

CHAPTER 2

WHAT CAN GO WRONG

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INTRODUCTION

The heart is one of the most efficient and durable pumps known to man. Hearts have been known to pump for more than 100 years without resting more than about a second at a time, a feat we have yet to equal with a man-made device. Like any other electromechanical device, however, the heart can become less efficient or break down. When something does go wrong, it can take many forms:

Arteriosclerotic disease occurs when fatty deposits block the inside of the coronary arteries, the blood vessels that supply blood to the heart muscle. Angina or a heart attack can occur when the heart's blood supply from the coronary arteries slows or stops.

High blood pressure results when the heart's efforts to pump blood meet with higher-than-normal resistance in the blood vessels outside the heart.

Heart failure occurs when the heart becomes excessively stiff or fatigued from working too hard—either because it must pump against too strong a resistance or because there has been a loss of heart muscle strength.

Arrhythmia (literally, “no rhythm”) occurs when the heart's electrical system goes haywire. An arrhythmia can be anything from an innocuous extra beat in the atria (upper, receiving chambers) to a dan-

gerous irregularity in the ventricles (lower, pumping chambers).

Valvular heart disease occurs when one or more of the heart's valves malfunctions because it has narrowed or fails to close properly. Heart failure is often the end result of valvular disease.

Heart muscle diseases of various kinds can rob the heart of its muscle tone and weaken it.

Congenital heart defects are faults in the anatomy of the heart that are present at birth.

The following sections describe what happens when something goes wrong with the heart or the circulatory system. (These conditions are covered in detail in other chapters.) Some cardiovascular conditions are preventable, many have symptoms that signal their presence, and many respond well to treatment. Anyone who suspects heart disease should see his or her physician promptly. If the symptoms are acute, early intervention in the nearest hospital emergency department may be lifesaving.

ARTERIOSCLEROTIC HEART DISEASE

Fats are essential to the functioning of many body organs, and it is normal to find fats in the blood-

stream. In all people, starting very early in life, some fatty material begins to buildup on the insides of the blood vessel walls, particularly in the medium and large arteries. Likewise, as people grow older, they experience some thickening and hardening of the arteries, a process known by the general name arteriosclerosis. In some people, the rate of deposit of fatty material on the artery walls is faster than in others. The result can be atherosclerosis (*athero* refers to the fatty substance). (See Chapter 11.) “Although the two terms are often used interchangeably, atherosclerosis is a type of arteriosclerosis that is characterized by deposits of plaque—an amalgam of fatty substances, cholesterol, cellular wastes, calcium, and the blood clotting material fibrin—on the inner lining of the arteries.

Arteriosclerosis is particularly dangerous when the vessel that is involved is a coronary artery, one of those that supply the heart muscle with blood. This condition is called *coronary artery disease* (CAD). The inner opening, or lumen, of a coronary artery must be narrowed by 50 to 70 percent of its normal diameter before the reduction of blood flow to the heart is considered serious. Although sometimes the terms are used interchangeably, coronary heart disease (CHD) refers to the symptoms and features that can result from advanced CAD. Coronary heart disease causes almost 500,000 deaths every year and is the leading cause of death in Americans today. Fortunately, the number of deaths from CHD within the United States is decreasing rapidly. The death rate from this disease has declined by more than 45 percent since 1972-73.

Evidence of arteriosclerotic disease appears outside the heart as well. Besides angina pectoris and coronary heart disease, effects of arteriosclerosis can include a stroke or peripheral vascular disease (involvement of the vessels that supply blood to the legs). These complications occur when blood vessels become severely narrowed or occluded.

ANGINA

For most people, the pain of angina represents an imbalance between the heart muscle's need for oxygen and its supply via the coronary artery. Narrowing in one or more of the coronary arteries decreases the supply of oxygen, and such factors as exercise may increase the demand. Tissues deprived of oxygen release metabolites that activate pain fibers in the heart. Someone with angina feels an intense pain in

the chest behind the breastbone, hence the term *angina pectoris*. Angina can be triggered by many different activities—exercise, emotional upset, exposure to cold, a heavy meal. In *stable angina*, the pain is brought on by a predictable amount of work and stops when there is reduced demand on the heart. In *unstable angina*, the pain comes on without a specific cause, and it may leave just as unpredictably.

Angina can be treated medically with a number of drugs that have various effects: They may dilate the blood vessels, lower blood pressure, slow the heart to reduce its need for oxygen, or reduce the likelihood of spasm. It is also treated by increasing the inner diameter of the blood vessels, using a procedure called percutaneous transluminal coronary angioplasty (PTCA), or simply balloon angioplasty. In severe cases, coronary artery bypass surgery may be needed to bypass narrowed or closed portions of the arteries. (See Chapters 24 and 25.)

About 2.5 million people in the United States today live with angina. In itself it is not fatal, but it is a warning sign or signal of underlying coronary artery disease. (See Chapter 11.)

HEART ATTACK

When a coronary artery is completely or almost completely blocked, either by an atherosclerotic plaque or by a blood clot, the result is a heart attack, or *myocardial infarction* (literally, death of heart muscle). Within minutes, the heart muscle begins to change. After about four to six hours, the portion of the affected muscle will have deteriorated to a nonfunctioning state. Because the damage occurs so swiftly, it is extremely important not to ignore the symptoms of a heart attack, which include chest pain, usually severe and persistent—lasting longer than two minutes; sweating; nausea; dizziness; and fainting. (Some heart attacks result from spasm of a coronary artery rather than from arteriosclerosis, but the symptoms are essentially the same.)

About 5 million Americans have a history of heart attack, angina pectoris, or both. As many as 1.5 million experience a heart attack each year, and about 500,000 will die. About 60 percent of these deaths occur within the first hour after the onset of symptoms (sudden death), often before the victim reaches the hospital.

The individual who sustains a heart attack and gets to the hospital quickly now has a much better chance of survival, thanks to a treatment known as throm-

bolysis, in which a clot-dissolving drug is injected into the bloodstream, where it can dissolve clot in a coronary artery, restoring some blood flow. After receiving thrombolytic therapy, patients have several treatment options: continued medical therapy, balloon angioplasty, or a coronary artery bypass graft. Long-term medical treatment can involve any of the drugs used to treat angina, as well as aspirin, which causes the blood to be less susceptible to clotting.

VASCULAR DISEASES

Several types of disorders can affect the blood vessels that supply various parts of the body. The most common is peripheral vascular disease (PVD), which refers to disease in the vessels that supply blood to the arms and legs. (See Chapter 17.) It involves a progressive narrowing of these blood vessels—most often in the legs—because of atherosclerosis. Smoking is probably the biggest risk factor for peripheral vascular disease. Having diabetes also puts someone at increased risk for this type of vascular disease.

When atherosclerotic plaques form in the blood vessels of the legs, causing these vessels to narrow, the symptom that results is called intermittent *claudication*. This condition is usually felt as pain in the calves or thighs when walking or during other activities; the exercising leg muscles' need for blood exceeds their supply. Other symptoms of peripheral vascular disease include cold or painful toes (or, in some cases, fingers) or redness or bluish discoloration in the toes. This discoloration may be most marked after sitting for long periods of time. If the narrowed vessel is in the pelvic area, the pain may be felt in the buttocks; in severe cases, impotence can occur.

If an exercise treatment program fails to relieve the condition, further treatment may include bypass grafts or balloon angioplasty. Physicians can sometimes use lasers to vaporize plaques and thereby restore blood flow, although this treatment is not yet widely available.

OTHER VASCULAR DISORDERS

Vascular disease can also affect areas closer to the heart, such as the branches of the aorta. When the aorta or its branches are narrowed, organs and tis-

ues throughout the body may be starved of oxygen. Symptoms can be dizziness, kidney impairment, intermittent claudication, pain when resting, paleness or redness of the feet, and changes in the skin or in some cases, there will be few if any symptoms.

Although technically not diseases of the peripheral arteries, some diseases of the branches of the aorta may cause a great deal of trouble. An aneurysm, for example, is a bulge in a major blood vessel at a point where there is a weakness in the vessel wall. Aneurysms in the ascending aorta (the portion of this major vessel after it leaves the heart) usually cause no symptoms but in some cases may cause chest pain, shortness of breath, difficulty in swallowing, and vocal cord paralysis.

Arteriosclerosis is the most common cause of an aneurysm of the descending aorta (the portion of the aorta below the diaphragm). This is usually asymptomatic and may not be detected unless a bulging or pulsation is felt by a physician during a routine examination of the abdomen. When pain occurs, it suggests that the vessel wall is being stretched or that there may be some tearing of the wall. Treatment involves surgical replacement of the diseased part of the aorta with a synthetic graft.

In a *dissecting aneurysm*, blood escapes through a tear in the wall of the aorta and the three layers of the aortic wall become separated; blood becomes trapped between them. X-rays typically will show this condition. When this type of aneurysm occurs in the ascending aorta or the aortic arch, surgery is necessary. A dissecting aneurysm in the descending thoracic aorta may wall off, and scar tissue may protect against further dissection. This can sometimes be handled by keeping blood pressure as low as possible with beta blockers and other medication, thus avoiding surgery.

HIGH BLOOD PRESSURE

Blood does not simply flow through the circulatory system like a lazy river. The heart pushes it, and the force with which it pushes is called blood pressure. The classic analogy used to explain this phenomenon is that of a garden hose: When the nozzle is open, the walls of the hose are under very little pressure and water pours out easily, but when the opening in the nozzle is narrowed, the pressure of the water

against the walls of the hose is higher. If the body's blood vessels are narrowed, the heart must pump harder than normal against the resistance. This is called high blood pressure, or hypertension. (See Chapter 12.) Eventually the heart enlarges, the muscle thickens, the heart needs more oxygen to function, and it becomes less efficient. After many years, heart failure may result.

The high pressure of the blood within a blood vessel is a factor in driving blood fat or cholesterol into the vessel walls, speeding up the process of atherosclerosis. This increases the possibility of a stroke or heart attack occurring as a result of clot formation. A stroke is also more likely, because increased blood pressure over many years causes a ballooning of a blood vessel (aneurysm), and this may, under certain circumstances, burst. If an aneurysm involves blood vessels in the brain, a cerebral hemorrhage results. Over time, high pressure can also scar the body's arterioles (small arteries), reducing their ability to carry blood to specific areas of the body. An example of this is a progressive loss of kidney function as a result of damaged vessels.

Hypertension usually is present without any symptoms; hence it is sometimes called the silent killer. Once hypertension is advanced, symptoms include headaches, fainting, dizziness (sometimes), loss of renal (kidney) function, and, in late stages, convulsions and swelling of the brain. An estimated 50 million Americans have hypertension, and perhaps a third of them are unaware that they have it.

Although the origin of hypertension in about 90 percent of patients is unknown (this is called *primary hypertension*), it is known that the level at which blood pressure settles is controlled by a complex interaction of hormones, chemical cell receptors, sodium intake (in some people), and the nervous system. In the remaining 10 percent of patients, high blood pressure is a symptom of an underlying problem such as narrowing of the arteries supplying the kidneys, a kidney abnormality, tumor of the adrenal gland, or congenital defect of the aorta. This is called secondary hypertension.

Mild high blood pressure can sometimes be treated by restricting the amount of sodium (salt) in the diet and controlling weight. If these measures are not effective, there are several classes of medications that work to reduce the heart rate and thus the output of blood; cause the muscles in the blood vessel walls to relax; prevent the nerves from contracting the blood vessels; or interfere with the body's production of angiotensin, a chemical that causes the arteries to constrict. (See Chapter 23.)

STROKE

Like angina and heart attacks, strokes can be caused by a blockage in a blood vessel, only in this case the blockage is in one of the arteries that supply blood to the brain. (See Chapter 18.) In a *thrombotic stroke*, a blood clot (thrombus) forms in a carotid artery narrowed by arteriosclerosis. Four of every five strokes are of this type. In *hemorrhagic stroke*, the artery leaks or bursts, interrupting the brain's blood supply. The least common type of stroke is an embolic stroke, in which a blood clot travels to the brain from the heart or other vessels and lodges in a small vessel in the brain.

Symptoms of a stroke may include sudden weakness or numbness of the face, arm, and leg on one side of the body; loss of speech, or trouble talking or understanding speech; dimness or loss of vision, especially in one eye; and unexplained dizziness, unsteadiness, or sudden falls. These are all the result of a lack of oxygen in cells that make up various parts of the brain. About 10 percent of strokes are preceded by *transient ischemic attacks* (TIAs), sometimes called ministrokes. In these cases, blood vessels may go into spasm but are not usually closed off, or a small embolus may close off a small branch of a vessel. The symptoms may be similar to those of a stroke but last an average of only a few minutes or so. When the ministroke is over, the symptoms usually recede within 24 hours, whereas in a full-blown stroke they do not.

Intravenous anticoagulants can sometimes combat a stroke in progress, although this procedure is still somewhat experimental. Later, as with a blocked coronary artery, surgeons may be able to bypass a blocked carotid artery or remove a plaque under direct vision, in a procedure called a carotid endarterectomy, to prevent further strokes.

People who have had one stroke are at risk for having another; thus, preventing subsequent strokes is a major priority in treatment. Some of the preventive measures are the same as those recommended for preventing heart disease: use of aspirin or other anticoagulants, measures to keep blood pressure and cholesterol levels low, and smoke-free living.

About 500,000 Americans have strokes each year, and almost 3 million Americans alive today have had strokes in the past. Stroke is a major cause of disability and is the third leading cause of death in the United States—about 150,000 die of stroke each year. About 85,000 to 90,000 fewer stroke deaths are re-

corded each year than in the early 1970s—largely the result of earlier treatment of hypertension.

HEART FAILURE

Unlike a heart attack, heart failure is usually a slow process. (See Chapter 14.) There are several major causes of heart failure:

- Long-standing hypertension. As the heart strains under increased pressure, it begins to enlarge and weaken.
- Narrowed *exit valves in the heart* [especially the *aortic*]. These increase the demand on the heart; the heart must pump harder to push the circulating blood.
- *Leaky heart valves*. Each time the heart pumps, some blood goes forward but some leaks back into its chamber. The heart must work harder to get adequate blood out to tissues.
- Viral infections. These may damage the heart muscle and weaken it to the point of heart failure.
- *Alcohol*. May cause similar damage to the heart.
- Inefficiency. Following a heart attack the heart muscle may not be able to pump efficiently, and blood backs up. This is the most common cause of heart failure.

About 50,000 Americans die annually of heart failure (sometimes called congestive heart failure). Although some 400,000 new cases are diagnosed each year, heart failure can be treated successfully in many cases, and more than 2 million Americans who have it are alive today.

When the heart can't do its job, blood flow slows. Blood returning to the heart from the veins backs up into the tissues, the way water builds up behind a dam. Sometimes fluid collects in the lungs and makes breathing more difficult, especially when lying down or during exercise. Other symptoms include easy fatigue, an inability to exercise, and, later, swelling in the ankles, legs, and abdomen.

Rest, a low-sodium diet, and a slower pace are nonmedical treatments for heart failure. Medical treatment may include the use of drugs that increase the pumping action of the heart, help the body elim-

inate excess salt and water, or expand the blood vessels and decrease the resistance in those vessels, making the heart's work easier.

VALVULAR DISEASE

The heart has four valves, two on the right (the pulmonary and tricuspid) and two on the left (the aortic and mitral), that control the flow of blood through the chambers of the heart and out to the body. Any of these valves may fail to function properly, but disease most commonly affects the valves on the left side of the heart. (See Chapter 13.) They may narrow (called stenosis), they may not close all the way (causing a backflow of blood called regurgitation), or they may close incorrectly (called prolapse). A *heart murmur* represents the sound that a leaky or narrowed heart valve makes as blood moves through it.

THE AORTIC AND MITRAL VALVES

Aortic stenosis is a narrowing of the aortic valve, through which blood flows from the left ventricle of the heart to the aorta, the major artery whose branches supply blood to various parts of the body. Sometimes this narrowness is a congenital (inborn) defect, but more often the valve narrows as a consequence of aging, or of infections, such as rheumatic fever. Aortic stenosis results in the left ventricle having to work harder and harder to push blood out. As this occurs, the muscular walls of the ventricle thicken, increasing their requirement for oxygen. Symptoms of aortic stenosis include chest pain when the oxygen needs exceed the supply from the coronary arteries; fainting (syncope), if the valve becomes very tight; and congestive heart failure, which usually does not occur unless the valve has been narrowed for many years. Valve replacement, either with a mechanical valve made of metal or plastic or with a valve from a pig, may help, although it does not provide a complete cure.

In mitral *stenosis*, the valve opening between the upper and lower chambers on the left side of the heart has become narrowed. The cause is almost always rheumatic fever, which is now rare in this country (although it is on the rise again in some communities) but is common in many parts of the world. When mitral stenosis occurs, the entry of blood into the left

ventricle from the atrium is impeded by the narrow valve. Pressure builds up behind the valve, leading to an elevation of pressure in the lungs. This in turn may lead to shortness of breath (dyspnea), which is one of the major symptoms of mitral stenosis. Often, however, it occurs without any symptoms.

In *aortic regurgitation*, the aortic valve fails to close completely after the heart has pumped blood out into the aorta. Blood leaks back from the aorta into the left ventricle. In *mitral regurgitation*, improper closure causes blood to leak from the left ventricle back into the left atrium. In either case, the valve does not close properly because of a physical change in its shape or its support. This change may be the result of rheumatic fever an infection (endocarditis), which may leave the valve scarred; or a heart attack, which causes loss of supporting muscle tissue. In the mitral valve, the change may be the result of a heart attack, which causes a loss of muscle tissue, or a spontaneous rupture of one of its muscular chords that normally act as guide wires to keep it in place.

Major symptoms include fatigue, shortness of breath, and edema. Medications such as digitalis, diuretics, and ACE inhibitors can help alleviate symptoms. (See Chapter 23.) Some defective mitral valves can be reconstructed or, failing that, replaced by an artificial valve.

Mitral valve prolapse is a congenital or developmental abnormality in which the leaflets, or flaps, of tissue that make up the valve are larger than normal. The valve fails to close properly; sometimes blood flows backward (regurgitates). The vast majority of individuals with mitral valve prolapse have no symptoms. If symptoms do occur, they may include chest pain, abnormal heart rhythms, dizziness, or palpitations. Severe mitral regurgitation is not common, and serious complications are extremely rare. Most cardiologists feel that the popular press makes too much of mitral valve prolapse. Although the condition is fairly common—it has been estimated to affect as many as 6 percent of the total population, and it occurs more often in women—it is not a problem for most of the people who have it.

A major problem with mitral prolapse is that its symptoms may mimic those of angina. A history of sticking pains occurring at rest or at odd times over various parts of the chest, rather than the pressure-type pains in the middle of the chest during exercise that are typical of angina, will help distinguish the two conditions. A typical murmur or clicking sound will help to make the diagnosis.

If treatment for mitral valve prolapse is necessary,

it may include the use of drugs to reduce the number of extra beats. Antibiotics at the time of dental work or other procedures are recommended to prevent infection.

THE PULMONIC AND TRICUSPID VALVES

In the pulmonic and tricuspid valves, any narrowing is rare and almost always congenital. Leakage (regurgitation) is unusual, but may occur when use of illicit intravenous drugs leads to infection that damages the valve. The infection, hallmarked by fever, often settles on these two valves because they are the first ones the bacteria come in contact with as they travel through the bloodstream. If the valve becomes leaky, swelling of the abdomen and legs may occur. As with other valves, treatment can include replacement, but this is rare and usually not as effective as it is when the aortic or mitral valve is involved.

RHEUMATIC HEART DISEASE

Years ago, before the antibiotic era, rheumatic heart disease was a major cause of valve disease. (See Chapter 13.) It started with a strep infection in the throat (which occasionally occurred without symptoms). Ten days to two weeks later, a bout of rheumatic fever would be noted. Inflammation of many of the body's connective tissues—not only in the heart, but in the joints and skin as well—would produce joint pain and swelling or a rash. A fever, arthritis-type pain, and, in children, the occurrence of a heart murmur or electrocardiographic (ECG) changes would indicate that the illness had affected the heart.

It is obviously important to treat strep throat with penicillin or another suitable antibiotic as soon as possible to prevent rheumatic fever and rheumatic heart disease. There is no treatment for rheumatic fever itself, but people who have already had it often take antibiotics daily or monthly to prevent streptococcal infections. Patients with any valve involvement must always take penicillin or some other appropriate antibiotic before dental work or other surgical procedures to prevent a heart valve infection. Fortunately, the wide use of antibiotics has almost eradicated rheumatic fever in this country, and many of those who have rheumatic fever do not end up with rheumatic heart disease or damaged heart valves.

CONGENITAL HEART DISEASE

The human heart develops between the eighth and tenth weeks after conception. When the heart is no larger than a small peanut, it is already fully developed and any congenital abnormalities are already present. (See Chapter 20.) Valve damage is not the only congenital condition that can affect the heart. Other forms of congenital heart disease include holes in the inner, separating walls of the heart that allow blood to leak or flow directly from one chamber or artery into another, rather than flowing in the proper sequence through the valves. A flow of blood from the left side of the heart directly into the right side is called a left-to-right shunt. The hole can be either between the two upper chambers of the heart (an atrial-septal defect) or between the two lower chambers (a ventricular-septal defect). In patent ductus arteriosus, a communication between the aorta and pulmonary artery remains, and blood flows directly between the two vessels.

In coarctation of the aorta, the aorta is pinched or narrowed after it leaves the heart. In pulmonary stenosis and aortic stenosis, the pulmonic or aortic valves are narrower than normal. Congenital cyanotic defects cause what are commonly called “blue babies”—a term that comes from the fact that lack of oxygen causes the lips and fingernails to appear blue. Among the cyanotic heart defects are tetralogy of Fallot, which includes a ventricular-septal defect and a narrowing of the pulmonary valve, and transposition of the great arteries, in which the positions of the pulmonary artery and aorta are reversed. This means that part of the blood returning to the heart from the body is pumped back to the body without going back to the lungs for oxygen. Infants and children with these congenital defects often show such symptoms as shortness of breath, fainting, unusual color (blueness, most commonly), and heart murmurs that a physician can hear with a stethoscope.

All these congenital defects call for surgery, and almost all of them can be corrected successfully today.

About 25,000 babies with heart defects are born annually in this country, making congenital heart disease relatively uncommon. There are more than 500,000 who are living with congenital heart disease, but each year about 5,600 people, most of them infants, lose their lives to one of these conditions.

CARDIAC ARRHYTHMIAS DISTURBANCES IN HEART RHYTHM

The heartbeat is regulated from centers within the heart and by nerve impulses from the brain and other parts of the nervous system. One group of cells at the top of the right atrium (the sinus node) emits electrical impulses that activate both atria. The current travels to another node (the atrioventricular node), which lies between the atria and ventricles, and from there, fibers activate the ventricular muscle.

Abnormalities in this sequence may cause arrhythmias, or may cause what are referred to as various degrees of heart block. (See Chapter 16.) Most irregularities of heartbeat are innocuous except when anatomic heart problems are also present, in which case an arrhythmia may have serious consequences. Ventricular arrhythmias are more serious than atrial arrhythmias, because the ventricles are the heart’s pumping chambers. An arrhythmia is not necessarily an indication of underlying heart disease; sometimes the cause can be as simple as a poor night’s sleep, smoking, or too much coffee, caffeinated cola, or alcohol.

Often an arrhythmia has no symptoms. Sometimes the patient can feel the irregular beating pattern, called a palpitation. Another sensation patients sometimes mention is a fluttering feeling in the chest or neck.

After a physician has used an electrocardiogram (ECG) or Holter monitor (see Chapter 10) to define the exact type of arrhythmia, the first step in treatment is to remove any of the environmental or self-imposed causes previously discussed. After that, the physician can prescribe a number of medications that usually can control the irregularity.

ATRIAL FIBRILLATION

In atrial fibrillation, the heart’s two upper chambers, the atria, beat irregularly at about 400 to 600 times per minute. The ventricles do not respond to each of these beats; hence the pulse that reflects the actual pumping activity may only be about 100 to 150. Atrial fibrillation can be associated with several types of heart disease, including high blood pressure, coronary heart disease, and heart valve disease. It can also occur in persons with an overactive thyroid gland,

THE HEART AND HOW IT WORKS

and occasionally it is noted in people without any evidence of heart disease.

A person with atrial fibrillation is at increased risk of embolic stroke, because the very rapid beats do not propel the blood through the heart efficiently. It begins to pool there, and, as a result, clots may form. One or more of these clots (emboli) can travel to the brain, or other parts of the body.

Atrial fibrillation responds to digitalis, which slows the ventricular rate. At times, medications such as quinidine or procainamide (Pronestyl) may stabilize the heart rhythm; beta blockers or calcium channel blockers are also helpful. (See Chapter 23.) Anticoagulants (blood thinners) reduce the risk of stroke. Aspirin has also been found to be useful in preventing clots from forming. If medications have been ineffective, a safe and effective technique called cardioversion maybe used, where physicians administer an electric shock in order to convert the rhythm to normal.

VENTRICULAR TACHYCARDIA

Unlike the atrial arrhythmias, ventricular arrhythmias can be life-threatening. In ventricular tachycardia, the ventricle beats abnormally fast and inefficiently. This interferes with normal filling of the heart with blood and with ejection of the blood from the ventricle. It can lead to heart failure if prolonged, shock if severe or acute, or even death because the heart does not pump out sufficient blood to nourish vital organs. A wide variety of medications can treat ventricular tachycardia. Emergency personnel can sometimes normalize the heartbeat with electrical defibrillation, and cardiac researchers have developed automatic implantable cardiac defibrillator that correct ventricular tachycardia before it becomes dangerous. (See Chapters 26 and 27.)

VENTRICULAR FIBRILLATION

When a heart is in ventricular fibrillation, pumping action is almost nonexistent, and the heart merely quivers. If fibrillation is not stopped and normal rhythm restored in two to five minutes, death results. Ventricular fibrillation may occur in a heart attack victim. The primary symptom of ventricular fibrillation is loss of consciousness, which can rapidly lead to death. As with ventricular tachycardia, treatments include medications and electrical defibrillation.

BRADYARRHYTHMIA

Bradyarrhythmia means that the heart is beating more slowly than usual. There are two types of bradyarrhythmia. In *sinus* bradycardia, the sinus node, which initiates all the beats, may send out impulses at a slower than normal rate (for example, at 40 to 50 beats per minute). This may be due simply to aging or to damage to the heart caused by a heart attack, or it maybe a side effect of medication. Trained athletes may also have a slow heartbeat that is not caused by any disease process.

In *heart block*, the sinus node may function properly, but there is an electrical blockage at the atrioventricular (AV) node. Some or all of the electrical impulses never reach the ventricle. A different group of cells below the atrioventricular node may take over, the way an emergency generator comes on in an electrical blackout. The heart beats, but slowly—there is too great a pause between impulses in the upper and lower chambers. Depending on the degree of heart block, the rate may be 50 or 60, or even as slow as 30 or 40. Heart block may be caused by a scar in the tissues that conduct the electrical impulses.

Some people can have periods of rapid heart rhythm alternating with periods of slow rhythm. The brady-tachysyndrome happens with aging, usually in people in their 60s. The sinus node beats more slowly than normal, but rapid rhythms, such as atrial fibrillation, periodically occur. In the course of a month, this may happen several times. Many people with this syndrome lead normal lives and, in fact, may be unaware that they have it. Existing medications can temporarily stabilize brady-tachy syndrome, but ultimately a pacemaker, as well as medication, maybe necessary.

PREMATURE VENTRICULAR CONTRACTIONS

A premature ventricular contraction (PVC) is an early heartbeat. PVCS are usually benign. Common causes include caffeine, tobacco, alcohol, lack of sleep, and stimulant drugs such as epinephrine (adrenaline). The use of cocaine may cause frequent extra beats or even more serious abnormal heart rhythms. The patient may feel that the heart is skipping beats, stopping, or thumping in the chest. Treatment for premature ventricular contractions includes removal of the inciting event followed by antiarrhythmic medications if the skipped or extra beats cause symptoms. (Most of the time they do not.) If the cause of the contractions is underlying heart disease, that condition should be

treated first, since the premature ventricular contraction may only be a symptom of an underlying problem.

OTHER DISORDERS

PERICARDITIS

Most often caused by a virus or other infection, pericarditis is an inflammation of the pericardium—the outer sac, or membrane, that surrounds the heart like a cellophane wrapping. In rare cases, pericarditis appears as part of a collagen vascular disease such as systemic lupus erythematosus, or as a complication of a tumor of the lung or of lymphoma (lymphatic cancer). It may also appear in the late stage of kidney disease, in patients having radiation therapy of the chest, or occasionally as a reaction to medications such as certain antiarrhythmic or antihypertensive drugs. Pericarditis caused by a viral infection tends to be less serious than pericarditis from other causes, because the viral infection usually runs its course and disappears. At times, however, viral pericarditis may be a recurrent illness.

Symptoms include variable types of chest pain, which often worsens when the individual lies down and improves when he or she sits up. In fact, any change of position may bring on pain. Sometimes pericarditis is accompanied by fever or shortness of breath. Treatments include bed rest, aspirin or nonsteroidal anti-inflammatory drugs (NSAIDs) for reducing inflammation, or, in persistent cases, cortisone. If pericarditis proves to be a relapsing condition, the pericardium may have to be removed surgically.

MYOCARDITIS

When the heart muscle itself becomes inflamed, the condition is known as myocarditis. Years ago, rheumatic fever was a common cause, but today, myocarditis is most often idiopathic—that is, no cause can be found, or it is secondary to a viral condition. In myocarditis, the heart muscle degenerates, becomes soft, and may no longer be able to function as an efficient pump. Patients who have it may develop heart failure or arrhythmias.

Cardiologists can sometimes control the symptoms of myocarditis with medication, and sometimes myocarditis goes away on its own. The patient recuperates and returns to a normal life. Sometimes, myocarditis is an inexorable progressive illness, and it is one of the reasons for cardiac transplants. This is not common, however. Researchers are now looking into treatment of some forms of myocarditis with immunosuppressive drugs, but this therapy is still considered experimental. (See Chapter 15.)

ENDOCARDITIS

Endocarditis is an infection of a heart valve or inner lining of the heart muscle. Because bacteria can destroy heart tissue, a valve can develop a leak if it is infected. Infection most often develops on a valve that was previously abnormal in some way, either scarred by rheumatic fever, congenitally abnormal, or prolapsed. Today, cardiologists are seeing endocarditis with increasing frequency in patients with normal valves who have used illicit intravenous drugs. Fever is the most common symptom; fatigue, weight loss, or heart failure may also be present.

About 19,000 cases of bacterial endocarditis, the most common type, are diagnosed each year; fewer than 2,000 of them are fatal. Many of the fatalities occur in intravenous drug abusers.

Antibiotics are usually effective against the bacteria that cause endocarditis. Anyone with a known heart valve problem should take antibiotics before having dental work, because bacteria from the mouth are capable of entering the bloodstream and causing endocarditis. This is true of any surgical procedure in which there is the possibility of bacterial contamination of the blood.

CARDIOMYOPATHIES

Cardiomyopathy is a term for a number of primary diseases of the heart muscle. In hypertrophic cardiomyopathy, the heart muscle, particularly the left ventricle, thickens. Sometimes the thickening of the heart muscle in the region directly below the aortic valve leads to a partial obstruction of blood leaving the left ventricle. *Restrictive* cardiomyopathy is characterized by the replacement of good heart muscle fibers with rigid, less elastic tissue, so that the heart (particularly the ventricles) cannot fill normally. Amyloid heart disease and sarcoidosis are rare types of restrictive cardiomyopathy in which proteins that the

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body manufactures infiltrate the heart muscle and cause symptoms of heart failure. Another rare type of restrictive cardiomyopathy is *hemochromatosis*, in which iron from the blood is deposited in the heart muscle. (See Chapter 15.)

Some of these heart problems can be controlled and treated. Increasingly, people who make the necessary life-style changes and receive proper medical care are able to keep their risks to a minimum.