness that result from **osteoarthritis** or **rheumatoid arthritis**. Joint resection, rather than joint replacement, is more likely to be performed on people with rheumatoid arthritis, especially when the elbow joint is involved. Total joint replacement is usually reserved for people over the age of 60.

Precautions

If both the bone and socket of a joint are damaged, joint replacement is usually the preferred treatment.

Description

Arthroplasty is performed under general or regional anesthesia in a hospital, by an orthopedic surgeon. Certain medical centers specialize in joint surgery and tend to have higher success rates than less specialized centers.

In joint resection, the surgeon makes an incision at the joint, then carefully removes minimum amount of bone necessary to allow free motion. The more bone that remains, the more stable the joint. Ligament attachments are preserved as much as possible. In interpositional reconstruction, both bones of the joint are reshaped, and a disk of material is placed between the bones to prevent their rubbing together. Length of hospital stay depends on which joint is treated, but is normally only a few days.

Preparation

Prior to arthroplasty, all the standard preoperative blood and urine tests are performed. The patient meets

KEY TERMS

Fascia—Thin connective tissue covering or separating the muscles and internal organs of the body.

Rheumatoid arthritis—A joint disease of unknown origins that may begin at an early age, causing deformity and loss of function in the joints.

with the anesthesiologist to discuss any special conditions that affect the administration of anesthesia.

Aftercare

Patients who have undergone arthroplasty must be careful not to over **stress** or destabilize the joint. Physical therapy is begun immediately. **Antibiotics** are given to prevent infection.

Risks

Joint resection and interpositional reconstruction do not always produce successful results, especially in patients with rheumatoid arthritis. Repeat surgery or total joint replacement may be necessary. As with any major surgery, there is always a risk of an allergic reaction to anesthesia or that blood clots will break loose and obstruct the arteries.

Normal results

Most patients recover with improved range of motion in the joint and relief from pain.

Resources

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Tish Davidson

Arthroscopic surgery

Definition

Arthroscopic surgery is a procedure to visualize, diagnose, and treat joint problems. The name is derived from the Greek words *arthron,* which means *joint,* and *skopein,* which means *to look at.*

Purpose

Arthroscopic surgery is used to identify, monitor, and diagnose joint injuries and disease; or to remove bone or cartilage or repair tendons or ligaments. Diagnostic arthroscopic surgery is performed when medical history, physical exam, x rays, and other tests such as MRIs or CTs don't provide a definitive diagnosis.

Precautions

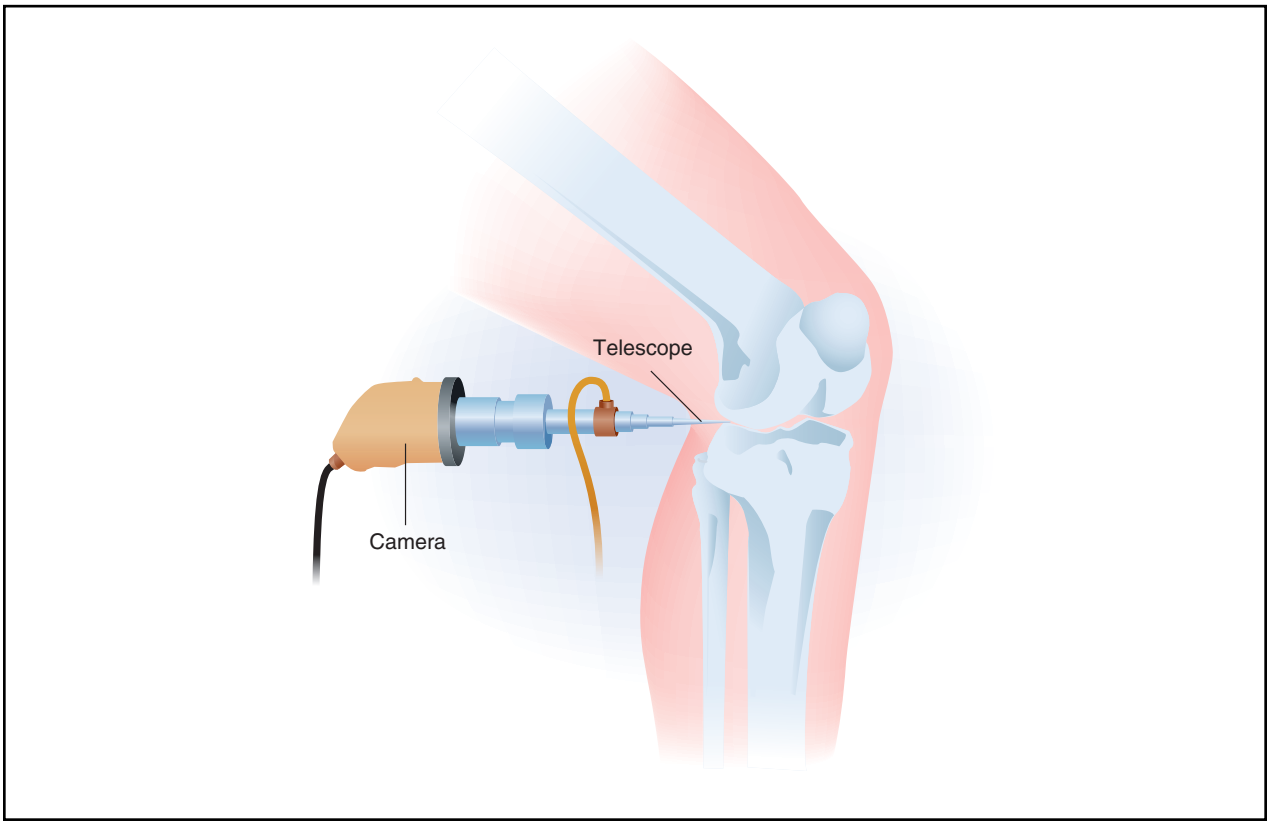
Diagnostic arthroscopic surgery should not be performed unless conservative treatment does not fix the problem.

Description

In arthroscopic surgery, an orthopedic surgeon uses an arthroscope, a fiber-optic instrument, to see the inside of a joint. After making an incision about the size of a buttonhole in the patient's skin, a sterile sodium chloride solution is injected to distend the joint. The arthroscope, an instrument the size of a pencil, is then inserted into the joint. The arthroscope has a lens and a lighting system through which the structures inside the joint are transmitted to a miniature television camera attached to the end of the arthroscope. The surgeon uses irrigation and suction to remove blood and debris from the joint before examining it. Other incisions may be made in order to see other parts of the joint or to insert additional instruments. Looking at the interior of the joint on the television screen, the surgeon can then determine the amount or type of injury and, if necessary, take a biopsy specimen or repair or correct the problem. Arthroscopic surgery can be used to remove floating bits of cartilage and treat minor tears and other disorders. When the procedure is finished, the arthroscope is removed and the joint is irrigated. The site of the incision is bandaged.

Arthroscopic surgery is used to diagnose and treat joint problems, most commonly in the knee, but also in the shoulder, elbow, ankle, wrist, and hip. Some of the most common joint problems seen with an arthroscope are:

- inflammation in the knee, shoulder, elbow, wrist, or ankle
- injuries to the shoulder (rotator cuff tendon tears, impingement syndrome, and recurrent dislocations), knee (cartilage tears, wearing down of or injury to the cartilage cushion, and anterior cruciate ligament tears with instability), and wrist (**carpal tunnel syndrome**)
- loose bodies of bone and/or cartilage in the knee, shoulder, elbow, ankle, or wrist



An arthroscope uses optical fibers to form an image of the damged cartilage, which it sends to a television monitor that helps the surgeon perform surgery. *(Illustration by Argosy Inc.)*

Corrective arthroscopic surgery is performed with instruments that are inserted through additional incisions. Arthritis can sometimes be treated with arthroscopic surgery. Some problems are treated with a combination of arthroscopic and standard surgery.

Also called **arthroscopy**, the procedure is performed in a hospital or outpatient surgical facility. The type of anesthesia (local, spinal, or general) and the length of the procedure depends on the joint operated on and the complexity of the suspected problem. Arthroscopic surgery rarely takes more than an hour. Most patients who have arthroscopic surgery are released that same day; some patients stay in the hospital overnight.

Considered the most important orthopedic development in the 20th century, arthroscopic surgery is widely used. The use of arthroscopic surgery on famous athletes has been well publicized. It is estimated that 80% of orthopedic surgeons practice arthroscopic surgery. Arthroscopic surgery was initially a diagnostic tool used prior to open surgery, but as better instruments and techniques were developed, it began to be used to actually treat a variety of joint problems. New techniques currently under development are likely to lead to other joints being treated with arthroscopic surgery in the future. Recently, lasers were introduced in arthroscopic surgery and other new energy sources are being explored. Lasers and electromagnetic radiation can repair rather than resect injuries and may be more cost effective than instruments.

Preparation

Before the procedure, blood and urine studies and x rays of the joint will be conducted.

Aftercare

Immediately after the procedure, the patient will spend several hours in the recovery room. An ice pack will be put on the joint that was operated on for up to 48 hours after the procedure. **Pain** medicine, prescription or non-prescription, will be given. The morning after the surgery, the dressing can be removed and replaced by adhesive strips. The patient should call his/her doctor upon experiencing an increase in pain, swelling, redness, drainage or bleeding at the site of the surgery, signs of infection (**headache**, muscle aches, **dizziness**, **fever**), or nausea or vomiting.

KEY TERMS

Joint—The point where bones meet. Arthroscopic surgery is used on joint problems.

Laser—A device that concentrates electromagnetic radiation into a narrow beam and treats tissue quickly without heating surrounding areas.

Orthopedics—The medical specialty that deals with preserving, restoring, and developing form and function in the extremities, spine, and other structures using medical, surgical, and physical methods. Arthroscopic surgery is performed by orthopedic surgeons.

It takes several days for the puncture **wounds** to heal, and several weeks for the joint to fully recover. Many patients can resume their daily activities, including going back to work, within a few days of the procedure. A **rehabilitation** program, including physical therapy, may be suggested to speed recovery and improve the future functioning of the joint.

Risks

Complications are rare in arthroscopic surgery, occurring in less than 1% of patients. These include infection and inflammation, blood vessel clots, damage to blood vessels or nerves, and instrument breakage.

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Lori De Milto

Arthroscopy

Definition

Arthroscopy is the examination of a joint, specifically, the inside structures. The procedure is performed by inserting a specifically designed illuminated device into the joint through a small incision. This instrument is called an arthroscope. The procedure of arthroscopy is primarily associated with the process of diagnosis. However, when actual repair is performed, the procedure is called **arthroscopic surgery**.

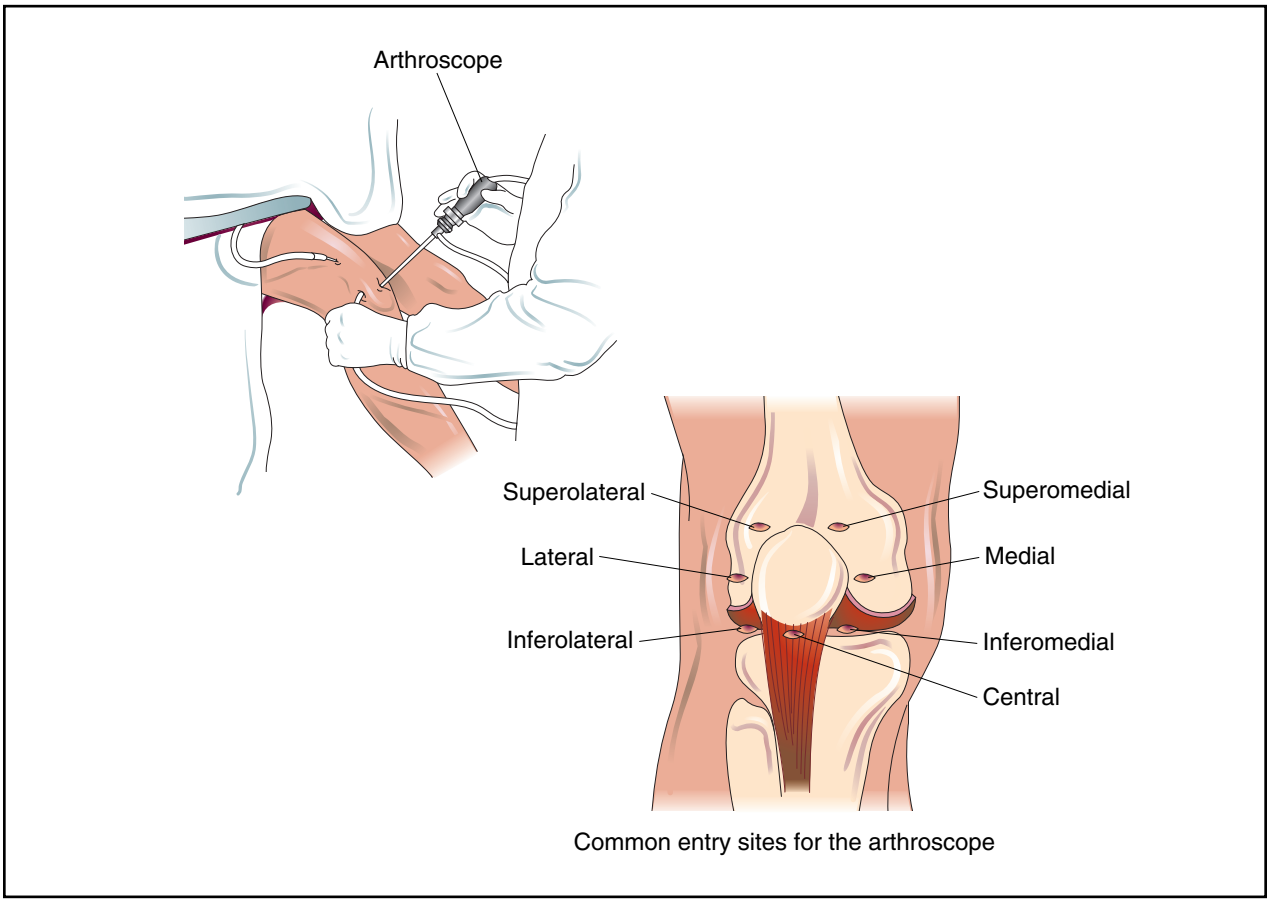
Purpose

Arthroscopy is used primarily by doctors who specialize in treating disorders of the bones and related structures (orthopedics) to help diagnose joint problems. Once described as essential for those who primarily care for athletic injuries, arthroscopy is now a technique commonly used by orthopedic surgeons for the treatment of patients of all ages. This procedure is most commonly used to diagnose knee and shoulder problems, although the elbow, hip, wrist, and ankle may also be examined with an arthroscope.

A joint is a complex system. Within a joint, ligaments attach bones to other bones, tendons attach muscles to bones, cartilage lines and helps protect the ends of bones, and a special fluid (synovial fluid) cushions and lubricates the structures. Looking inside the joint allows the doctors to see exactly which structures are damaged. Arthroscopy also permits earlier diagnosis of many types of joint problems which had been difficult to detect in previous years.

Precautions

Most arthroscopic procedures today are performed in same-day surgery centers where the patient is admitted just before surgery. A few hours following the procedure, the patient is allowed to return home, although usually someone else must drive. Depending on the type of anesthesia used, the patient may be told not to eat for several hours before arriving. Before the procedure, the anesthesiologist will ask if the patient has any known **allergies** to local or general anesthetics. Airway obstruction is always possible in any patient who receives a general



Arthroscopy is primarily used to help diagnose joint problems. This procedure, most commonly associated with knee and shoulder problems, allows accurate examination and diagnosis of damaged joint ligaments, surfaces, and other related joint structures. The illustration above indicates the most common entry sites, or portals, in knee arthroscopy. *(Illustration by Electronic Illustrators Group.)*

anesthesia. Because of this, oxygen, suction, and monitoring equipment must be available. The patient's cardiac status should always be monitored in the event that any cardiac abnormalities arise during the arthroscopy.

Description

The arthroscope is an instrument used to look directly into the joint. It contains magnifying lenses and glass-coated fibers that send concentrated light into the joint. A camera attached to the arthroscope allows the surgeon to see a clear image of the joint. This image is then transferred to a monitor located in the operating room at the time of the arthroscopy. This video technology is also important for documentation of the arthroscopic procedure. For example, if the surgeon decides after the arthroscopic examination that a conventional approach to surgically expose or "open" the joint (arthrotomy) must be used, a good photographic record will be useful when the surgeon returns to execute the final surgical plan.

The procedure requires the surgeon to make several small incisions (portals) through the skin's surface into the joint. Through one or two of the portals, a large-bore needle, called a cannula, is attached to tubing and inserted into the joint. The joint is inflated with a sterile saline solution to expand the joint and ensure clear arthroscopic viewing. Often, following a recent traumatic injury to a joint, the joint's natural fluid may be cloudy, making interior viewing of the joint difficult. In this condition, a constant flow of the saline solution is necessary. This inflow of saline solution may be through the cannula with the outflow through the arthroscope, or the positions may be reversed. The arthroscope is placed through one of the portals to view and evaluate the condition of the joint.

Preparation

Before an arthroscopy can take place, the surgeon completes a thorough medical history and evaluation. Important for the accuracy of this diagnostic procedure, a

medical history and evaluation may discover other disorders of the joint or body parts, proving the procedure unnecessary. This is always an important preliminary step, because **pain** can often be referred to a joint from another area of the body. Anatomical models and pictures are useful aids to explain to the patient the proposed arthroscopy and what the surgeon may be looking at specifically.

Proper draping of the body part is important to prevent contamination from instruments used in arthroscopy, such as the camera, light cords, and inflow and outflow drains placed in the portals. Draping packs used in arthroscopy include disposable paper gowns and drapes with adhesive backing. The surgeon may also place a tourniquet above the joint to temporarily block blood flow to the area during the arthroscopic exam.

General or local anesthesia may be used during arthroscopy. Local anesthesia is usually used because it reduces the risk of lung and heart complications and allows the patient to go home sooner. The local anesthetic may be injected in small amounts in multiple locations in skin and joint tissues in a process called infiltration. In other cases, the anesthetic is injected into the spinal cord or a main nerve supplying the area. This process is called a "block," and it blocks all sensation below the main trunk of the nerve. For example, a femoral block anesthetizes the leg from the thigh down (its name comes from femur, the thighbone). Most patients are comfortable once the skin, muscles, and other tissues around the joint are numbed by the anesthetic; however, some patients are also given a sedative if they express **anxiety** about the procedure. (It's important for the patient to remain still during the arthroscopic examination.)

General anesthesia, in which the patient becomes unconcious, may be used if the procedure may be unusually complicated or painful. For example, people who have relatively "tight" joints may be candidates for general anesthesia because the procedure may take longer and cause more discomfort.

Aftercare

The portals are closed by small tape strips or stitches and covered with dressings and a bandage. The patient spends a short amount of time in the recovery room after arthroscopy. Most patients can go home after about an hour in the recovery room. Pain medication may be prescribed for a short period; however, many patients find various over-the-counter pain relievers sufficient.

Following the surgical procedure, the patient needs to be aware of the signs of infection, which include redness, warmth, excessive pain, and swelling. The risk of infection increases if the incisions become wet too early following surgery. Because of this, it is good practice to cover the joint with plastic (for example, a plastic bag) while showering after arthroscopy.

The use of crutches is commonplace after arthroscopy, with progression to independent walking on an "as tolerated" basis by the patient. Generally, a **rehabilitation** program, supervised by a physical therapist, follows shortly after the arthroscopy to help the patient regain mobility and strength of the affected joint and limb.

Risks

The incidence of complications is low compared to the high number of arthroscopic procedures performed every year. Possible complications include infection, swelling, damage to the tissues in the joint, blood clots in the leg veins (**thrombophlebitis**), leakage of blood into the joint (hemarthrosis), blood clots that move to the lung (pulmonary embolus), and injury to the nerves around the joint.

Normal results

The goal of arthroscopy is to diagnose a joint problem causing pain and/or restrictions in normal joint function. For example, arthroscopy can be a useful tool in locating a tear in the joint surface of the knee or locating a torn ligament of the shoulder. Arthroscopic examination is often followed by arthroscopic surgery performed to repair the problem with appropriate arthroscopic tools. The final result is to decrease pain, increase joint mobility, and thereby improve the overall quality of the patient's activities of daily living.

Abnormal results

Less optimal results that may require further treatment include adhesive capsulitis. In this condition, the joint capsule that naturally forms around the joint becomes thickened, forming adhesions. This results in a stiff and less mobile joint. This problem is frequently corrected by manipulation and mobilization of the joint with the patient placed under general anesthesia.

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KEY TERMS

Hemarthrosis—A condition of blood within a joint.

Pulmonary embolus—Blockage of an artery of the lung by foreign matter such as fat, tumor, tissue, or a clot originating from a vein.

Thrombophlebitis—Inflamation of a vein with the formation of a thrombus or clot.

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Jeffrey P. Larson, RPT

Artificial insemination *see* **Infertility therapies**

Art therapy

Definition

Art therapy, sometimes called creative arts therapy or expressive arts therapy, encourages people to express and understand emotions through artistic expression and through the creative process.

Purpose

Art therapy provides the client-artist with critical insight into emotions, thoughts, and feelings. Key benefits of the art therapy process include:

- Self-discovery. At its most successful, art therapy triggers an emotional catharsis.
- Personal fulfillment. The creation of a tangible reward can build confidence and nurture feelings of self-worth. Personal fulfillment comes from both the creative and the analytical components of the artistic process.
- Empowerment. Art therapy can help people visually express emotions and fears that they cannot express through conventional means, and can give them some sense of control over these feelings.
- Relaxation and **stress** relief. Chronic stress can be harmful to both mind and body. Stress can weaken and damage the immune system, can cause **insomnia** and depression, and can trigger circulatory problems (like high blood pressure and irregular heartbeats). When used alone or in combination with other relaxation techniques such as **guided imagery**, art therapy can effectively relieve stress.
- Symptom relief and physical **rehabilitation**. Art therapy can also help patients cope with **pain**. This therapy can promote physiological healing when patients identify and work through anger, resentment, and other emotional stressors. It is often prescribed to accompany pain control therapy for chronically and terminally ill patients.

Description

Origins

Humans have expressed themselves with symbols throughout history. Masks, ritual pottery, costumes, other objects used in rituals, cave drawings, Egyptian hieroglyphics, and Celtic art and symbols are all visual records of self-expression and communication through art. Art has also been associated spiritual power, and artistic forms such as the Hindu and Buddhist mandala and Native American sand painting are considered powerful healing tools.

In the late nineteenth century, French psychiatrists Ambrose Tardieu and Paul-Max Simon both published studies on the similar characteristics of and symbolism in the artwork of the mentally ill. Tardieu and Simon viewed art therapy as an effective diagnostic tool to identify specific types of mental illness or traumatic events. Later, psychologists would use this diagnostic aspect to develop psychological drawing tests (the Draw-A-Man test, the Draw-A-Person Questionnaire [DAP.Q]) and projective personality tests involving visual symbol recognition (e.g., the Rorschach Inkblot Test, the **Thematic Apperception Test** [TAT], and the Holtzman Inkblot Test [HIT]).

The growing popularity of milieu therapies at psychiatric institutions in the twentieth century was an important factor in the development of art therapy in the

United States. Milieu therapies (or environmental therapy) focus on putting the patient in a controlled therapeutic social setting that provides the patient with opportunities to gain self-confidence and interact with peers in a positive way. Activities that encourage self-discovery and empowerment such as art, music, dance, and writing are important components of this approach.

Educator and therapist Margaret Naumburg was a follower of both Freud and Jung, and incorporated art into psychotherapy as a means for her patients to visualize and recognize the unconscious. She founded the Walden School in 1915, where she used students' artworks in psychological counseling. She published extensively on the subject and taught seminars on the technique at New York University in the 1950s. Today, she is considered the founder of art therapy in the United States.

In the 1930s, Karl, William, and Charles Menninger introduced an art therapy program at their Kansas-based psychiatric hospital, the Menninger Clinic. The Menninger Clinic employed a number of artists in residence in the following years, and the facility was also considered a leader in the art therapy movement through the 1950s and 60s. Other noted art therapy pioneers who emerged in the 50s and 60s include Edith Kramer, Hanna Yaxa Kwiatkowska (National Institute of Mental Health), and Janie Rhyne.

Art therapy, sometimes called expressive art or art psychology, encourages self-discovery and emotional growth. It is a two part process, involving both the creation of art and the discovery of its meaning. Rooted in Freud and Jung's theories of the subconscious and unconscious, art therapy is based on the assumption that visual symbols and images are the most accessible and natural form of communication to the human experience. Patients are encouraged to visualize, and then create, the thoughts and emotions that they cannot talk about. The resulting artwork is then reviewed and its meaning interpreted by the patient.

The "analysis" of the artwork produced in art therapy typically allows patients to gain some level of insight into their feelings and lets them to work through these issues in a constructive manner. Art therapy is typically practiced with individual, group, or family psychotherapy (talk therapy). While a therapist may provide critical guidance for these activities, a key feature of effective art therapy is that the patient/artist, not the therapist, directs the interpretation of the artwork.

Art therapy can be a particularly useful treatment tool for children, who frequently have limited language skills. By drawing or using other visual means to express troublesome feelings, younger patients can begin to address these issues, even if they cannot identify or label these emotions with words. Art therapy is also valuable for adolescents and adults who are unable or unwilling to talk about thoughts and feelings.

Beyond its use in mental health treatment, art therapy is also used with traditional medicine to treat organic diseases and conditions. The connection between mental and physical health is well documented, and art therapy can promote healing by relieving stress and allowing the patient to develop coping skills.

Art therapy has traditionally centered on visual mediums, like paintings, sculptures, and drawings. Some mental healthcare providers have now broadened the definition to include music, film, dance, writing, and other types of artistic expression.

Art therapy is often one part of a psychiatric inpatient or outpatient treatment program, and can take place in individual or **group therapy** sessions. Group art therapy sessions often take place in hospital, clinic, shelter, and community program settings. These group therapy sessions can have the added benefits of positive social interaction, empathy, and support from peers. The client-artist can learn that others have similar concerns and issues.

Preparations

Before starting art therapy, the therapist may have an introductory session with the client-artist to discuss art therapy techniques and give the client the opportunity to ask questions about the process. The client-artist's comfort with the artistic process is critical to successful art therapy.

The therapist ensures that appropriate materials and space are available for the client-artist, as well as an adequate amount of time for the session. If the individual artist is exploring art as therapy without the guidance of a trained therapist, adequate materials, space, and time are still important factors in a successful creative experience.

The supplies used in art therapy are limited only by the artist's (and/or therapist's) imagination. Some of the materials often used include paper, canvas, poster board, assorted paints, inks, markers, pencils, charcoals, chalks, fabrics, string, adhesives, clay, wood, glazes, wire, bendable metals, and natural items (like shells, leaves, etc.). Providing artists with a variety of materials in assorted colors and textures can enhance their interest in the process and may result in a richer, more diverse exploration of their emotions in the resulting artwork. Appropriate tools such as scissors, brushes, erasers, easels, supply trays, glue guns, smocks or aprons, and cleaning materials are also essential.

An appropriate workspace should be available for the creation of art. Ideally, this should be a bright, quiet, comfortable place, with large tables, counters, or other

suitable surfaces. The space can be as simple as a kitchen or office table, or as fancy as a specialized artist's studio.

The artist should have adequate time to become comfortable with and explore the creative process. This is especially true for people who do not consider themselves "artists" and may be uncomfortable with the concept. If performed in a therapy group or one-on-one session, the art therapist should be available to answer general questions about materials and/or the creative process. However, the therapist should be careful not to influence the creation or interpretation of the work.

Precautions

Art materials and techniques should match the age and ability of the client. People with impairments, such as traumatic brain injury or an organic neurological condition, may have difficulties with the self-discovery portion of the art therapy process depending on their level of functioning. However, they may still benefit from art therapy through the sensory stimulation it provides and the pleasure they get from artistic creation.

While art is accessible to all (with or without a therapist to guide the process), it may be difficult to tap the full potential of the interpretive part of art therapy without a therapist to guide the process. When art therapy is chosen as a therapeutic tool to cope with a physical condition, it should be treated as a supplemental therapy and not as a substitute for conventional medical treatments.

Research and general acceptance

A wide body of literature supports the use of art therapy in a mental health capacity. And as the mind-body connection between psychological well-being and physical health is further documented by studies in the field, art therapy gains greater acceptance by mainstream medicine as a therapeutic technique for organic illness.

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American Art Therapy Association.1202 Allanson Rd., Mundelein, IL 60060-3808. 888-290-0878 or 847-949-6064. Fax: 847-566-4580. arttherapy@ntr.net. <http://www.arttherapy.org>.

Paula Ford-Martin

KEY TERMS

Catharsis—Therapeutic discharge of emotional tension by recalling past events.

Mandala—A design, usually circular, that appears in religion and art. In Buddhism and Hinduism, the mandala has religious ritual purposes and serves as a yantra (a geometric emblem or instrument of contemplation).

Organic illness—A physically, biologically based illness.

Asbestosis

Definition

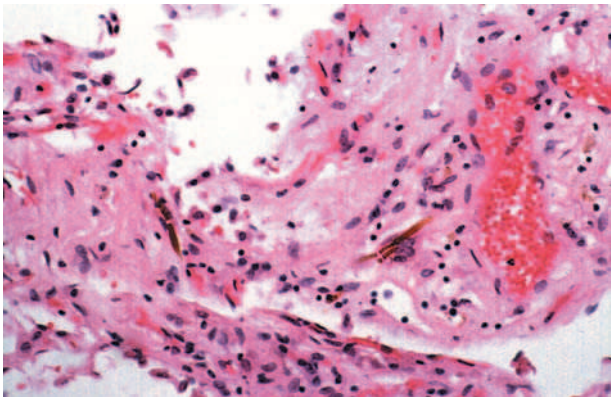
Asbestosis is chronic, progressive inflammation of the lung. It is not contagious.

Description

Asbestosis is a consequence of prolonged exposure to large quantities of asbestos, a material once widely used in construction, insulation, and manufacturing. When asbestos is inhaled, fibers penetrate the breathing passages and irritate, fill, inflame, and scar lung tissue. In advanced asbestosis,, the lungs shrink, stiffen, and become honeycombed (riddled with tiny holes).

Legislation has reduced use of asbestos in the United States, but workers who handle automobile brake shoe linings, boiler insulation, ceiling acoustic tiles, electrical equipment, and fire-resistant materials are still exposed to the substance. Asbestos is used in the production of paints and plastics. Significant amounts can be released into the atmosphere when old buildings or boats are razed or remodeled.

Asbestosis is most common in men over 40 who have worked in asbestos-related occupations. Smokers or heavy drinkers have the greatest risk of developing this disease. Between 1968 and 1992, more than 10,000 Americans over the age of 15 died as a result of asbestosis. Nearly 25% of those who died lived in California or



Micrograph of asbestos fibers embedded in lung tissue. *(Photograph by Dr. E. Walker, Custom Medical Stock Photo. Reproduced by permission.)*

New Jersey, and most of them had worked in the construction or shipbuilding trades.

Causes and symptoms

Occupational exposure is the most common cause of asbestosis, but the condition also strikes people who inhale asbestos fiber or who are exposed to waste products from plants near their homes. Family members can develop the disease as a result of inhaling particles of asbestos dust that cling to workers' clothes.

It is rare for asbestosis to develop in anyone who hasn't been exposed to large amounts of asbestos on a regular basis for at least 10 years. Symptoms of the disease do not usually appear until 15–20 years after initial exposure to asbestos.

The first symptom of asbestosis is usually **shortness of breath** following **exercise** or other physical activity. The early stages of the disease are also characterized by a dry **cough** and a generalized feeling of illness.

As the disease progresses and lung damage increases, shortness of breath occurs even when the patient is at rest. Recurrent respiratory infections and coughing up blood are common. So is swelling of the feet, ankles, or hands. Other symptoms of advanced asbestosis include chest **pain**, hoarseness, and restless sleep. Patients who have asbestosis often have clubbed (widened and thickened) fingers. Other potential complications include **heart failure**, collapsed (deflated) lung, and **pleurisy** (inflammation of the membrane that protects the lung).

Diagnosis

Screening of at-risk workers can reveal lung inflammation and lesions characteristic of asbestosis. Patients' medical histories can identify occupations, hobbies, or other situations likely to involve exposure to asbestos fibers.

X rays can show shadows or spots on the lungs or an indistinct or shaggy outline of the heart that suggests the presence of asbestosis. Blood tests are used to measure concentrations of oxygen and carbon dioxide. Pulmonary function tests can be used to assess a patient's ability to inhale and exhale, and a computed tomography scan (CT) of the lungs can show flat, raised patches associated with advanced asbestosis.

Treatment

The goal of treatment is to help patients breathe more easily, prevent colds and other respiratory infections, and control complications associated with advanced disease. Ultrasonic, cool-mist humidifiers or controlled coughing can loosen bronchial secretions.

Regular exercise helps maintain and improve lung capacity. Although temporary bed rest may be recommended, patients are encouraged to resume their regular activities as soon as they can.

Antibiotics may be prescribed to combat infection. **Aspirin** or acetominophen (Tylenol) can relieve minor discomfort and **bronchodilators** that are swallowed or inhaled can relax and widen breathing passages.

Diuretics (drugs that increase urine production and excretion) or digitalis glycoside (*Digitalis purpurea*) are prescribed for some patients. Others may need to use supplemental oxygen or use less salt.

Anyone who develops symptoms of asbestosis should see a family physician or lung disease specialist. A doctor should be notified if someone who has been diagnosed with asbestosis:

- coughs up blood
- continues to lose weight
- is short of breath
- has chest pain
- develops a sudden **fever** of 101°F (38.3°C) or higher
- develops unfamiliar, unexplained symptoms

Prognosis

Asbestosis can't be cured, but its symptoms can be controlled. Doctors don't know why the health of some patients deteriorates and the condition of others remain the same, but believe the difference may be due to varying exposures of asbestos. People with asbestosis who smoke, particularly those who smoke more than one pack of cigarettes each day, are at increased risk for

KEY TERMS

Asbestos—A silicate (containing silica) mineral that occurs in a variety of forms; it is characterized by a fibrous structure and resistance to fire.

developing lung **cancer** and should be strongly advised to quit **smoking**.

Prevention

Workers in asbestosis-related industries should have regular x rays to determine whether their lungs are healthy. A person whose lung x ray shows a shadow should eliminate asbestos exposure even if no symptoms of the condition have appeared.

Anyone who works with asbestos should wear a protective mask or a hood with a clean-air supply and obey recommended procedures to control asbestos dust. Anyone who is at risk of developing asbestosis should:

- not smoke
- be vaccinated against **influenza** and **pneumonia**
- exercise regularly to maintain cardiopulmonary fitness
- avoid crowds and people who have respiratory infections

A person who has asbestosis should exercise regularly, relax, and conserve energy whenever necessary.

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Maureen Haggerty

Ascariasis *see* **Roundworm infections**

Ascending cholangitis *see* **Cholangitis**

Ascending contrast phlebography *see* **Venography**

Ascites

Definition

Ascites is an abnormal accumulation of fluid in the abdomen.

Description

Rapidly developing (acute) ascites can occur as a complication of trauma, perforated ulcer, **appendicitis**, or inflammation of the colon or other tube-shaped organ (diverticulitis). This condition can also develop when intestinal fluids, bile, pancreatic juices, or bacteria invade or inflame the smooth, transparent membrane that lines the inside of the abdomen (peritoneum). However, ascites is more often associated with liver disease and other long-lasting (chronic) conditions.

Types of ascites

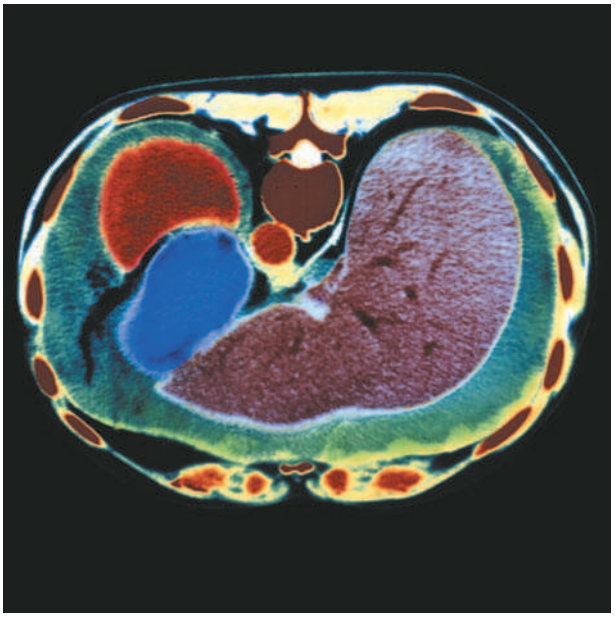
Cirrhosis, which is responsible for 80% of all instances of ascites in the United States, triggers a series of disease-producing changes that weaken the kidney's ability to excrete sodium in the urine.

Pancreatic ascites develops when a cyst that has thick, fibrous walls (pseudocyst) bursts and permits pancreatic juices to enter the abdominal cavity.

Chylous ascites has a milky appearance caused by lymph that has leaked into the abdominal cavity. Although chylous ascites is sometimes caused by trauma, abdominal surgery, **tuberculosis**, or another peritoneal infection, it is usually a symptom of lymphoma or some other **cancer**.

Cancer causes 10% of all instances of ascites in the United States. It is most commonly a consequence of disease that originates in the peritoneum (peritoneal carcinomatosis) or of cancer that spreads (metastasizes) from another part of the body.

Endocrine and renal ascites are rare disorders. Endocrine ascites, sometimes a symptom of an endocrine system disorder, also affects women who are taking fertility drugs. Renal ascites develops when blood levels of albumin dip below normal. Albumin is the major protein



A computed tomography (CT) scan of an axial section through the abdomen, showing ascites. At right is the liver occupying much of the abdomen; the stomach and spleen are also seen. Around these organs is fluid giving rise to this condition. *(Custom Medical Stock Photo. Reproduced by permission.)*

in blood plasma. It functions to keep fluid inside the blood vessels.

Causes and symptoms

Causes

The two most important factors in the production of ascites due to chronic liver disease are:

- Low levels of albumin in the blood that cause a change in the pressure necessary to prevent fluid exchange (osmotic pressure). This change in pressure allows fluid to seep out of the blood vessels.
- An increase in the pressure within the branches of the portal vein that run through liver (portal **hypertension**). Portal hypertension is caused by the scarring that occurs in cirrhosis. Blood that cannot flow through the liver because of the increased pressure leaks into the abdomen and causes ascites.

Other conditions that contribute to ascites development include:

- hepatitis
- heart or kidney failure
- inflammation and fibrous hardening of the sac that contains the heart (constrictive **pericarditis**)

Persons who have **systemic lupus erythematosus** but do not have liver disease or portal hypertension occasionally develop ascites. Depressed thyroid activity sometimes causes pronounced ascites, but inflammation of the pancreas (**pancreatitis**) rarely causes significant accumulations of fluid.

Symptoms

Small amounts of fluid in the abdomen do not usually produce symptoms. Massive accumulations may cause:

- rapid weight gain
- abdominal discomfort and distention
- shortness of breath
- swollen ankles

Diagnosis

Skin stretches tightly across an abdomen that contains large amounts of fluid. The navel bulges or lies flat, and the fluid makes a dull sound when the doctor taps the abdomen. Ascitic fluid may cause the flanks to bulge.

Physical examination generally enables doctors to distinguish ascites from **pregnancy**, intestinal gas, **obesity**, or ovarian tumors. Ultrasound or **computed tomography scans** (CT) can detect even small amounts of fluid. Laboratory analysis of fluid extracted by inserting a needle through the abdominal wall (diagnostic **paracentesis**) can help identify the cause of the accumulation.

Treatment

Reclining minimizes the amount of salt the kidneys absorb, so treatment generally starts with bed rest and a low-salt diet. Urine-producing drugs (**diuretics**) may be prescribed if initial treatment is ineffective. The weight and urinary output of patients using diuretics must be carefully monitored for signs of :

- hypovolemia (massive loss of blood or fluid)
- azotemia (abnormally high blood levels of nitrogen-bearing materials)
- potassium imbalance
- high sodium concentration. If the patient consumes more salt than the kidneys excrete, increased doses of diuretics should be prescribed

Moderate-to-severe accumulations of fluid are treated by draining large amounts of fluid (large-volume paracentesis) from the patient's abdomen. This procedure is safer than diuretic therapy. It causes fewer complications and requires a shorter hospital stay.

Large-volume paracentesis is also the preferred treatment for massive ascites. Diuretics are sometimes

KEY TERMS

Computed tomography scan (CT)—An imaging technique in which cross-sectional x rays of the body are compiled to create a three-dimensional image of the body's internal structures.

Interferon—A protein formed when cells are exposed to a virus. Interferon causes other noninfected cells to develop translation inhibitory protein (TIP). TIP blocks viruses from infecting new cells.

Paracentesis—A procedure in which fluid is drained from a body cavity by means of a catheter placed through an incision in the skin.

Systemic lupus erythematosus—An inflammatory disease that affects many body systems, including the skin, blood vessels, kidneys, and nervous system. It is characterized, in part, by arthritis, skin rash, weakness, and fatigue.

Ultrasonography—A test using sound waves to measure blood flow. Gel is applied to a hand-held transducer that is pressed against the patient's body. Images are displayed on a monitor.

used to prevent new fluid accumulations, and the procedure may be repeated periodically.

Alternative treatment

Dietary alterations, focused on reducing salt intake, should be a part of the treatment. In less severe cases, herbal diuretics like dandelion (*Taraxacum officinale*) can help eliminate excess fluid and provide potassium. Potassium-rich foods like low-fat yogurt, mackerel, cantaloupe, and baked potatoes help balance excess sodium intake.

Prognosis

The prognosis depends upon the condition that is causing the ascites. Carcinomatous ascites has a very bad prognosis. However, salt restriction and diuretics can control ascites caused by liver disease in many cases.

Therapy should also be directed towards the underlying disease that produces the ascites. Cirrhosis should be treated by abstinence from alcohol and appropriate diet. The new interferon agents maybe helpful in treating chronic hepatitis.

Prevention

Modifying or restricting use of salt can prevent most cases of recurrent ascites.

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Maureen Haggerty

Ascorbic acid deficiency *see* **Scurvy**

ASD *see* **Atrial septal defect**

Asian American health *see* **Minority health**

Asian flu *see* **Influenza**

Aspartate aminotransferase test

Definition

The Aspartate aminotransferase test measures levels of AST, an enzyme released into the blood when certain organs or tissues, particularly the liver and heart, are injured. Aspartate aminotransferase (AST) is also known as serum glutamic oxaloacetic transaminase (SGOT).

Purpose

The determination of AST levels aids primarily in the diagnosis of liver disease. In the past, the AST test was used to diagnose **heart attack** (myocardial infarction or MI) but more accurate blood tests have largely replaced it for cardiac purposes.

Description

AST is determined by analysis of a blood sample, usually from taken from a venipuncture site at the bend of the elbow.

AST is found in the heart, liver, skeletal muscle, kidney, pancreas, spleen, lung, red blood cells, and brain tissue. When disease or injury affects these tissues, the cells are destroyed and AST is released into the bloodstream. The amount of AST is directly related to the number of cells affected by the disease or injury, but the level of elevation depends on the length of time that the blood is tested after the injury. Serum AST levels become elevated eight hours after cell injury, peak at 24-36 hours, and return to normal in three to seven days. If the cellular injury is chronic (ongoing), AST levels will remain elevated.

One of the most important uses for AST determination has formerly been in the diagnosis of a heart attack, or MI. AST can assist in determining the timing and extent of a recent MI, although it is less specific than creatine phosphokinase (CPK), CKMB, myglobin, troponins, and lactic dehydrogenase (LDH). Assuming no further cardiac injury occurs, the AST level rises within 6-10 hours after an acute attack, peaks at 12-48 hours, and returns to normal in three to four days. Myocardial injuries such as **angina** (chest **pain**) or **pericarditis** (inflammation of the pericardium, the membrane around the heart) do not increase AST levels.

AST is also a valuable aid in the diagnosis of liver disease. Although not specific for liver disease, it can be used in combination with other enzymes to monitor the course of various liver disorders. Chronic, silent hepatitis (**hepatitis C**) is sometimes the cause of elevated AST. In alcoholic hepatitis, caused by excessive alcohol ingestion, AST values are usually moderately elevated; in acute viral hepatitis, AST levels can rise to over 20 times normal. Acute extrahepatic (outside the liver) obstruction (e.g. gallstone), produces AST levels that can quickly rise to 10 times normal, and then rapidly fall. In cases of **cirrhosis**, the AST level is related to the amount of active inflammation of the liver. Determination of AST also assists in early recognition of toxic hepatitis that results from exposure to drugs toxic to the liver, like **acetaminophen** and cholesterol lowering medications.

Other disorders or diseases in which the AST determination can be valuable include acute **pancreatitis**, muscle disease, trauma, severe burn, and **infectious mononucleosis**.

KEY TERMS

Cirrhosis—Disease of the liver caused by chronic damage to its cells.

Myocardial infarction—Commonly known as a heart attack. Sudden death of part of the heart muscle, characterized, in most cases, by severe, unremitting chest pain.

Preparation

The physician may require discontinuation of any drugs that might affect the test. These types include such drugs as antihypertensives (for treatment of high blood pressure), coumarin-type anticoagulants (blood-thinning drugs), digitalis, erythromycin (an antibiotic), **oral contraceptives**, and opiates, among others. The patient may also need to cut back on strenuous activities temporarily, because **exercise** can also elevate AST for a day or two.

Risks

Risks for this test are minimal, but may include slight bleeding from the blood-drawing site, **fainting** or feeling lightheaded after venipuncture, or hematoma (blood accumulating under the puncture site).

Normal results

Normal ranges for the AST are laboratory-specific, but can range from 3-45 units/L (units per liter).

Abnormal results

Striking elevations of AST (400-4000 units/L) are found in almost all forms of acute hepatic necrosis, such as viral hepatitis and carbon tetrachloride **poisoning**. In alcoholics, even moderate doses of the analgesic acetaminophen have caused extreme elevations (1,960-29,700 units/L). Moderate rises of AST are seen in **jaundice**, cirrhosis, and metastatic carcinoma. Approximately 80% of patients with infectious mononucleosis show elevations in the range of 100-600 units/L.

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Janis O. Flores

Asperger's syndrome *see* **Pervasive developmental disorders**

Aspergilloma *see* **Aspergillosis**

Aspergillosis

Definition

Aspergillosis refers to several forms of disease caused by a fungus in the genus *Aspergillus*. Aspergillosis fungal infections can occur in the ear canal, eyes, nose, sinus cavities, and lungs. In some individuals, the infection can even invade bone and the membranes that enclose the brain and spinal cord (**meningitis**).

Description

Aspergillosis is primarily an infection of the lungs caused by the inhalation of airborne spores of the fungus *Aspergillus*. Spores are the small particles that most fungi use to reproduce. Although virtually everyone is exposed to this fungus in their daily environment, it rarely causes disease. When *Aspergillus* does cause disease, however, it usually occurs in those individuals with weakened immune systems (immunocompromised) or who have a history of respiratory ailments. Because it does not present distinctive symptoms, aspergillosis is generally thought to be underdiagnosed and underreported. Furthermore, many patients with the more severe forms of aspergillosis tend to have multiple, complex health problems, such as **AIDS** or a blood disorder like leukemia, which can further complicate diagnosis and treatment.

Once considered particularly rare, the incidence of reported aspergillosis has risen somewhat with the development of more sophisticated methods of diagnosis and advances made in other areas of medicine, such as with the increased use of certain chemotherapeutic and corticosteroid drugs that are extremely useful in treating various types of **cancer** but that decrease the individual's immune response, making them more susceptible to other diseases like aspergillosis.

Our advanced ability to perform tissue and organ transplants has also increased the number of people vulnerable to fungal infections. Transplant recipients, particularly those receiving bone marrow or heart transplants, are highly susceptible to *Aspergillus*, which may be circulating in the hospital air.

Aspergillosis can be a serious, potentially deadly threat for two primary reasons:

- Aspergillosis usually occurs in those individuals who are already ill or have weakened immune systems, such as patients who have undergone **chemotherapy** for cancer.
- None of the currently available antifungal drugs are reliably effective against *Aspergillus*.

Causes and symptoms

Aspergillus is a fungus that is found almost everywhere, but particularly in soil, water, decaying vegetation, and stored grain. The fungus has also been cultured from ventilation systems and may be stirred up during building renovations. The species most commonly identified in patients with confirmed disease are *A. fumigatus* and *A. flavus*.

Airborne *Aspergillus* spores enter the body primarily through inhalation but can also lodge in the ear or eye. Normally functioning immune systems are generally able to cope without consequent development of aspergillosis.

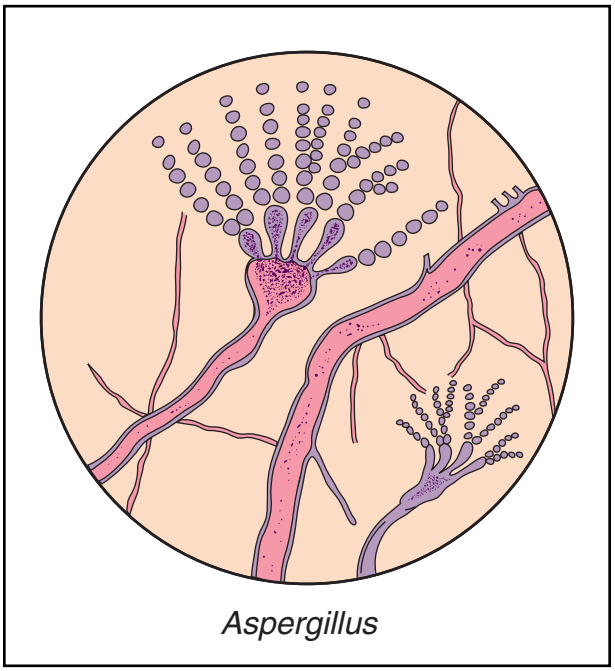
It is important to make distinctions between the various forms of aspergillosis, as the treatment and prognosis varies considerably among types. Aspergillosis as a diagnosis refers to three general forms:

- Allergic bronchopulmonary aspergillosis (ABPA) is seen in patients with long-standing **asthma**, particularly in patients taking oral **corticosteroids** for a long period of time. This is usually the least serious and most treatable form.
- Aspergilloma refers to the mass formed when fungal spores settle into or colonize areas of the lung that have been pitted and scarred as a result of **tuberculosis** or prior **pneumonia**. There are several available treatments, although the success rate varies with each treatment.
- Invasive fungal infection refers to rare cases in which the fungus spreads throughout the body via the blood stream and invades other organ systems. Once established, invasive fungal infections are extremely difficult to cure and, as a result, the associated **death** rate is extremely high.

Aspergillus infection of the ear (called otomycosis), can produce **itching** and a discharge, sometimes noticed as a spot on the pillow. Fungal infection of the cornea of the eye in a susceptible person can result in blindness, if not diagnosed and treated promptly.

Diagnosis

Aspergillosis can be quite difficult to diagnose because the symptoms, such as coughing and **wheezing**, if present at all, are common to many respiratory disorders. Furthermore, blood and sputum cultures are not very helpful. The presence of *Aspergillus* is so common, even in asthmatics, that a positive culture alone is insufficient for a diagnosis. Other, potentially more useful, screening tools include examining the sample obtained after repeatedly washing the bronchial tubes of the lung with water (bronchial lavage), but examining a tissue sample (biopsy) is the most reliable diagnostic tool. Researchers are currently attempting to develop a practi-



Aspergillosis is an infection of the lungs caused by inhalation of airborne spores of the fungus *Aspergillus*. *(Illustration by Electronic Illustrators Group).*

cal, specific, and rapid blood test that would confirm *Aspergillus* infection.

Signs of ABPA include a worsening of bronchial asthma accompanied by a low-grade **fever**. Brown flecks or clumps may be seen in the sputum. Pulmonary function tests may show decreased blood flow, suggesting an obstruction within the lungs. Elevated blood levels of an antibody produced in response to *Aspergillus* and of certain immune system cells may indicate a specific allergic-type immune system response.

A fungal mass (aspergilloma) in the lung usually does not produce clear symptoms and is generally diagnosed when seen on chest x rays. However, 70% or more of patients spit up blood from the lungs (**hemoptysis**) at least once, and this may become repetitive and serious. Hemoptysis, then, is another indication that the patient may be suffering from an aspergilloma.

In patients with lowered immune systems who are at risk for developing invasive aspergillosis, the physician may use a combination of **blood culture** with visual diagnostic techniques, such as **computed tomography scans** (CT) and radiography, to arrive at a likely diagnosis.

Treatment

The treatment method selected depends on the form of aspergillosis. ABPA can usually be treated with many of the same drugs used to treat asthma, such as systemic steroids. Long-term therapy may be required, however, to prevent recurrence. Antifungal agents are not recommended in the treatment of ABPA. In cases of aspergilloma, it may become necessary to surgically remove or reduce the size of a fungal mass, especially if the patient continues to spit up blood. In aspergillosis cases affecting the nose and nasal sinuses, surgery may also be required.

In non-ABPA cases, the use of antifungal drugs may be indicated. In such cases, amphotericin B (Fungizone) is the first-line therapy. The prescribed dose will depend on the patient's condition but usually begins with a small test dose and then escalates. Less than one-third of patients are likely to respond to amphotericin B, and its side effects often limit its use. For patients who do not respond to oral amphotericin B, another option is a different formulation of the same drug called liposomal amphotericin B.

For patients who fail to respond or who cannot tolerate amphotericin B, another drug called itraconazole (Sporanox), given 400-600 mg daily, has also been approved. Treatment generally lasts about 3 months. Giving itraconazole can produce adverse reactions if prescribed in combination with certain other drugs by increasing the concentrations of both drugs in the blood and creating a potentially life-threatening situation. Even **antacids** can significantly affect itraconazole levels. As a result, drug levels must be continually monitored to ensure that absorption is occurring at acceptable levels.

Two other methods of treatment are being studied: direct instillation of an antifungal agent into the lungs and administration of antifungals using a nebulizer. Instilling or injecting amphotericin B or itraconazole directly into the lung cavity or into the fungal ball (aspergilloma) itself has been helpful in stopping episodes of hemoptysis, but not in preventing future recurrences. Furthermore, many patients with aspergillomas are poor risks for surgery because their lung function is already compromised. As a result, instillation of a fungal agent should only be considered in those who have significant hempotysis.

A popular method of treating some respiratory disorders is to add a liquid drug to another carrier liquid and aerosolize or produce a fine mist that can be inhaled into the lungs through a device called a nebulizer. However, this has not yet been shown to improve the patient's condition in cases of aspergillosis, possibly because the drug is not reaching the aspergilloma.

At this point, preventative therapy for aspergillosis is not suggested for susceptible individuals, primarily because overuse of the drugs used to fight fungal infections may lead to the development of drug-resistant

aspergillosis against which current antifungal drugs are no longer effective.

Prognosis

The likelihood of recovery from aspergillosis depends on any underlying medical conditions, the patient's general health, and the specific type of aspergillosis. If the problem is based on an allergic response, as in ABPA, the patient will likely respond well to systemic steroids.

Patients who require **lung surgery**, especially those who have problems with coughing up blood, have a mortality rate of about 7-14%, and complications or recurrence may result in a higher overall death rate. However, by treating aspergilloma with other, non-surgical methods, that risk rises to 26%, making surgery a better option in some cases.

Unfortunately, the prognosis for the most serious form, invasive aspergillosis, is quite poor, largely because these patients have little resilience due to their underlying disorders. Death rates have ranged from about 50% in some studies to as high as 95% for bone-marrow recipients and patients with AIDS. The course of the illness can be rapid, resulting in death within a few months of diagnosis.

Prevention

Fungal infection by *Aspergillus* presents a major challenge, particularly in the patient with a suppressed immune system (immunocompromised). Hospitals and government health agencies continually seek ways to minimize exposure for hospitalized patients. Practical suggestions are minimal but include moving leaf piles away from the house. Unfortunately, overall avoidance of this fungus is all but impossible because it is present in the environment virtually everywhere. Research efforts are being directed at enhancing patients' resistance to *Aspergillus* rather than trying to eliminate exposure to the fungus. Given the growing number of people with immune disorders or whose immune systems have been suppressed in the course of treating another disease, research and clinical trials for new antifungal agents will be increasingly important in the future.

Resources

BOOKS

Bonadio, G. R. *Air Pollution of Humans With Bacteria, Fungus, and Molds in Homes, Offices, and Hospitals: Index of New Information With Author & Subjects*. ABBE Publishers Association of Washington, DC, 1995.

PERIODICALS

Greenberger, P. A. "Immunologic Aspects of Lung Diseases and Cystic Fibrosis." *The Journal of the American Medical Association* 278 (10 Dec. 1997):1924-1930.

KEY TERMS

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

Aspergilloma—A ball or mass made of *Aspergillus* fungi that can form in the lungs of patients with suppressed immune systems.

Bronchial lavage—A procedure that involves repeatedly washing the inside of the bronchial tubes of the lung.

Hemoptysis—Spitting up blood from the lungs or sputum stained with blood.

Immunocompromised—A state in which the immune system is suppressed or not functioning properly.

Meningitis—Inflammation of the membranes covering the brain and spinal cord, called the meninges.

Nebulizer—A device that produces an extremely fine mist that is readily inhalable.

Spores—The small, thick-walled reproductive structures of fungi.

Sputum—Mucus and other matter coughed up from the airways.

ORGANIZATIONS

American College of Allergy, Asthma, and Immunology. 85 West Algonquin Road, Suite 550, Arlington Heights, IL 60005. <http://allergy.mcg.edu>.

OTHER

"Lung, Allergic and Immune Diseases: Mold Allergy: Prevention Techniques." National Jewish Medical and Research. <http://nationaljewish.org/main.html>.

Office of Rare Diseases (ORD) at National Institutes of Health, Bldg. 31,1BO3, Bethesda, MD 20892-2082. (301) 402-4336 <http://rarediseases.info.nih.gov/ord>.

Jill S. Lasker

Aspirin

Definition

Aspirin is a medicine that relieves **pain** and reduces **fever**.

Purpose

Aspirin is used to relieve many kinds of minor aches and pains—headaches, toothaches, muscle pain, menstrual cramps, the joint pain from arthritis, and aches associated with colds and flu. Some people take aspirin daily to reduce the risk of **stroke**, **heart attack**, or other heart problems.

Description

Aspirin—also known as acetylsalicylic acid—is sold over the counter and comes in many forms, from the familiar white tablets to chewing gum and rectal suppositories. Coated, chewable, buffered, and extended release forms are available. Many other over-the-counter medicine contain aspirin. Alka-Seltzer Original Effervescent Antacid Pain Reliever, for example, contains aspirin for pain relief and sodium bicarbonate to relieve acid **indigestion**, **heartburn**, and sour stomach.

Aspirin belongs to a group of drugs called salicylates. Other members of this group include sodium salicylate, choline salicylate, and magnesium salicylate. These drugs are more expensive and no more effective than aspirin. However, they are a little easier on the stomach. Aspirin is quickly absorbed into the bloodstream and provides quick and relatively long-lasting pain relief. Aspirin also reduces inflammation. Researchers believe these effects come about because aspirin blocks the production of pain-producing chemicals called prostaglandins.

In addition to relieving pain and reducing inflammation, aspirin also lowers fever by acting on the part of the brain that regulates temperature. The brain then signals the blood vessels to widen, which allows heat to leave the body more quickly.

Recommended dosage

Adults

TO RELIEVE PAIN OR REDUCE FEVER. one to two tablets every three to four hours, up to six times per day.

TO REDUCE THE RISK OF STROKE. one tablet four times a day or two tablets twice a day.

TO REDUCE THE RISK OF HEART ATTACK. Check with a physician for the proper dose and number of times per week aspirin should, if at all, be taken.

Children

Check with a physician.

Precautions

Aspirin—even children's aspirin—should never be given to children or teenagers with flu-like symptoms or **chickenpox**. Aspirin can cause **Reye's syndrome**, a life-threatening condition that affects the nervous system and liver. As many as 30% of children and teenagers who develop Reye's syndrome die. Those who survive may have permanent brain damage.

Check with a physician before giving aspirin to a child under 12 years for arthritis, rheumatism, or any condition that requires long-term use of the drug.

No one should take aspirin for more than 10 days in a row unless told to do so by a physician. Anyone with fever should not take aspirin for more than 3 days without a physician's consent. Do not to take more than the recommended daily dosage.

People in the following categories should not use aspirin without first checking with their physician:

- Pregnant women. Aspirin can cause bleeding problems in both the mother and the developing fetus. Aspirin can also cause the infant's weight to be too low at birth.
- Women who are breastfeeding. Aspirin can pass into breast milk and may affect the baby.
- People with a history of bleeding problems.
- People who are taking blood-thinning drugs, such as warfarin (Coumadin).
- People with a history of ulcers.
- People with a history of **asthma**, **nasal polyps**, or both. These people are more likely to be allergic to aspirin.
- People who are allergic to fenoprofen, ibuprofen, indomethacin, ketoprofen, meclofenamate sodium, naproxen, sulindac, tolmetin, or the orange food-coloring tartrazine. They may also be allergic to aspirin.
- People with **AIDS** or AIDS-related complex who are taking AZT (zidovudine). Aspirin can increase the risk of bleeding in these patients.
- People taking certain other drugs (discussed in Interactions).
- People with liver damage or severe kidney failure.

Aspirin should not be taken before surgery, as it can increase the risk of excessive bleeding. Anyone who is scheduled for surgery should check with his or her surgeon to find out how long before surgery to avoid taking aspirin.

Aspirin can cause stomach irritation. To reduce the likelihood of that problem, take aspirin with food or milk or drink a full 8-oz glass of water with it. Taking coated or buffered aspirin can also help. Be aware that drinking alcohol can make the stomach irritation worse.

Stop taking aspirin immediately and call a physician if any of these symptoms develop:

- ringing or buzzing in the ears

KEY TERMS

Diuretic—Medicine that increases the amount of urine produced and relieves excess fluid buildup in body tissues. Diuretics may be used in treating high blood pressure, lung disease, premenstrual syndrome, and other conditions.

Inflammation—Pain, redness, swelling, and heat that usually develop in response to injury or illness.

NSAIDs—Nonsteroidal anti-inflammatory drugs. Drugs such as ketoprofen and ibuprofen which relieve pain and reduce inflammation.

Polyp—A lump of tissue protruding from the lining of an organ, such as the nose, bladder, or intestine. Polyps can sometimes block the passages in which they are found.

Prostaglandin—A hormonelike chemical produced in the body. Prostaglandins have a wide variety of effects, and may be responsible for the production of some types of pain and inflammation.

Reye's syndrome—A life-threatening disease that affects the liver and the brain and sometimes occurs after a viral infection, such as flu or chickenpox. Children or teenagers who are given aspirin for flu or chickenpox are at increased risk of developing Reye's syndrome.

Rhinitis—Inflammation of the membranes inside the nose.

Salicylates—A group of drugs that includes aspirin and related compounds. Salicylates are used to relieve pain, reduce inflammation, and lower fever.

- hearing loss
- **dizziness**
- stomach pain that does not go away

Do not take aspirin that has a vinegary smell. That is a sign that the aspirin is too old and ineffective. Flush such aspirin down the toilet.

Because aspirin can increase the risk of excessive bleeding, do not take aspirin daily over long periods—to reduce the risk of stroke or heart attack, for example—unless advised to do so by a physician.

Side effects

The most common side effects include stomachache, heartburn, loss of appetite, and small amounts of blood in stools. Less common side effects are **rashes**, **hives**, fever, vision problems, liver damage, thirst, stomach ulcers, and bleeding. People who are allergic to aspirin or those who have asthma, **rhinitis**, or polyps in the nose may have trouble breathing after taking aspirin.

Interactions

Aspirin may increase, decrease, or change the effects of many drugs. Aspirin can make drugs such as methotrexate (Rheumatrex) and valproic acid (Depakote, Depakene) more toxic. If taken with blood-thinning drugs, such as warfarin (Coumadin) and dicumarol, aspirin can increase the risk of excessive bleeding. Aspirin counteracts the effects of other drugs, such as angiotensin-converting enzyme (ACE) inhibitors and **beta blockers**, which lower blood pressure, and medicines used to treat **gout** (probenecid and sulfinpyrazone). Blood pressure may drop unexpectedly and cause **fainting** or dizziness if aspirin is taken along with nitroglycerin tablets. Aspirin may also interact with **diuretics**, diabetes medicines, other **nonsteroidal anti-inflammatory drugs** (NSAIDs), seizure medications, and steroids. Anyone who is taking these drugs should ask his or her physician whether they can safely take aspirin.

Resources

PERIODICALS

"How to Give Medicine to Children" (Includes related article on health risks of aspirin for children). *FDA Consumer* (Jan./Feb. 1996): 6.

"The Miracle Drug in Your Medicine Cabinet." *American Health* (Jan./Feb. 1996): 67.

"No Aspirin, Please." *Current Health* (Dec. 1992): 12.

"What's the Best Pain Reliever? Depends on Your Pain." *Consumer Reports*, May 1996, 62.

Nancy Ross-Flanigan

AST *see* **Aspartate aminotransferase test**

Astemizole *see* **Antihistamines**

Asthma

Definition

Today asthma is viewed as a chronic (long-lasting) inflammatory disease of the airways. In those susceptible to asthma, this inflammation causes the airways to narrow periodically. This, in turn, produces **wheezing** and breathlessness, sometimes to the point where the patient

gasps for air. Obstruction to air flow either stops spontaneously or responds to a wide range of treatments, but continuing inflammation makes the airways hyperresponsive to stimuli such as cold air, **exercise**, dust mites, pollutants in the air, and even **stress** and **anxiety**.

Description

About 10 million Americans have asthma, and the number seems to be increasing. Between 1982-92, the rate actually rose by 42%. Not only is asthma becoming more frequent, but it also is a more severe disease than before, despite modern drug treatments. In the same 10-year period, the **death** rate from asthma in the United States increased by 35%.

The changes that take place in the lungs of asthmatic persons makes the airways (the "breathing tubes," or *bronchi* and the smaller *bronchioles*) hyper-reactive to many different types of stimuli that don't affect healthy lungs. In an asthma attack, the muscle tissue in the walls of bronchi go into spasm, and the cells lining the airways swell and secrete mucus into the air spaces. Both these actions cause the bronchi to become narrowed (bronchoconstriction). As a result, an asthmatic person has to make a much greater effort to breathe in air and to expel it.

Cells in the bronchial walls, called mast cells, release certain substances that cause the bronchial muscle to contract and stimulate mucus formation. These substances, which include histamine and a group of chemicals called leukotrienes, also bring white blood cells into the area, which is a key part of the inflammatory response. Many patients with asthma are prone to react to such "foreign" substances as pollen, house dust mites, or animal dander; these are called allergens. On the other hand, asthma affects many patients who are not "allergic" in this way.

Asthma usually begins in childhood or adolescence, but it also may first appear during adult years. While the symptoms may be similar, certain important aspects of asthma are different in children and adults.

Child-onset asthma

When asthma does begin in childhood, it often does so in a child who is likely, for genetic reasons, to become sensitized to common "allergens" in the environment (atopic person). When these children are exposed to house-dust mites, animal proteins, fungi, or other potential allergens, they produce a type of antibody that is intended to engulf and destroy the foreign materials. This has the effect of making the airway cells sensitive to particular materials. Further exposure can lead rapidly to an asthmatic response. This condition of atopy is present in at least one-third and as many as half of the general population. When an infant or young child wheezes during viral infections, the presence of allergy (in the child itself or a close relative) is a clue that asthma may well continue throughout childhood.

Adult-onset asthma

Allergenic materials may also play a role when adults become asthmatic. Asthma can actually start at any age and in a wide variety of situations. Many adults who are not allergic do have such conditions as **sinusitis** or **nasal polyps**, or they may be sensitive to **aspirin** and related drugs. Another major source of adult asthma is exposure at work to animal products, certain forms of plastic, wood dust, or metals.

Causes and symptoms

In most cases, asthma is caused by inhaling an allergen that sets off the chain of biochemical and tissue changes leading to airway inflammation, bronchoconstriction, and wheezing. Because avoiding (or at least minimizing) exposure is the most effective way of treating asthma, it is vital to identify which allergen or irritant is causing symptoms in a particular patient. Once asthma is present, symptoms can be set off or made worse if the patient also has **rhinitis** (inflammation of the lining of the nose) or sinusitis. When, for some reason, stomach acid passes back up the esophagus (acid reflux), this can also make asthma worse. A viral infection of the respiratory tract can also inflame an asthmatic reaction. Aspirin and a type of drug called beta-blockers, often used to treat high blood pressure, can also worsen the symptoms of asthma.

The most important inhaled allergens giving rise to attacks of asthma are:

- animal dander
- mites in house dust
- fungi (molds) that grow indoors
- cockroach allergens
- pollen
- occupational exposure to chemicals, fumes, or particles of industrial materials in the air

Inhaling tobacco smoke, either by **smoking** or being near people who are smoking, can irritate the airways and trigger an asthmatic attack. Air pollutants can have a similar effect. In addition, there are three important factors that regularly produce attacks in certain asthmatic patients, and they may sometimes be the sole cause of symptoms. They are:

- inhaling cold air (cold-induced asthma)
- exercise-induced asthma (in certain children, asthma is caused simply by exercising)
- stress or a high level of anxiety

Wheezing is often very obvious, but mild asthmatic attacks may be confirmed when the physician listens to the patient's chest with a stethoscope. Besides wheezing and being short of breath, the patient may **cough** and may report a feeling of "tightness" in the chest. Children may have **itching** on their back or neck at the start of an attack. Wheezing is often loudest when the patient breathes out, in an attempt to expel used air through the narrowed airways. Some asthmatics are free of symptoms most of the time but may occasionally be short of breath for a brief time. Others spend much of their days (and nights) coughing and wheezing, until properly treated. Crying or even laughing may bring on an attack. Severe episodes are often seen when the patient gets a viral respiratory tract infection or is exposed to a heavy load of an allergen or irritant. Asthmatic attacks may last only a few minutes or can go on for hours or even days (a condition called status asthmaticus).

Being short of breath may cause a patient to become very anxious, sit upright, lean forward, and use the muscles of the neck and chest wall to help breathe. The patient may be able to say only a few words at a time before stopping to take a breath. Confusion and a bluish tint to the skin are clues that the oxygen supply is much too low, and that emergency treatment is needed. In a severe attack that lasts for some time, some of the air sacs in the lung may rupture so that air collects within the chest. This makes it even harder to breathe in enough air. Almost always, even patients with the most severe attacks will recover completely.

Diagnosis

Apart from listening to the patient's chest, the examiner should look for maximum chest expansion while taking in air. Hunched shoulders and contracting neck muscles are other signs of narrowed airways. Nasal polyps or increased amounts of nasal secretions are often noted in asthmatic patients. Skin changes, like **atopic dermatitis** or eczema, are a tipoff that the patient has allergic problems.

Inquiring about a family history of asthma or **allergies** can be a valuable indicator of asthma. The diagnosis may be strongly suggested when typical symptoms and signs are present. A test called spirometry measures how rapidly air is exhaled and how much is retained in the lungs. Repeating the test after the patient inhales a drug that widens the air passages (a bronchodilator) will show whether the airway narrowing is reversible, which is a very typical finding in asthma. Often patients use a related instrument, called a peak flow meter, to keep track of asthma severity when at home.

Often, it is difficult to determine what is triggering asthma attacks. Allergy skin testing may be used, although an allergic skin response does not always mean that the allergen being tested is causing the asthma. Also, the body's immune system produces antibody to fight off the allergen, and the amount of antibody can be measured by a blood test. This will show how sensitive the patient is to a particular allergen. If the diagnosis is still in doubt, the patient can inhale a suspect allergen while using a spirometer to detect airway narrowing. Spirometry can also be repeated after a bout of exercise if exercise-induced asthma is a possibility. A **chest x ray** will help rule out other disorders.

Treatment

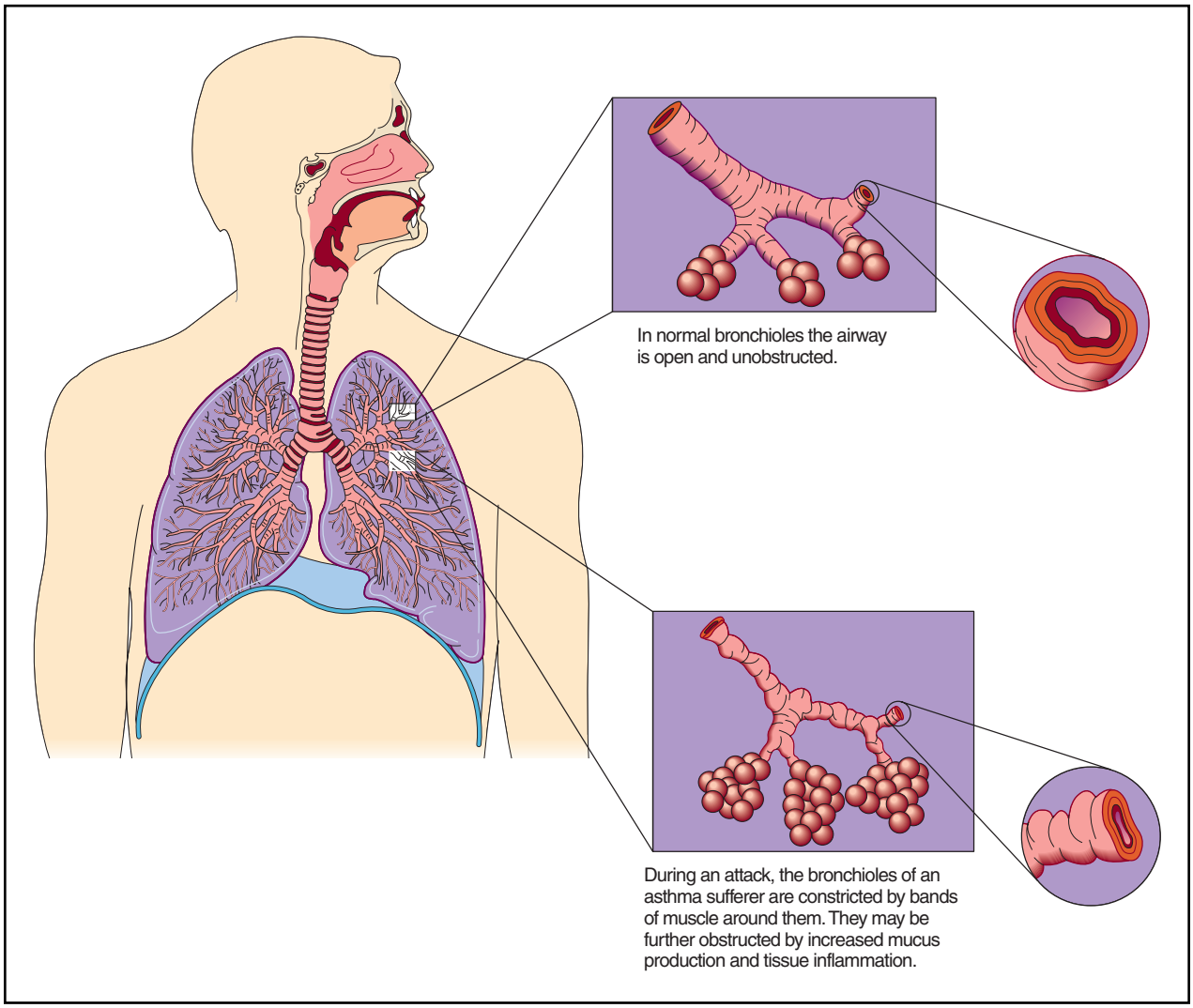
Patients should be periodically examined and have their lung function measured by spirometry to make sure that treatment goals are being met. These goals are to prevent troublesome symptoms, to maintain lung function as close to normal as possible, and to allow patients to pursue their normal activities including those requiring exertion. The best drug therapy is that which controls asthmatic symptoms while causing few or no side-effects.

Drugs

METHYLXANTHINES. The chief methylxanthine drug is theophylline. It may exert some anti-inflammatory effect, and is especially helpful in controlling nighttime symptoms of asthma. When, for some reason, a patient cannot use an inhaler to maintain long-term control, sustained-release theophylline is a good alternative. The blood levels of the drug must be measured periodically, as too high a dose can cause an abnormal heart rhythm or convulsions.

BETA-RECEPTOR AGONISTS. These drugs, which are **bronchodilators**, are the best choice for relieving sudden attacks of asthma and for preventing attacks from being triggered by exercise. Some agonists, such as albuterol, act mainly in lung cells and have little effect on other organs, such as the heart. These drugs generally start acting within minutes, but their effects last only four to six hours (although longer-acting forms are being developed). They may be taken by mouth, inhaled, or injected.

STEROIDS. These drugs, which resemble natural body hormones, block inflammation and are extremely effective in relieving symptoms of asthma. When steroids are taken by inhalation for a long period, asthma



A comparison of normal bronchioles and those of an asthma sufferer. *(Illustration by Hans & Cassady.)*

attacks become less frequent as the airways become less sensitive to allergens. This is the strongest medicine for asthma, and can control even severe cases over the long term and maintain good lung function. Steroids can cause numerous side-effects, however, including bleeding from the stomach, loss of calcium from bones, **cataracts** in the eye, and a diabetes-like state. Patients using steroids for lengthy periods may also have problems with wound healing, may gain weight, and may suffer mental problems. In children, growth may be slowed. Besides being inhaled, steroids may be taken by mouth or injected, to rapidly control severe asthma.

LEUKOTRIENE MODIFIERS. Leukotriene modifiers are a new type of drug that can be used in place of steroids, for older children or adults who have a mild degree of asthma that persists. They work by counteracting leukotrienes, which are substances released by white blood cells in the lung that cause the air passages to constrict and promote mucus secretion.

OTHER DRUGS. Cromolyn and nedocromil are anti-inflammatory drugs that are often used as initial treatment to prevent asthmatic attacks over the long term in children. They can also prevent attacks when given before exercise or when exposure to an allergen cannot be avoided. These are safe drugs but are expensive, and must be taken regularly even if there are no symptoms. Anti-cholinergic drugs, such as atropine, are useful in controlling severe attacks when added to an inhaled beta-receptor agonist. They help widen the airways and suppress mucus production.

If a patient's asthma is caused by an allergen that cannot be avoided and it has been difficult to control symptoms by drugs, immunotherapy may be worth try-

ing. Typically, increasing amounts of the allergen are injected over a period of three to five years, so that the body can build up an effective immune response. There is a risk that this treatment may itself cause the airways to become narrowed and bring on an asthmatic attack. Not all experts are enthusiastic about immunotherapy, although some studies have shown that it does reduce asthmatic symptoms caused by exposure to house-dust mites, ragweed pollen, and cats.

Managing asthmatic attacks

A severe asthma attack should be treated as quickly as possible. It is most important for a patient suffering an acute attack to be given extra oxygen. Rarely, it may be necessary to use a mechanical ventilator to help the patient breathe. A beta-receptor agonist is inhaled repeatedly or continuously. If the patient does not respond promptly and completely, a steroid is given. A course of steroid therapy, given after the attack is over, will make a recurrence less likely.

Maintaining control

Long-term asthma treatment is based on inhaling a beta-receptor agonist using a special inhaler that meters the dose. Patients must be instructed in proper use of an inhaler to be sure that it will deliver the right amount of drug. Once asthma has been controlled for several weeks or months, it is worth trying to cut down on drug treatment, but this must be done gradually. The last drug added should be the first to be reduced. Patients should be seen every one to six months, depending on the frequency of attacks.

Starting treatment at home, rather than in hospital, makes for minimal delay and helps the patient to gain a sense of control over the disease. All patients should be taught how to monitor their symptoms so that they will know when an attack is starting, and those with moderate or severe asthma should know how to use a flow meter. They should also have a written "action plan" to follow if symptoms suddenly become worse, including how to adjust their medication and when to seek medical help. If more intense treatment is necessary, it should be continued for several days. Over-the-counter "remedies" should be avoided. When deciding whether a patient should be hospitalized, the past history of acute attacks, severity of symptoms, current medication, and whether good support is available at home all must be taken into account.

Referral to an asthma specialist should be considered if:

- there has been a life-threatening asthma attack or severe, persistent asthma
- treatment for three to six months has not met its goals
- some other condition, such as nasal polyps or chronic lung disease, is complicating asthma
- special tests, such as allergy skin testing or an allergen challenge, are needed
- intensive steroid therapy has been necessary

Special populations

INFANTS AND YOUNG CHILDREN. It is especially important to closely watch the course of asthma in young patients. Treatment is cut down when possible and if there is no clear improvement, some other treatment should be tried. If a viral infection leads to severe asthmatic symptoms, steroids may help. The health care provider should write out an asthma treatment plan for the child's school. Asthmatic children often need medication at school to control acute symptoms or to prevent exercise- induced attacks. Proper management will usually allow a child to take part in play activities. Only as a last resort should activities be limited.

THE ELDERLY. Older persons often have other types of obstructive lung disease, such as chronic **bronchitis** or **emphysema**. This makes it important to know to what extent the symptoms are caused by asthma. Giving steroids for two to three weeks can help determine this. Side-effects from beta-receptor agonist drugs (including a speeding heart and tremor) may be more common in older patients. These patients may benefit from receiving an anti-cholinergic drug, along with the beta-receptor agonist. If theophylline is given, the dose should be limited, as older patients are less able to clear this drug from their blood. Steroids should be avoided, as they often make elderly patients confused and agitated. Steroids may also further weaken the bones.

Prognosis

Most patients with asthma respond well when the best drug or combination of drugs is found, and they are able to lead relatively normal lives. More than half of affected children stop having attacks by the time they reach 21 years of age. Many others have less frequent and less severe attacks as they grow older. Urgent measures to control asthma attacks and ongoing treatment to prevent attacks are equally important. A small minority of patients will have progressively more trouble breathing and they run a risk of going into **respiratory failure** and they must receive intensive treatment.

Prevention

Minimizing exposure to allergens

There are a number of ways to cut down exposure to the common allergens and irritants that provoke asthmatic attacks, or to avoid them altogether:

KEY TERMS

Allergen—A foreign substance, such as mites in house dust or animal dander which, when inhaled, causes the airways to narrow and produces symptoms of asthma.

Atopy—A state that makes persons more likely to develop allergic reactions of any type, including the inflammation and airway narrowing typical of asthma.

Hypersensitivity—The state where even a tiny amount of allergen can cause the airways to constrict and bring on an asthmatic attack.

Spirometry—A test using an instrument called a spirometer that shows how difficult it is for an asthmatic patient to breathe. Used to determine the severity of asthma and to see how well it is responding to treatment.

- If the patient is sensitive to a family pet, remove the animal or at least keep it out of the bedroom (with the bedroom door closed). Keep the pet away from carpets and upholstered furniture. Remove all feathers.
- To reduce exposure to house dust mites, remove wall-to-wall carpeting, keep the humidity down, and use special pillow and mattress covers. Cut down on stuffed toys, and wash them each week in hot water.
- If cockroach allergen is causing asthma attacks, kill the roaches (using poison, traps, or boric acid rather than chemicals). Take care not to leave food or garbage exposed.
- Keep indoor air clean by vacuuming carpets once or twice a week (with the patient absent), avoid using humidifiers, and do use air conditioning during warm weather (so that the windows can be closed).
- Avoid exposure to tobacco smoke.
- Do not exercise outside when air pollution levels are high.
- When asthma is related to exposure at work, take all precautions, including wearing a mask and, if necessary, arrange to work in a safer area.

Resources

BOOKS

Gershwin, M. Eric, E. L. Klinglhofer. *Asthma: Stop Suffering, Start Living.* 2nd ed. Reading, MA: Addison-Wessey Publishing Co., l992.

Haas, Francois, and Sheila S Haas. *The Essential Asthma Book: A Manual for Asthmatics of All Ages.* New York: Ivy Books, 1987.

ORGANIZATIONS

Asthma and Allergy Foundation of America. 1233 20th Street, NW, Suite 402, Washington, DC 20036. (800) 727-8462. <http://www.aafa.org>.

Mothers of Asthmatics, Inc. 3554 Chain Bridge Road, Suite 200, Fairfax, VA 22030. (800) 878-4403.

National Asthma Education Program. 4733 Bethesda Ave., Suite 350, Bethesda, MD 20814. 301-495-4484.

National Jewish Medical and Research Center. 1400 Jackson St., Denver, CO 80206. 800-222-LUNG.

David A. Cramer, MD

Astigmatism

Definition

Astigmatism is the result of an inability of the cornea to properly focus an image onto the retina. The result is a blurred image.

Description

The cornea is the outermost part of the eye. It is a transparent layer that covers the colored part of the eye (iris), pupil, and lens. The cornea bends light and helps to focus it onto the retina where specialized cells (photo receptors) detect light and transmit nerve impulses via the optic nerve to the brain where the image is formed. The cornea is dome shaped. Any incorrect shaping of the cornea results in an incorrect focusing of the light that passes through that part of the cornea. The bending of light is called refraction and focusing problems with the cornea are called diseases of refraction or refractive disorders. Astigmatism is an image distortion that results from an improperly shaped cornea. Usually the cornea is spherically shaped, like a baseball. However, in astigmatism the cornea is elliptically shaped, more like a football. There is a long meridian and a short meridian. These two meridians generally have a constant curvature and are generally perpendicular to each other (regular astigmatism). Irregular astigmatism may have more than two meridians of focus and they may not be 90° apart. A point of light, therefore, going through an astigmatic cornea will have two points of focus, instead of one nice sharp image on the retina. This will cause the person to have blurry vision. What the blur looks like will depend upon the amount and the direction of the astigmatism. A person with nearsightedness (**myopia**) or farsightedness

(**hyperopia**) may see a dot as a blurred circle. A person with astigmatism may see the same dot as a blurred oval or frankfurter-shaped blur.

Some cases of astigmatism are caused by problems in the lens of the eye. Minor variations in the curvature of the lens can produce minor degrees of astigmatism (lenticular astigmatism). In these patients, the cornea is usually normal in shape. Infants, as a group, have the least amount of astigmatism. Astigmatism may increase during childhood, as the eye is developing.

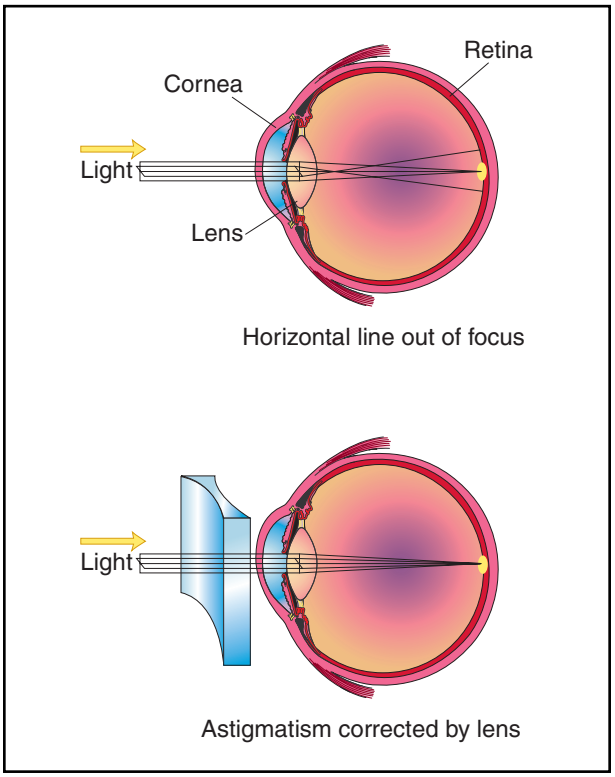
Causes and symptoms

The main symptom of astigmatism is blurring. People can also experience headaches and eyestrain. Parents can notice that a child may have astigmatism when the child can see some part of a pattern or picture more clearly than others. For example, lines going across may seem clearer than lines going up and down.

Regular astigmatism can be caused by the weight of the upper eyelid resting on the eyeball creating distortion, surgical incisions in the cornea, trauma or scarring to the cornea, the presence of tumors in the eyelid, or a developmental factor. Irregular astigmatism can be caused by scarring or keratoconus. Keratoconus is a condition in which the cornea thins and becomes cone shaped. It usually occurs around **puberty** and is more common in women. Although the causes of keratoconus are unknown, it may be hereditary or a result of chronic eye rubbing, as in people with **allergies**. The center of the cone may not be in line with the center of the cornea. Diabetes can play a role in the development of astigmatism. High blood sugar levels can cause shape changes in the lens of the eye. This process usually occurs slowly and, often, is only noticed when the diabetic has started treatment to control their blood sugar. The return to a more normal blood sugar allows the lens to return to normal and this change is sometimes noticed by the patient as farsightedness. Because of this, diabetics should wait until their blood sugar is under control for at least one month to allow vision to stabilize before being measured for eyeglasses.

Diagnosis

Patients seek treatment because of blurred vision. A variety of tests can be used to detect astigmatism during the eye exam. The patient may be asked to describe the astigmatic dial, a series of lines that radiate outward from a center. People with astigmatism will see some of the lines more clearly than others. One diagnostic instrument used is the keratometer. This measures the curvature of the central cornea. It measures the amount and direction of the curvature. A corneal topographer can measure a larger area of the cornea. It can measure the central area and mid-periphery of the cornea. A keratoscope projects a series of concentric light rings onto the cornea. Misshapen areas of the cornea are revealed by noting areas of the light pattern that do not appear concentric on the cornea. Because these instruments are measuring the cornea, it is also important to have a refraction in case the lens is also contributing to the astigmatism. The refraction measures the optics or visual status of the eye and the result is the eyeglass prescription. The refraction is when the patient is looking at an eye chart and the doctor is putting different lenses in front of the patient's eyes and asks which one looks better.



Astigmatism can be treated by the use of cylindrical lenses. The lenses are shaped to counteract the shape of the sections of the cornea that are causing the difficulty. *(Illustration by Electronic Illustrators Group.)*

Treatment

Astigmatism can be treated by the use of cylindrical lenses. They can be in eyeglasses or contact lenses. The unit of measure describing the power of the lens system or lens is called the diopter (D). The lenses are shaped to counteract the shape of the sections of cornea that are causing the difficulty. Because the correction is in one direction, it is written in terms of the axis the correction is in. On a prescription, for example, it may say -1.00D × 180°.

KEY TERMS

Meridian—A section of a sphere. For example, longitude or latitude on the globe. Or, on a clock, a section going through 12:00-6:00 or 3:00-9:00, etc.

Refraction—The turning or bending of light waves as the light passes from one medium or layer to another. In the eye it means the ability of the eye to bend light so that an image is focused onto the retina.

Cylinders correct astigmatism, minus spheres correct myopia, and plus spheres correct hyperopia.

There is some debate as to whether people with very small amounts of astigmatism should be treated. Generally, if visual acuity is good and the patient experiences no overt symptoms, treatment is not necessary. When treating larger amounts of astigmatism, or astigmatism for the first time, the doctor may not totally correct the astigmatism. The cylindrical correction in the eyeglasses may make the floor appear to tilt, thus making it difficult for the patient at first. Generally, the doctor will place lenses in a trial frame to allow the patient to try the prescription at the exam. It may take a week or so to get used to the glasses, however, if the patient is having a problem they should contact their doctor, who might want to recheck the prescription.

Contact lenses that are used to correct astigmatism are called toric lenses. When a person blinks, the contact lens rotates. In toric lenses, it is important for the lens to return to the same position each time. Lenses have thin zones, or cut-off areas (truncated), or have other ways to rotate and return to the correct position. Soft toric lenses are available in a variety of prescriptions, materials, and even in tints. Patients should ask their doctors about the possibility of toric lenses.

In 1997, the Food and Drug Administration (FDA) approved laser treatment of astigmatism. Patients considering this should make sure the surgeon has a lot of experience in the procedure and discuss the possible side effects or risks with the doctor. In the case of keratoconus, a corneal transplant is performed if the astigmatism can not be corrected with hard contact lenses.

Prognosis

Astigmatism is a condition that may be present at birth. It may also be acquired if something is distorting the cornea. Vision can generally be corrected with eyeglasses or contact lenses. The major risks of surgery (aside from the surgical risks) are over and under correction of the astigmatism. There is no cure for over correction. Under correction can be solved by repeating the operation.

Resources

BOOKS

Albert, D. M., and F. A. Jakobiec. *Principles and Practice of Ophthalmology.* New York: W. B. Saunders Co., 1994.

Berkow, Robert, ed. *Merck Manual of Medical Information.* Whitehouse Station, NJ: Merck Research Laboratories, 1997.

Newell, Frank W. *Ophthalmology: Principles and Concepts.* 8th ed. St. Louis: Mosby, 1996.

John T. Lohr, PhD

Aston-Patterning

Definition

Aston-Patterning is an integrated system of movement education, bodywork, ergonomic adjustments, and fitness training that recognizes the relationship between the body and mind for well being. It helps people who seek a remedy from acute or chronic **pain** by teaching them to improve postural and movement patterns.

Purpose

Aston-Patterning assists people in finding more efficient and less stressful ways of performing the simple movements of everyday life to dissipate tension in the body. This is done through massage, alteration of the environment, and fitness training.

Description

Seeking to solve movement problems, Aston-Patterning helps make the most of their own unique body types rather than trying to force them to conform to an ideal. Unlike **Rolfing**, it doesn't strive for linear symmetry. Rather it works with asymmetry in the human body to develop patterns of alignment and movement that feel right to the individual. Aston also introduced the idea of working in a three-dimensional spinal pattern.

Aston-Patterning sessions have four general components. They are:

- A personal history that helps the practitioner assess the client's needs.
- Pre-testing, in which the practitioner and the client explore patterns of movement and potential for improvement.