Arrhythmias

A healthy heartbeat is stimulated by electrical pulses that arise from within the heart itself, spread throughout the heart in a coordinated pattern, and cause cardiac muscle contractions that send blood pulsing through the body's network of arteries and veins. Ideally, this system works without problems. When there is a problem with this electrical system, however, an irregular heartbeat, or arrhythmia, may develop. There are several kinds of arrhythmias, depending on the nature of the abnormal heart rhythm:

- **Tachyarrhythmias**: rhythms that are abnormally rapid, with or without other abnormalities
- **Bradyarrhythmias**: rhythms that are abnormally slow, with or without other abnormalities
- **Fibrillations**: uncoordinated, very rapid and weak rhythms

Sometimes arrhythmias are also identified by where in the heart they arise. For example, atrial fibrillation describes a chaotic, quivering rhythm that occurs in the upper chambers of the heart, or the atria.

Certain kinds of abnormal heartbeats are common. They occur even among healthy people occasionally, sometimes stimulated by emotion or fear or even by drinking coffee, and pose no threat. If, however, you have abnormal heartbeats that become frequent or are associated with other symptoms, such as dizziness, light-headedness, nausea, or chest pain, you should visit a physician for evaluation. Arrhythmias can be caused by a number of underlying conditions or diseases. Very serious arrhythmias are life-threatening medical emergencies.

CAUSES OF ARRHYTHMIAS

The four-chambered heart is made from special cardiac muscle that conducts electricity. Beats are generated by electrical impulses in the atria (top chambers of the heart) and are then conducted to the ventricles, where they produce the powerful muscle contraction that pumps blood. The generation and conduction of these electrical signals, as well as the muscle contraction itself, depend on the flow of sodium, potassium, calcium, and magnesium through cardiac cells. Imbalances in the levels of these minerals, as well as damage to cells (e.g., from surgery, oxidants, toxins, or drugs), can prevent impulses from forming, cause them to form prematurely, or prevent their proper conduction through the heart. The result is an arrhythmia. The following factors have been known to cause arrhythmias:

Food, drugs, and medications. Coffee, tea, chocolate, red wine, or simply overeating may cause rapid heartbeats that may be frightening when felt but are rarely serious. People may have allergies or idiosyncratic reactions to many other foods and beverages that cause transitory arrhythmias. Long-term nicotine exposure and any cocaine exposure can cause much more serious arrhythmias.

Many over-the-counter medications are capable of producing serious heartbeat irregularities. This is especially true for people with unrecognized cardiovascular disease, as well as those taking prescription medications for chronic illnesses.

Many over-the-counter cold, cough, and sinus medications for children and adults may be arrhythmogenic, especially if the patient is running a fever. Most products labeled as decongestants contain pseudoephedrine hydrochloride and should be avoided by people with hypertension or heart disease.

Underlying disease. Underlying health problems that may contribute to the development of arrhythmias include congenital heart defects, coronary artery disease, high blood pressure (hypertension), high cholesterol or triglyceride levels, atherosclerosis, diabetes, thyroid disease, and damaged heart valves. Smoking, obesity, and a diet high in fatty foods may increase the likelihood of arrhythmias. People who have had a heart attack (myocardial infarction) and those who have undergone cardiac surgery are also prone to arrhythmias.

Cardiac arrhythmias can be diagnosed in a physician's office. The most common method of diagnosing a cardiac arrhythmia is the electrocardiogram. By studying the characteristic wave pattern of a series of heartbeats, physicians can determine what kind of arrhythmia is present. Some patients may be asked to exercise on a treadmill during the electrocardiogram in an attempt to detect exercise-induced arrhythmias. This procedure is called a stress test. If exercise is impossible, drugs may be given to stimulate a more rapid heartbeat.

The best method of studying arrhythmias is an electrophysiologic study. This procedure, performed under local anesthesia, involves

small, temporary electrode catheters positioned in the heart's chambers and conduction system. Electrical signals are recorded to help identify where the arrhythmia originates.

In some cases, the arrhythmia may be uncommon or unlikely to occur in the physician's office. In this event, the patient may be outfitted with a continuous loop recorder (Holter monitor) or event recorder that allows for remote monitoring of the heartbeat. These devices may monitor the heartbeat for a full 24 hours, allowing a physician to see any abnormal activity over the course of a day. The patient may be equipped with a button to press when the abnormal heart rate is felt, marking the place on the event recorder.

Oxidant stress. A growing body of scientific literature has implicated oxidative stress in arrhythmias. Oxidative stress occurs in response to rising levels of free radicals, which damage cells and tissues. Oxidative stress is a common feature of ischemic-reperfusion injuries, which occur when the heart is temporarily deprived of oxygenated blood (a state known as ischemia), followed by the reintroduction of oxygenated blood (reperfusion). When oxygen-rich blood flow is restored to ischemic tissue, a large number of free radicals, known as reactive oxygen species, are generated. These highly reactive molecules cause damage to proteins, lipids, and DNA, and they also stimulate an inflammatory reaction that causes an increase in the levels of cytokines and inflammatory cells. This inflammatory reaction further damages tissue. Ischemic-reperfusion injury (as it is called) is a major source of arrhythmias among people who have suffered from heart attacks and other forms of heart disease (Leonardi M et al 2005; Chung MK 2004).

Environmental factors. Chronic exposure to a variety of air pollutants and chemicals has been linked specifically to the development of arrhythmias, most likely as a result of oxidative stress and inflammation (Brook RD et al 2003; Routledge HC et al 2005; Kaufman JD et al 1994). Voluntary exposure to chemicals, such as taking inhalants or sniffing glue, is also linked to fatal arrhythmias among young people (Pfeiffer H et al 2005).

TYPES OF ARRHYTHMIAS

Although there are many types of arrhythmias, the following are more common or especially dangerous:

Atrial fibrillation. Atrial fibrillation is the most commonly treated arrhythmia, affecting more than 2 million adults in the United States (Aviles RJ et al 2003; Cybulski J et al 2004; Mozaffarian D et al 2004). It is especially common in older people and is often associated with cardiovascular disease, metabolic diseases, or inflammation. The risk of developing atrial fibrillation is increased by factors that enlarge the left atrium, such as elevated systolic blood pressure (Psaty BM et al 1997). Obesity also enlarges the left atrium, and more than 40 percent of obese individuals have obstructive sleep apnea, which causes increased blood pressure in the lungs (pulmonary hypertension), thereby enlarging the right atrium (Coromilas J 2004).

Patients often develop atrial fibrillation after a heart attack or cardiac surgery (Kalus JS et al 2004). Inflammation, which may contribute to atrial fibrillation, occurs following 25 percent to 45 percent of cardiac surgery. C-reactive protein, a general marker of inflammation, may be predictive of atrial fibrillation (Aviles RJ et al 2003).

Atrial fibrillation is rarely directly life threatening, but it does contribute to a doubling of the death rate (Heart Rhythm Society 2004; Coromilas J 2004). Untreated, it may present as chronic fatigue and may lead to heart failure. Low blood flow through the atrium tends to create blood clots and may release fragments (emboli) into the bloodstream. They can lodge in arteries, blocking blood flow to the brain or other organs. Atrial fibrillation increases the risk of stroke threefold to fivefold (Coromilas J 2004).

Ventricular fibrillation. Ventricular fibrillation is a life-threatening arrhythmia responsible for more than 50 percent of deaths from cardiovascular disease in the United States each year (Heart Rhythm Society 2004). It begins abruptly, causing the ventricles to quiver rather than contract, which causes immediate cessation of blood flow. The victim loses consciousness within seconds, and if the fibrillation is not immediately converted to a normal rhythm by means of electrical defibrillation, death can occur within minutes.

Cardiopulmonary resuscitation may help prolong life in cases of ventricular fibrillation by supplying oxygen and limited blood flow, but only defibrillation will reestablish a normal heart rhythm. The American Heart Association estimates that 95 percent of all victims of cardiac arrest die before they receive emergency help. Most often the cause of ventricular fibrillation is underlying cardiac disease, although it may also occur in someone who receives an accidental high-voltage electrical shock or is struck by lightning.

People who survive a cardiac arrest are at high risk of arrhythmias and may be candidates for an implantable cardioverter defibrillator (ICD) and antiarrhythmic medication.

Premature contractions. Premature atrial contractions (PACs) are beats that occur before the normal rhythmic beat starts in the sinoatrial node. PACs are commonly referred to as palpitations or sometimes as skipped beats. No beat is actually skipped. The ventricular beat is only delayed, and the resulting larger blood volume in that beat produces the sensation of fluttering, pounding, racing, or flip-flopping.

Although disconcerting, PACs are usually transitory. They may have a variety of causes, such as caffeine, nicotine, alcohol, anxiety, or fatigue. PACs are sometimes associated with very high fevers and infections. If PACs recur frequently or are associated with fainting, shortness of breath, chest pain, or light-headedness, a physician should be consulted. Unrecognized cardiovascular disease, pulmonary disease, or heart valve malfunctions may be present.

Premature ventricular contractions arise in the lower chambers of the heart. Although frequently less apparent to the individual, they can be serious. Any of the symptoms described for PACs may occur with premature ventricular contractions.

CONVENTIONAL TREATMENT

The choice of medication depends on the type, frequency, and severity of the arrhythmia and the location in the heart where it begins. Antiarrhythmic therapy is highly individualized and requires close supervision by a cardiologist. Consequently, patients are usually hospitalized when the therapy begins. Medications used to treat arrhythmias have a narrow therapeutic index, meaning there may be only a small difference between the therapeutic dose and an adverse dose. Therefore, a medication could possibly produce new rhythm problems, especially if a patient is taking additional medications for other health conditions. It is imperative that the physician be aware of all substances the person takes, including nutrients and over-the-counter medications.

Antiarrhythmic medications are grouped into classes based on their primary mechanism of action, although there is considerable overlap because many antiarrhythmics have multiple classes of action. There are four primary classes of antiarrhythmics:

- **Class I agents**. This group is further divided into three subgroups. Class I agents interfere with the sodium channel in the heart. Class IA medications have been used for many years, particularly for arrhythmias arising above the ventricles, collectively referred to as supraventricular arrhythmias. The class IA medication quinidine (sulfate) is an oral prescription medication used to treat this type of arrhythmia and should not be confused with quinine, which has other medical uses and also may be found in some over-the-counter drugs and drink mixes. Other class I agents include procainamide, disopyramide, lidocaine, mexiletine, encainide, and flecainide.
- **Class II agents**. Class II agents are conventional beta blockers. They work by selectively decreasing sympathetic activity in the heart and are used to treat rapid heartbeats that arise above the ventricles. Drugs in this class include esmolol, propranolol, and metoprolol.
- **Class III agents**. Class III agents, such as Cordarone, Tikosyn®, or Betapace®, are the most widely used antiarrhythmics (Heart Rhythms Society 2004). They act by blocking potassium channels in the heart.
- **Class IV agents**. These are slow calcium channel blockers that decrease electricity conduction through the atrioventricular node. Drugs in this class include verapamil and diltiazem.

In emergency situations, medications such as procainamide or lidocaine may be given intravenously for immediate effect. For recent-onset atrial fibrillation, treatment with oral medication may continue 3 to 30 days before the arrhythmia is converted to a normal rhythm. When these patients also have ventricular dysfunction or hemodynamic problems, direct electrical conversion is advisable (Khan IA et al 2004; Slavik RS et al 2001). Other drugs that may be prescribed to heart patients with arrhythmias include beta-blockers and calcium channel blockers.

Devices. Arrhythmias and pulse rates of more than 100 beats per minute (tachycardias) that originate in the ventricles are much less likely to respond to medication. The timing of treatment is very important because ventricular tachycardia may develop into ventricular fibrillation that will result in sudden cardiac death within minutes. For this reason, many airplanes and public places now have electrical defibrillators available for emergency use.

For people known to be at risk for developing ventricular tachycardia or fibrillation, an ICD is indicated. ICDs should not be confused with cardiac pacemakers, which are used for patients with too slow a pulse (bradycardia) and may pace one or both ventricles. However, some ICDs are capable of both defibrillating and pacing.

ICDs are relatively small devices that are surgically implanted under the skin below the collarbone. Wires from the ICD lead to the heart muscle and constantly monitor its electrical status. If the ICD detects a ventricular arrhythmia, it delivers an electrical shock to convert the chaotic rhythm to a normal beat.

Even with an ICD in place, a patient is often placed on oral Class III antiarrhythmic medications to reduce the frequency and severity of situations when a defibrillating shock would be necessary. Unlike pacemakers, which function beneath the level of a person's awareness, the ICD's lifesaving defibrillation can be quite uncomfortable.

Ablation. In selected cases, patients may undergo a procedure during electrophysiological testing called cardiac ablation. Using x-rays to guide them, physicians pass an electrode through a catheter in a large blood vessel. When the abnormally functioning part of the heart's electrical system is reached, high-energy radio waves or extreme cold are used to destroy the tissue and restore conduction to normal. This procedure requires extremely accurate localization of the problem.

NUTRITIONAL THERAPY FOR ARRHYTHMIAS

Due to the connection between oxidative stress, ischemic-reperfusion injury (which occurs during bypass surgery and heart attacks), inflammation, and arrhythmias, people at risk for arrhythmias (e.g., recent heart attack patients or people who work around solvents) should consider liberal doses of antioxidants, such as vitamin C and vitamin E (Korantzopoulos P et al 2005; Das S et al 2003).

Other supplements that may help reduce the risk of arrhythmias include the following:

Omega-3 fatty acids. The main fatty acid in the Western diet is linoleic acid, found mostly in vegetable oils. However, epidemiologic studies many years ago showed that people with a high intake of fatty fish, like the Japanese, have less cardiovascular disease than those who consume Western-type diets (Lee KW et al 2003). Fatty fish, such as mackerel, salmon, herring, sardines, and albacore tuna, and their oils are good sources of long-chain omega-3 polyunsaturated fatty acids (Calder PC et al 2002). The most important omega-3 fatty acids are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which when ingested are immediately available for use in the body.

Extensive scientific studies, both animal and human, have shown that supplementing the diet with fish and their oils has a beneficial effect on the heart, particularly in preventing cardiac arrhythmias (Nair SS et al 1997). The omega-3 fatty acids in fish oils appear to stabilize the electrical activity of the heart muscle, reducing susceptibility even to ventricular arrhythmias and ultimately decreasing the risk of sudden cardiac death (Lee KW et al 2003; Kang JX et al 2000).

The GISSI-Prevention study of more than 11,000 people taking a purified form of omega-3 fatty acids as a supplement has shown a significant decrease in the occurrence of sudden cardiac death among the participants (Lee KW et al 2003; De Caterina R et al 2002; Richter WO 2003). The efficacy of this preparation was greater than that of pravastatin, a commonly prescribed statin drug. Remarkably, the reduction in fatalities was seen even in patients who were already taking preventive medications such as aspirin and statin drugs (Lee KW et al 2003; Richter WO 2003). Beneficial effects may be seen within 90 days of starting omega-3 therapy and may continue progressively with longer use, leading to their recommendation as a “promising additional measure for secondary prevention” (Richter WO 2003).

The American Heart Association recommends that healthy adults eat at least two servings of fish a week. This fish should be a cold-water, high-omega-3 variety such as salmon and should be prepared without frying (Mozaffarian D et al 2004).

Magnesium and potassium. Both magnesium and potassium are intricately involved in the heart’s electrical stability (Cybulski J et al 2004); consequently, maintaining normal functional blood levels and ratios of each is important. Potassium is found in every cell of the body, and magnesium, the second-most-abundant intracellular mineral, is involved in many chemical processes (Swain R et al 1999). Magnesium deficiency may result in irregular heartbeats, muscle weakness, and irritability. Conversely, an excessive amount may cause a very slow heartbeat (bradycardia), dizziness, blurred vision, or breathing difficulty.

Magnesium deficiency is usually due to inadequate dietary intake or depletion. Most present-day diets include inadequate amounts of magnesium, and aging is a risk factor for deficiency. Insufficient magnesium may contribute to the symptoms routinely associated with aging (Durlach J et al 1998). Medications such as diuretics, used to treat chronic diseases, may be responsible for more loss of magnesium. Magnesium deficiency is more likely among older people who are institutionalized (Durlach J et al 1998).

Potassium may also be reduced by medications widely used to treat diseases associated with aging. Some heart medications, such as diuretics used as adjunctive treatment for high blood pressure, may dangerously deplete potassium levels. Besides causing severe muscle weakness and possible arrhythmias, inadequate potassium, which may lead to electrolyte imbalance, may cause mental confusion that may be attributed mistakenly to age or incompetence. The underlying electrolyte imbalance resulting from deficient levels of potassium or magnesium in the serum may also predispose people to arrhythmias (Cybulski J et al 2004).

For More Information

The following chapters may also be of interest:

- Atherosclerosis
- Congestive Heart Failure
- Controlling High Cholesterol
- Cerebrovascular Disease and Stroke

LIFE EXTENSION FOUNDATION RECOMMENDATIONS

A heart-healthy lifestyle through a balanced, low-fat diet and adequate exercise is the best way to decrease the risk of heart problems. More and more, scientific studies are proving that obesity is a major health risk factor, so achieving and maintaining an appropriate weight are essential. A heart-healthy diet should aid in controlling weight.

In addition, the following nutrients may help regulate the heart's electrical system and prevent oxidative damage that raises the risk of arrhythmia:

- **Vitamin C**—1000 to 3000 milligrams (mg) daily
- **Vitamin E**—400 international units (IU) daily (with at least 200 mg of gamma tocopherol)
- **EPA/DHA**—2100 mg EPA and 1500 mg DHA daily
- **Potassium**—amount to be determined by a physician (on the basis of blood levels)
- **Magnesium**—at least 500 elemental mg daily from supplements.

ARRHYTHMIAS SAFETY CAVEATS

An aggressive program of dietary supplementation should not be launched without the supervision of a qualified physician. Several of the nutrients suggested in this protocol may have adverse effects. These include:

EPA/DHA

- Consult your doctor before taking EPA/DHA if you take warfarin (Coumadin). Taking EPA/DHA with warfarin may increase the risk of bleeding.
- Discontinue using EPA/DHA 2 weeks before any surgical procedure.

Magnesium

- Do not take magnesium if you have kidney failure or myasthenia gravis.

Potassium

- Do not take potassium if you have hyperkalemia (a greater-than-normal concentration of potassium in the blood).
- Consult your doctor before taking potassium for potassium deficiency.
- Potassium can cause rash and gastrointestinal symptoms such as nausea, vomiting, and diarrhea.

Vitamin C

- Do not take vitamin C if you have a history of kidney stones or of kidney insufficiency (defined as having a serum creatine level greater than 2 milligrams per deciliter and/or a creatinine clearance less than 30 milliliters per minute.
- Consult your doctor before taking large amounts of vitamin C if you have hemochromatosis, thalassemia, sideroblastic anemia, sickle cell anemia, or erythrocyte glucose-6-phosphate dehydrogenase (G6PD) deficiency. You can experience iron overload if you have one of these conditions and use large amounts of vitamin C.

Vitamin E

- Consult your doctor before taking vitamin E if you take warfarin (Coumadin).
- Consult your doctor before taking high doses of vitamin E if you have a vitamin K deficiency or a history of liver failure.
- Consult your doctor before taking vitamin E if you have a history of any bleeding disorder such as peptic ulcers, hemorrhagic stroke, or hemophilia.
- Discontinue using vitamin E 1 month before any surgical procedure.

For more information see the Safety Appendix

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