Atrial fibrillation is an irregular heart rhythm that starts in the heart’s upper chambers (atria). When it occurs, your heart may not pump very efficiently, so you may feel tired or weak. You also may feel frightened by the odd sensations or fluttering you feel in your chest. When this is happening, you may wonder if you are having a heart attack or another life-threatening problem.

While these sensations may concern you, brief periods of atrial fibrillation are not life threatening. However, they may be related to other problems that require medical attention. Most people who have these irregular heart rhythms can continue to do most of their normal daily activities if their irregular rhythms are managed carefully. Generally, the irregular rhythms can be controlled with medications, certain medical procedures (such as cardiac ablation or pacemaker implantation), surgery or a combination of these treatments.

This material is meant to give you information about atrial fibrillation and a related rhythm called atrial flutter, including the symptoms you should watch for and types of treatment you may receive. Words in bold are defined in the word list beginning on page 32.
Background

How the heart pumps blood
Your heart is a four-chambered, muscular pump about the size of an adult fist. Normally, the adult heart beats 60 to 100 times per minute, pumping blood throughout your body with each beat. Two upper heart chambers called the right and left atria (each is called an atrium) receive blood that comes back to the heart from the body. Veins carry this returning blood to the atria. When the muscles of the atria contract, blood is squeezed into the two larger, lower heart chambers called the right and left ventricles. When the muscles of the ventricles contract, blood is propelled through arteries throughout the body. The pumping action of the ventricles creates the pulse you feel in your wrist or neck.

Your heart’s electrical system
To pump blood efficiently, your heart muscles must contract and relax in a coordinated manner at a proper rate. Contraction and relaxation are controlled by electrical messages that travel through heart muscle like electricity through wires.

Normally, these electrical messages begin in a cluster of cells in the right atrium, called the sinus node (SA node). From the sinus node, the electrical message spreads in a predictable pattern through the atrial muscle (figure 1). Before reaching the ventricles, the electrical messages are slowed briefly in the atrioventricular node (AV node), an area between the atria and the ventricles. The ventricles are then activated by the spread of electrical current through each muscle cell.

If the electrical current does not spread through the heart muscle properly, abnormal heart rhythms develop. These rhythms, called arrhythmias, may reduce the performance of the heart.
Figure 1. **Normal heart rhythm.** In this view of the heart, the arrows represent electrical signals beginning at the sinus node, activating the atria, and passing through the atrioventricular node on their way to the ventricles. The graph below the heart is a typical electrocardiogram (ECG or EKG) recording from a heart with a normal rhythm.
Atrial fibrillation
Atrial fibrillation is the most common arrhythmia. More than two million Americans have it. As people age, they have a greater chance of getting this arrhythmia. For example, less than one in every 100 people in their 50s has atrial fibrillation, but about 10 in every 100 people in their 80s have it.

During atrial fibrillation both atria beat without coordination, sometimes as fast as 300 to 400 times per minute. Instead of beginning in the sinus node, the electrical signals begin in several areas in both atria (figure 2). Two types of electrical activity may occur at the onset or during an episode of atrial fibrillation:

- **Re-entrant electrical wavelets** — In many forms of atrial fibrillation, four to seven small waves wander about the atria, activating both atria irregularly.
- **Focal atrial fibrillation** — Atrial fibrillation also may be caused by one or more abnormal trigger areas, or “hot spots,” that activate or stimulate the atria at a rapid rate. Often these “hot spots” originate in the pulmonary veins that return blood from the lungs to the heart.

Regardless of the type of electrical activity in the atria, all of the signals go to the AV node. However, the AV node does not let all the signals go into the ventricles. As a result, the ventricles may continue to pump blood throughout your body at a relatively normal rate. In some cases, however, the rate may be too fast, leading to inefficient ventricular pumping action.
Figure 2. **Atrial fibrillation.** In this view of the heart, the circular arrows represent the paths of small waves (wavelets) of electrical activity during atrial fibrillation. They activate the atria in several places at once. The graphs below the heart are typical electrocardiogram recordings from a heart with a normal rhythm (left) and from a heart during atrial fibrillation (right). The trigger area (hot spot) is shown in the left superior pulmonary vein.
Atrial flutter
In atrial flutter, the electrical signals are more organized than they are in atrial fibrillation (figure 3). In atrial flutter the atria may beat fast — from 220 to 300 beats per minute — but they tend to beat with a more coordinated and regular rhythm, created by a single re-entrant electrical pathway. Although the atria may beat up to 300 times per minute, your pulse rate may be much less because the AV node usually prevents at least every other beat from reaching the ventricles.

Your pulse
In both atrial fibrillation and atrial flutter, the atria beat faster than the ventricles. The AV node only lets some of the electrical activity of the upper chambers to pass through it. For example, your pulse (which reflects the pumping of the ventricles) may be only 60 to 150 beats per minute even though the atria beat much faster.
Figure 3. **Atrial flutter.** In this view of the heart, the circular arrows represent possible conditions causing atrial flutter. In different kinds of atrial flutter, the electrical circuit may go around a heart valve, a scar from prior surgery or around other normal or abnormal structures. The graphs below the heart are typical electrocardiogram recordings from a heart with a normal rhythm (left) and from a heart during atrial flutter (right).
Atrial fibrillation and atrial flutter have many possible causes. The causes are not usually related to blockages in the arteries serving your heart muscle (coronary arteries), and they do not mean you are having a heart attack or any other serious heart problems. However, most people with atrial fibrillation have another disease, such as any of the following:

- High blood pressure (hypertension)
- Too much thyroid hormone (hyperthyroidism)
- Abnormalities of the heart valves (thin tissue flaps that keep blood flowing in one direction through the heart)
- Abnormalities of the heart’s pumping function (heart failure)

The cause of atrial fibrillation is unknown in about one-third of the people who have it. Possible causes in these people include the following:

- Microscopic abnormalities of the muscle of the atria
- Abnormalities within individual heart cells
- Abnormal electrical properties of groups of heart cells
- Exposure of the heart to stimulants such as caffeine

Atrial flutter may occur in people who have abnormal atrial tissue, or it may occur after open-heart surgery.
Atrial fibrillation and atrial flutter themselves are not life threatening, but you may feel palpitations, fatigue, weakness or light-headedness during an episode. In addition, the abnormal rhythms may lead to potentially serious problems, such as blood clots. If you have a poorly controlled or consistently fast heart rate for several months, your heart chambers may enlarge and the heart muscle may weaken. After prolonged episodes, you may be more likely to have future episodes.

**Blood clots**
The most important problem that may occur with atrial fibrillation is the formation of blood clots, or *thrombi*, within the atria. When the walls of the atria quiver rapidly instead of contracting forcefully, the heart chambers do not empty completely. As a result, some blood stays in the atria longer than normal, and blood clots are more likely to form. If a blood clot breaks free, leaves the heart, travels to the head and blocks the blood supply to part of the brain, it may cause a *stroke*. If a blood clot blocks an artery elsewhere, the part of your body served by the artery may be damaged, whether it is a kidney, an arm or a leg.

Figure 4. A blood clot in the heart may travel to an artery in the brain, causing a stroke.
Signs and symptoms of stroke
A stroke (brain attack) occurs when the blood supply to the brain is blocked or if a blood vessel in the brain ruptures. This may cause brain cell damage. Any of the following signs may occur:
• Sudden numbness, weakness or paralysis (inability to move a body part) in the face, arm or leg, usually on one side of the body
• Difficulty speaking or trouble understanding others
• Sudden blurred, decreased vision, or double vision
• Dizziness, loss of balance or loss of coordination
• Sudden, severe headache

If you ever think you are having a stroke, immediately seek emergency help by activating your local emergency system (such as calling 911 or contacting an emergency room).

Blood clots are most likely to form in people who have the following risk factors:
• Age older than 65 years
• High blood pressure
• Diabetes
• A previous stroke
• Hyperthyroidism
• Weakened ventricle or heart failure
• Heart-valve abnormalities or after heart-valve replacement surgery
• Other structural abnormalities of the heart

People with atrial fibrillation who do not have these risk factors have a 0.5 to 1.5 percent risk per year of having a stroke, while people with these risk factors have a chance of having a stroke that ranges from 3 to 15 percent each year. This risk may be reduced by using medications to prevent blood clots (anticoagulants), sometimes called “blood thinners.”
Cardiomyopathy
A second problem caused by atrial fibrillation or atrial flutter is a weakening of the heart muscle called cardiomyopathy. If the ventricles beat fast (tachycardia) for several weeks or months, the heart muscle may weaken. Even without other heart disease, rapid heart rates alone may lead to heart failure with symptoms such as shortness of breath, weakness, fatigue and exercise intolerance (tiring easily with activity). The problem becomes more serious if you have other heart disease. Contact your physician if you get any of these symptoms or if you already have these symptoms and they become worse.

Cardiomyopathy occurs in less than one in every five people who have long-term atrial fibrillation. However, the risk of getting cardiomyopathy emphasizes the importance of controlling the rapid heart rate. One way to do this is by using medication to slow the electrical impulses traveling from the atria to the ventricles.

Effects on your life
While most people with atrial fibrillation or atrial flutter do not get blood clots or cardiomyopathy, their lives may be affected by palpitations (uncomfortable sensations of your heartbeat in your chest), fatigue, exercise intolerance, light-headedness and shortness of breath. These symptoms may be caused by a fast, irregular heart rate or by a combination of electrical abnormalities and weakened pumping ability of the heart. Symptoms may occur at unpredictable moments and may frighten you. Some people wonder if they are having a heart attack. Usually people with atrial fibrillation or atrial flutter do not have chest pain, one of the frequent symptoms of a heart attack.

Signs and symptoms of a heart attack
- Intense, prolonged chest pain, often described as a feeling of heavy pressure
- Pain that may extend beyond the chest to the left shoulder and arm, back, teeth and jaw
- Prolonged pain in upper abdomen
- Shortness of breath
- Nausea, vomiting, fainting, intense sweating

If you ever think you are having a heart attack, immediately seek emergency help by activating your local emergency system (such as calling 911 or contacting an emergency room).
The symptoms of atrial fibrillation and atrial flutter may not be visible to others. As a result, you may find that others do not understand how your symptoms affect your life. Some people feel so uneasy about their symptoms that they restrict their daily activities. However, an arrhythmia does not have to change your lifestyle dramatically. Discuss your concerns and questions with your physician. You may find that you can continue to do most of your usual activities, but ask your physician for guidelines:

• For example, though exercise may help control diabetes and help lower your blood pressure, ask how intensely you should exercise. Exercise restrictions generally depend more on other existing heart disease than on your abnormal heart rhythm.

• Ask whether you should avoid drinking alcoholic beverages, which may affect some people’s arrhythmias.

• Also ask about drinking beverages with caffeine and using other types of stimulants (including those in nonprescription medications and supplements).

Tell your physician about the activities, foods and beverages you enjoy, and ask for guidelines.
A thorough medical evaluation is necessary to learn about your overall health and determine what other heart problems exist. Besides discussing your medical history with you and doing a physical examination, your physician may do several tests, including the following:

- **Blood tests** – Blood samples may be drawn. These samples may be tested to learn, for example, whether you have anemia (too few red blood cells), thyroid gland problems or blood-clotting problems.

- **A chest X-ray** – A chest X-ray produces an image on film that outlines your heart, lungs and other structures in your chest. A chest X-ray provides information such as the size and shape of your heart and the condition of your lungs.

- **An electrocardiogram** – Electrical activity of your heart is detected by electrodes taped to your skin. This activity is recorded as waves that represent the electrical forces in different parts of the heart (figure 5). Different rhythms produce different patterns of waves.

Figure 5. During electrocardiography, adhesive skin electrodes are attached to your chest and limbs to record the electrical activity of your heart while you rest. Usually the recording takes no more than a minute.
• **Echocardiography** (abbreviated echo) – Sound waves (too high-pitched to be heard) are used to make images of your heart or analyze blood flow (figure 6). The sound waves are sent into your body from a **transducer**, and then the sound waves are reflected back from internal structures. Different forms of echocardiography are used for different purposes. One form, for example, is useful for measuring the exact size of various heart structures, such as heart chambers. Another form shows how parts of the heart work when they move.

Figure 6. During echocardiography, a transducer sends ultrasound waves into your chest. The sound waves bounce off internal structures (such as parts of your heart). The transducer detects the waves bouncing back. A computer analyzes the waves and projects images on a monitor.
• **Stress tests** – Several types of stress tests may be done, depending on the information needed. For example, the exercise ECG test is an ECG obtained while you walk on a treadmill or pedal a stationary bike. One purpose of the exercise ECG is to look for rhythm abnormalities that may occur during exercise. The exercise ECG also may tell you how fast your heart rate is with activity if you have atrial fibrillation.

![Figure 7. Exercise ECG](image)

During your evaluation ask your physician to check your pulse after you have exercised (such as after climbing stairs or walking briskly in the hall). Ask whether you should check your pulse at home and, if so, what information you should report to your physician.
Your pulse rate tells how fast your heart is beating. If you are taking medications to regulate your heartbeat, your pulse rate tells the physician whether the medicine is working. You also may be asked to take your pulse:

- To check if your pacemaker is working properly
- To find out if you are exercising at the proper rate
- To monitor your heart rate if you have an abnormal heart rhythm

Your health care provider will help you decide where you should take your pulse. Learn how to take your pulse so it becomes a normal part of your daily routine.

Always count your pulse for a full minute, unless told otherwise. If you have questions or concerns about taking your pulse, ask your health care provider.

**Steps in taking your radial pulse**

Your radial pulse can be taken on either wrist.

1. With your palm up, find the area between your wrist bone and the tendon on the thumbside of your wrist.
2. Use the tips of your index and third fingers to feel the pulse in your radial artery between your wrist bone and the tendon on the thumbside of the wrist.
3. Apply just enough pressure so you can count each beat. Do not push too hard or you will obstruct the blood flow.
4. Use the second hand on your watch/clock to count how many times your heart beats in 60 seconds.
5. Record your pulse.
Steps in taking your carotid pulse
Your carotid pulse can be taken on either side of your neck.
1. Find the area on one side of your neck near your windpipe.
2. Use the tips of your index and third fingers to take your pulse. Use right-hand fingers to find the pulse on the left side of your neck and vice versa.
3. Place these fingers in the groove of your neck along your windpipe.
4. Do not press on the carotid arteries on both sides of your neck at the same time. This may cause light-headedness, dizziness or fainting.
5. Apply just enough pressure so you can count each beat. Do not push too hard or you will obstruct the blood flow.
6. Use the second hand on your watch/clock to count how many times your heart beats in 60 seconds.
7. Record your pulse.

If you have problems taking your pulse
If you have problems taking either your radial or carotid pulse, you can use a stethoscope to check your apical pulse. This pulse lies directly over the heart. Ask your health care provider to show you how to use the stethoscope so you can find the apical pulse.

Record your pulse
Ask your health care provider how often you need to take and record your pulse. Bring your record each time you visit your health care provider. Your record will help your health care provider see the daily changes in your heart rate.

General hints for taking your pulse
• Take your pulse the same time each day so it becomes part of your daily routine.
• Sit down and rest several minutes before taking your pulse unless told otherwise.
• Count your pulse for one full minute unless told otherwise.
• Write your pulse rate on a record sheet or calendar.
• Check with your health care provider about an appropriate range for your heart rate.
Treatment for atrial fibrillation or atrial flutter depends on the cause. Usually, the goals of initially treating atrial fibrillation or atrial flutter include improving your quality of life by doing the following:

- Prevent blood clot formation
- Slow the rate at which the ventricles contract
- Restore and maintain a normal rhythm

Medications work well for many people, but sometimes different medications or combinations of medications must be tried to find out which ones work best for an individual. Some people need three types of medications: one to prevent blood clots, one to slow the heart rate and one to maintain a normal rhythm.

**Preventing blood clot formation with anticoagulants**

Your physician will determine whether your risks of developing blood clots are high enough to use an anticoagulant medication such as warfarin (Coumadin™). People with atrial fibrillation or atrial flutter may have an increased risk of developing a blood clot, so anticoagulants are an important part of their treatment. Some people need to take anticoagulants the rest of their lives.

Anticoagulants, sometimes called “blood thinners,” are medications that interfere with your body’s blood-clotting mechanisms. They do not change the “thickness” of blood. Instead, they prolong the time normally required for blood to clot. In this way, they are used to prevent clot formation within the heart and blood vessels.

If your risk of developing blood clots is low, your physician may recommend that you take aspirin (325 milligrams daily) instead of warfarin. However, in people who have significant risk factors for stroke, long-term aspirin therapy does not work as well as warfarin to prevent blood clot formation with atrial fibrillation and atrial flutter.

Besides being used for long-term prevention of blood clots, anticoagulants are used before and after electrical cardioversion, the process of restoring the heart to a normal rhythm. During cardioversion, there is a higher risk of dislodging a blood clot when atrial fibrillation or atrial flutter ends, and a normal rhythm begins. This is of concern for anyone who has had an abnormal rhythm for more than 24 to 36 hours. Normal pumping function of the atria may not return for several hours to three or four weeks after cardioversion. During this time, blood clots could form and travel to other parts of the body.
Therefore, it is strongly recommended that people take anticoagulants for three to four weeks before cardioversion and for at least one month after cardioversion. In many cases, anticoagulants should be continued for a longer time. During this time, the desired results of a blood-clotting test called the prothrombin time (PT), reported as the international normalized ratio (INR) are usually between 2.0 and 3.0. Your blood may need to be tested every month (or more often) to adjust and monitor your dosage. If you take too little anticoagulant, you may have a higher risk of having a stroke, and if you take too much anticoagulant, you may bleed excessively. Follow your physician’s testing and dosage instructions exactly.

My goal INR level is: ____________________________.

An alternative to using an oral anticoagulant for three to four weeks before cardioversion is to have an echo to look for blood clots in the right and left atria. During this test, called transesophageal echocardiography (TEE), your throat is numbed and you swallow the echo tube. In your esophagus (the food tube that runs from your mouth to your stomach), the transducer is closer to your heart than it is when it is pressed against your chest skin. If clots are not seen with the TEE, then cardioversion may be done without using oral anticoagulants for three to four weeks beforehand. Even after a TEE, however, anticoagulants are necessary at the time of, and for at least a month after, cardioversion.

Many foods and medications (including medications for your heart) can interfere with anticoagulants. Aspirin is one medication that may increase the risk of bleeding if you are taking warfarin. Before you take anticoagulants, tell your physician about every medication that you take, including prescription and nonprescription medications and supplements. Ask your physician for more information about anticoagulants.

**Slowing the ventricular heart rate with medication**

Most medications used to treat a fast heart rate during atrial fibrillation or atrial flutter work in a similar way. They slow the transmission and decrease the number of electrical signals that pass through the AV node from the upper to lower chambers of the heart. The goal is to slow the heart rate to 70 to 90 beats per minute when you are resting, and to less than 100 to 120 beats per minute when you are active. For this reason, your physician may evaluate the medication by checking your pulse when you are resting and also after you have been active, such as after walking briskly or climbing stairs.
Three types of medication are commonly used alone or in combination with others:

**Digitalis** — Such as digoxin and Lanoxin™ – This type of medication has been used most widely over the years. However, it is less likely to work in people who are active or whose electrical signals pass through the AV node very quickly.

**Beta blockers** — Such as propranolol (Inderal™), metoprolol (Toprol-XL™, Lopressor™), atenolol (Tenormin™), acebutolol (Sectral™), pindolol (Visken™), and carvedilol (Coreg™) – This type of medication especially may help active people, people with coronary artery disease or heart failure, or people who have had a heart attack. Most people tolerate these medications well, but side effects prevent some people from using them.

**Calcium-channel blockers** — Such as verapamil (Calan™, Isoptin™) and diltiazem (Cardizem™, Dilacor™) – This type of medication may help many people with rapid ventricular rates. Calcium-channel blockers are usually well tolerated.

Medications affect different people differently. You may need to try several medications for periods ranging from two days to up to two months to see if they work for you. It is also possible that your medications may work fine for several months or longer, and then become less effective, so you would need to try other medications.

Discuss each of your medications with your physician and ask about side effects. For example, some of these medications may decrease your heart’s pumping action. They also may irritate your stomach or slow your heart rate too much. If you think you are having a significant side effect, contact your physician or an emergency room immediately.

**Restoring a normal heart rhythm**

After the risks of a stroke or other problems with blood clots are minimized, normal rhythm usually can be restored. This process, cardioversion, may be done with medication or an electrical device.

**Medications to restore a normal heart rhythm**

Antiarrhythmic medications may prevent abnormal heartbeats. In some cases, these medications also can be used to restore normal heart rhythm. Examples include quinidine, procainamide, disopyramide, propafenone, flecainide, sotalol,
dofetilide, ibutilide and amiodarone. These medications may cause serious side effects, including making the heart rhythm worse. When people receive these medications, they are usually hospitalized so their hearts can be monitored continuously. The risk of side effects depends largely on how much heart disease a person has. Ask your physician about your specific risks and benefits from medication you might use.

**Electrical cardioversion**

Electrical (direct-current) cardioversion consists of delivering a small electrical shock to convert the heart to a normal rhythm. This brief electrical shock may be used after medications fail to restore a normal rhythm, or it may be used before antiarrhythmic medications are given. The procedure may be done more than once. Sometimes medications do not work very well to restore normal rhythm, but they may work well to keep the rhythm normal after electrical cardioversion. Your physician will determine whether electrical cardioversion is appropriate for you and whether you should use it with or without antiarrhythmic medications and anticoagulants.

![Figure 8. Electrical cardioversion](image-url)
Long-term treatment with medication
Many people do not need long-term treatment with medication to maintain normal rhythm. For example, the rhythm may remain normal after an underlying problem is treated, such as reducing excessive thyroid hormone production. About a third of all people who have had open-heart surgery get atrial fibrillation after surgery. Medication to maintain a normal rhythm may be needed for only three to six months after heart surgery.

Some people do not have symptoms during atrial fibrillation or atrial flutter, so they only need medication to control rapid heart rates and to prevent blood clot formation. Others may have symptoms once and may not have another episode for months or years, if ever. They may not need drugs to maintain normal rhythm. On the other hand, some people have a recurrence within weeks of their first episode. It is difficult to predict who will have recurrences. People most likely to need long-term treatment to maintain normal rhythm are those who have recurring arrhythmias with symptoms that interfere with their health or activity.

Medications are chosen according to each individual’s situation. A medication that helps one person may harm another. Furthermore, medications for arrhythmias may interact with other medications you take, such as anticoagulants. Therefore, when you start any new medication for an arrhythmia or for other health problems, you need to be monitored carefully. Most of the time, starting or changing anti-arrhythmic medications should be done while you are in the hospital.

Success of long-term treatment
Treatment of atrial fibrillation or atrial flutter may be frustrating. Only half of the people who use antiarrhythmic medications for atrial fibrillation or atrial flutter keep a normal rhythm for the following year. For many people, drug therapy is only partly successful, but it may dramatically decrease the number of episodes of atrial fibrillation or atrial flutter, even if it does not eliminate them completely. For others, drug therapy does not prevent the recurrence of abnormal rhythms. It is difficult to predict who will respond well to a particular medication. Often, several medications must be tried before finding one that works.

Whether or not to use antiarrhythmic medication depends on the symptoms people have with atrial fibrillation or atrial flutter. In some people, the risk of side effects from the antiarrhythmic medication outweighs the benefits. For example, people with no symptoms or minor symptoms often do well with only medications for control of the heart rate and anticoagulation.
Sometimes long-term treatment with medications cannot control atrial fibrillation or atrial flutter. If people have persistent, unacceptable symptoms or rapid ventricular heart rates, or if they cannot tolerate the medications, they may need treatments that do not rely on medication.

**Implanted pacemaker without ablation**
An implanted pacemaker may decrease the occurrence of atrial fibrillation or atrial flutter in people who need a pacemaker because of sinus node disease. In some cases, activating the heart at 80 to 90 beats per minute may prevent or reduce the frequency of atrial fibrillation or atrial flutter. Another method activates the atria from the center area of the heart (the septum). If atrial fibrillation or atrial flutter has become persistent, this kind of pacemaker is not effective.

**Atrial defibrillators**
A specialized pacemaker, called an atrial defibrillator, may decrease the need for emergency care to restore normal rhythm. Several wires are permanently positioned inside the heart. When atrial fibrillation or atrial flutter occurs, the wires deliver an electrical shock to the heart, converting the rhythm to normal, or pacing the heart rapidly to stop the abnormal rhythm.

Defibrillators may be helpful for people who have infrequent atrial fibrillation that does not stop on its own. Frequent shocks are uncomfortable.

**Catheter ablation to isolate the pulmonary vein(s) (pulmonary vein isolation or PVI) to treat focal atrial fibrillation**
In some people atrial fibrillation is caused by “hot spots.” These hot spots are like abnormal pacemaker cells that fire so rapidly the atria fibrillate. When present, the hot spots are found most commonly in the pulmonary veins, the veins that return blood from the lungs to the heart.
Catheter ablation to isolate the veins electrically can stop them from starting atrial fibrillation. During ablation, catheters (long, narrow tubes) are inserted into veins and advanced into the heart. In the ablation procedure, energy is applied through the tip of the catheter to the place where the pulmonary veins enter the left atrium (figure 9). This eliminates the arrhythmia without the need for medication or implantable devices (pacemaker, ICD). This procedure is most likely to work in younger people without significant heart valve disease who have frequent episodes of atrial fibrillation.

Figure 9. Catheter ablation to isolate the pulmonary vein(s) and to treat focal atrial fibrillation. Catheters are used to “map” the electrical paths in the heart. The catheters may help to find the spot from which the extra beats come. Then ablation can be used to “isolate” the spot(s) and stop the electrical impulse from moving to other areas of the heart. This can be effective treatment for some kinds of atrial fibrillation.
Ablation of the AV node and pacemaker implantation

Ablation of the AV node may be done to slow the heart rate when medications do not work or are not tolerated well. During ablation, catheters (long, narrow tubes) are inserted into a leg vein and advanced into the heart. One of the catheters is used to “map” the electrical paths of the heart. Another catheter works as a temporary pacemaker. The tip of the ablation catheter is placed near the AV node, the electrical connection between the atria and ventricles (figures 10, 11). The tip is heated, destroying the electrical connection between the atria and ventricles. After the AV node is destroyed, a permanent implanted pacemaker is needed to control the heart rate.

Figure 10. AV node ablation and pacemaker
Most people who have AV node ablation have fewer palpitations, less fatigue, better capacity for exercise and less shortness of breath after the procedure. However, the atria continue to fibrillate or flutter, and some people continue to have symptoms because the atria are not contracting as they should. Since the atria are not contracting normally, long-term use of anticoagulants is required to prevent blood clots from forming in the atria.

Figure 11. Atrial flutter ablation
Surgical MAZE procedures
A surgical procedure has been developed to cure atrial fibrillation. The surgical MAZE procedure is an open-heart surgery in which the surgeon makes multiple cuts (incisions) in the muscle of the atria and then sews the cuts back together (figure 12a). The scars that result interfere with the stray electrical pathways that may cause atrial fibrillation and, as in a maze, the scars leave the electrical impulse only one possible path to the AV node (figure 12b). This restores a normal pattern of contraction to the atrium and ventricle.

Figure 12a. Surgical MAZE procedure. Surgeons make many incisions (cuts) on the heart muscle. These cuts form scar tissue that blocks the abnormal pathways and directs the electrical impulses in the right direction.
12b. As in a maze, surgical scars allow the electrical impulses to pass through only one open pathway from the SA node to the AV node.

The MAZE procedure may eliminate atrial fibrillation in 80 to 90 percent of the people who have it done — even in people who have had atrial fibrillation for many years. However, atrial fibrillation may not stop right away. About one-third of people still have atrial fibrillation from six weeks to three months after the procedure. During this time, they still may need medication to control the atrial fibrillation. However, most of the time the atrial fibrillation will go away for good as the atrium heals. Even people who do not have favorable results may have more success with medication therapy than they did before the surgery.

The MAZE procedure requires open-heart surgery with cardiopulmonary bypass (heart-lung machine). In general, the risk of the procedure is low, but the risk involved depends on the individual’s health. Some people may need a pacemaker after the procedure. Ask your surgeon about your specific risks.
Which Treatment Is Best?

Most people who need treatment for atrial fibrillation or atrial flutter require more than one type of treatment. For example, some people need medications along with pacemakers or ablation. Treatment that works for one person may not work for another. The goal of your treatment is for you to return to your normal activities.

In addition, each form of treatment has its own potential benefits and risks. For example, the surgical MAZE has risks similar to other open-heart surgeries, and catheter ablation can cause blood vessel damage or strokes. The risks and benefits depend on your situation. After a careful evaluation by your physician, discuss the risks and benefits of treatments that are most appropriate for you. Also, at each visit, ask your physician whether there are new treatments that might be appropriate for you.
While you are at Mayo Clinic, you may be asked to participate in a research study. Researchers design studies to test the safety and effectiveness of medical treatments. Treatments can be a drug, a surgical device such as an artificial valve, a medical device like an insulin pump, or a surgical technique. Some studies test treatments that have already been proven, comparing them to other forms of therapy to see which ones are better.

You may be asked to participate in a study. You may wish to participate for a variety of reasons:
- To get access to treatments that are not yet available on the general market.
- For better health. Studies show that people who take part in clinical trials tend to do better than if they had not participated.
- For the good feeling you get knowing you are doing something to benefit mankind.

However, the decision whether or not to take part in a study is entirely up to you. If you are asked to participate in a study, be sure you understand the study’s purpose, how long it will last and your responsibilities. Know that you can stop at any time and that your decision — either to participate or not or to stop — in no way affects your medical care at Mayo Clinic.

If you have questions about a study you are asked to participate in, speak with your physician.
When to Contact Your Physician

Usually episodes of atrial fibrillation or atrial flutter are not dangerous. However, if the abnormal rhythm lasts longer than 36 to 48 hours, you will need anticoagulant therapy for three to four weeks before trying to restore your normal rhythm. Contact your physician for any of the following situations:

• You have side effects to a medication.
• Your pulse (checked at your wrist) is greater than 120 to 150 beats per minute.
• You start a new medication.
• You have other concerns related to atrial fibrillation or atrial flutter.

If you experience any of the following, immediately seek emergency help by activating your local emergency system (such as calling 911 or contacting an emergency room):

• You have persistent chest pain.
• You feel dizzy or faint.
• Suddenly you feel weak, or you have difficulty walking or talking, or your speech is slurred.
• Any of your usual symptoms worsen.
• You are unexpectedly short of breath.
• You think you are having a stroke, a heart attack or another serious health problem.

Mayo Clinic: Scottsdale and Phoenix, Ariz.
480-301-8000

Mayo Clinic: Jacksonville, Fla.
904-953-2000

Mayo Clinic: Rochester, Minn.
507-284-2511
Ablation – Elimination or removal of abnormal rhythm usually by burning the abnormal tissue in the heart.

Antiarrhythmic medication – Drug that corrects or prevents abnormal heart rhythms.

Anticoagulant – Medication that prevents blood clotting (sometimes called blood thinner).

Arrhythmia – Abnormal heart rhythm.

Atria – See atrium.

Atrioventricular (AV) node – Cluster of cells between the atria and ventricles that slows the electrical current as it passes into the ventricles.

Atrium – One of two upper heart chambers that receive blood from the veins and squeeze it into the ventricles; plural is atria.

Cardiomyopathy – Disease of the heart muscle.

Cardioversion – Process of converting an abnormal heart rhythm to a normal one.

Coronary artery – Artery supplying blood to the heart muscle.

Diabetes – Disease in which too much glucose (sugar) remains in the bloodstream.

Direct-current cardioversion – Process of giving the heart a brief electrical shock to convert an abnormal heart rhythm to a normal one.

Echocardiography (Echo) – Using ultrasound to make images of the heart.

Electrocardiogram (ECG, EKG) – Recording of the electrical activity of the heart.

Esophagus – Muscular tube between the mouth and the stomach.

Heart failure - Condition caused when the heart is unable to pump enough blood to meet the needs of the body.
**Hot spot** – One abnormal area in the heart that stimulates the atria to contract rapidly.

**Hypertension** – High blood pressure.

**Hyperthyroidism** – High levels of thyroid hormone in the bloodstream.

**Implanted pacemaker** – Device that is surgically placed in your body to deliver electrical signals that cause your heart to contract and prevent slow heart rates.

**Implantable cardioverter defibrillator (ICD)** – Device that is surgically placed in your body to deliver electrical signals to your heart as needed to convert an abnormal rapid rhythm to a normal one.

**International normalized ratio (INR)** – Mathematical equation that standardizes the results of the prothrombin time (PT).

**Palpitations** – Uncomfortable sensations in your chest of rapid heartbeat or heart fluttering.

**Prothrombin time (PT)** – Blood test that measures the ability of blood to clot.

**Re-entrant electrical wavelets** – Small, wandering, abnormal electrical signals that activate the atria irregularly.

**Sinus (SA) node** – Cluster of cells in the heart’s right atrium that normally initiates electrical signals that stimulate the heart to contract.

**Stroke** – Brain injury caused by an inadequate supply of blood to the brain.

**Surgical MAZE** – Surgical procedure in which incisions are made into the muscle of the atria to eliminate abnormal electrical circuits.

**Tachycardia** – Rapid heartbeat.

**Thrombi** – See thrombus.

**Thrombus** – Blood clot formed within the heart or a blood vessel (plural is thrombi).
**Transducer** – Device used in echocardiography to send ultrasound waves into your body and to detect them when they bounce off internal structures.

**Transesophageal echocardiography (TEE)** – Special type of echocardiography in which the transducer is placed inside your esophagus instead of on the skin of your chest.

**Ventricle** – One of two large, lower pumping chambers of the heart.

**Warfarin** – Generic (or common) name of oral anticoagulant.
BARBARA WOODWARD LIPS PATIENT EDUCATION CENTER

Mrs. Lips, a resident of San Antonio, Texas, was a loyal patient of Mayo Clinic for more than 40 years. She was a self-made business leader who significantly expanded her family’s activities in oil, gas and ranching, even as she assembled a museum-quality collection of antiques and fine art. She was best known by Mayo staff for her patient advocacy and support.

Upon her death in 1995, Mrs. Lips paid the ultimate compliment by leaving her entire estate to Mayo Clinic. Mrs. Lips had a profound appreciation for the care she received at Mayo Clinic. By naming the Barbara Woodward Lips Patient Education Center, Mayo honors her generosity, her love of learning, her belief in patient empowerment and her dedication to high-quality care.