The Normal Heart Rhythm

The heart pumps blood to the rest of the body. During each heart beat, the two upper chambers of the heart (atria) contract, followed by the two lower chambers (ventricles). These actions, when timed perfectly, allow for an efficient pump. The timing of the heart’s contractions is directed by the heart’s electrical system.

The electrical impulse begins in the sinoatrial (SA node), located in the right atrium. Normally, the SA node adjusts the rate of impulses, depending on the person’s activity. For example, the SA node increases the rate of impulses during exercise and decreases the rate of impulses during sleep.

When the SA node fires an impulse, electrical activity spreads through the right and left atria, causing them to contract and force blood into the ventricles.

The impulse travels to the atrioventricular (AV) node, located in the septum (near the middle of the heart). The AV node is the only electrical bridge that allows the impulses to travel from the atria to the ventricles. The impulse travels through the walls of the ventricles, causing them to contract. They squeeze and pump blood out of the heart. The right ventricle pumps blood to the lungs, and the left ventricle pumps blood to the body.

When the SA node is directing the electrical activity of the heart, the rhythm is called “normal sinus rhythm.” The normal heart beats in this type of regular rhythm, about 60 to 100 times per minute at rest.
What is atrial fibrillation?

Atrial fibrillation (AF or AFib) is the most common irregular heart rhythm that starts in the atria. Instead of the SA node (sinus node) directing the electrical rhythm, many different impulses rapidly fire at once, causing a very fast, chaotic rhythm in the atria. Because the electrical impulses are so fast and chaotic, the atria cannot contract and/or squeeze blood effectively into the ventricle.

Instead of the impulse traveling in an orderly fashion through the heart, many impulses begin at the same time and spread through the atria, competing for a chance to travel through the AV node. The AV node limits the number of impulses that travel to the ventricles, but many impulses get through in a fast and disorganized manner. The ventricles contract irregularly, leading to a rapid and irregular heartbeat. The rate of impulses in the atria can range from 300 to 600 beats per minute.

What causes atrial fibrillation?

There is no one “cause” of atrial fibrillation, although it is associated with many conditions, including:

- Hypertension (high blood pressure)
- Coronary artery disease
- Heart valve disease
- After heart surgery
- Chronic lung disease
- Heart failure
- Cardiomyopathy
- Congenital heart disease
- Pulmonary embolism

Less common causes:

- Hyperthyroidism
- Pericarditis
- Viral infection

In at least 10 percent of the cases, no underlying heart disease is found. In these cases, AF may be related to alcohol or excessive caffeine use, stress, certain drugs, electrolyte or metabolic imbalances, severe infections, or genetic factors. In some cases, no cause can be found.

The risk of AF increases with age, particularly after age 60.

How is atrial fibrillation diagnosed?

The most commonly used tests to diagnose atrial fibrillation include:

- **Electrocardiogram (ECG or EKG):** The ECG draws a picture on graph paper of the electrical impulses traveling through the heart muscle. An EKG provides an electrical “snapshot” of the heart.

- **Holter monitor:** A small external recorder is worn over a short period of time, usually one to three days. Electrodes (sticky patches) are placed on the skin of your chest. Wires are attached from the electrodes to the monitor. The electrical impulses are continuously recorded and stored in the monitor. After the monitor is removed, a technician uses a computer to analyze the data to evaluate the heart’s rhythm.

- **Portable event monitor:** A monitor that is worn for about a month for patients who have less frequent irregular heartbeat episodes and symptoms. Electrodes (sticky patches) are placed on the skin of your chest. Wires are attached from the electrodes to the monitor. The patient presses a button to activate the monitor when symptoms occur. The device records the electrical activity of the heart for several seconds. The patient then transmits the device’s recorded information over a telephone line to the doctor’s office for evaluation. The portable event monitor is very useful in determining what heart rhythm is causing your symptoms.

- **Transtelephonic monitor:** When you develop symptoms of atrial fibrillation, a strip of your current heart rhythm can be transmitted to your doctor’s office over the telephone, using a monitor with two bracelets or by placing the monitor against your chest wall.

These monitoring devices help your doctor determine if an irregular heart rhythm (arrhythmia) is causing your symptoms.
What are the dangers of atrial fibrillation?

Some people live for years with atrial fibrillation without problems. However, atrial fibrillation can lead to future problems:

- Because the atria are beating rapidly and irregularly, blood does not flow through them as quickly. This makes the blood more likely to clot. If a clot is pumped out of the heart, it can travel to the brain, resulting in a stroke. People with atrial fibrillation are 5 to 7 times more likely to have a stroke than the general population. Clots can also travel to other parts of the body (kidneys, heart, intestines), and cause other damage.
- Atrial fibrillation can decrease the heart’s pumping ability. The irregularity can make the heart work less efficiently. In addition, atrial fibrillation that occurs over a long period of time can significantly weaken the heart and lead to heart failure.
- Atrial fibrillation is associated with an increased risk of stroke, heart failure and even death.

What are the symptoms of atrial fibrillation?

You may have atrial fibrillation without having any symptoms. If you have symptoms, they may include:

- **Heart palpitations** - Sudden pounding, fluttering or racing sensation in the chest
- **Lack of energy** or feeling over-tired
- **Dizziness** - Feeling light-headed or faint
- **Chest discomfort** - Pain, pressure or discomfort in the chest
- **Shortness of breath** - Having difficulty breathing during normal activities and even at rest

How is atrial fibrillation treated?

The goals of treatment for atrial fibrillation include regaining a normal heart rhythm (sinus rhythm), controlling the heart rate, preventing blood clots and reducing the risk of stroke.

Many options are available to treat atrial fibrillation, including lifestyle changes, medications, catheter-based procedures and surgery. The type of treatment that is recommended for you is based on your heart rhythm and symptoms.

Medications

Initially, medications are used to treat atrial fibrillation. Medications may include:

**Rhythm control medications** *(antiarrhythmic drugs)*

Antiarrhythmic medications help return the heart to its normal sinus rhythm or maintain normal sinus rhythm.

There are several types of rhythm control medications, including: quinidine (Quinidex); procainamide (Pronestyl); disopyramide (Norpace); metoprolol (Toprol, Lopressor); flecainide acetate (Tambocor); propafenone (Rythmol); sotalol (Betapace); dofetilide (Tikosyn) and amiodarone (Cordarone).

You may have to stay in the hospital when you first start taking these medications so your heart rhythm and response to the medication can be carefully monitored. These medications are effective 30 to 60 percent of the time, but may lose their effectiveness over time. Your doctor may need to prescribe several different antiarrhythmic medications to determine the right one for you.

Some rhythm control medications may actually cause more arrhythmias, so it is important to talk to your doctor about your symptoms and any changes in your condition.

**Rate control medications**

Rate control medications, such as digoxin (Lanoxin), beta-blockers [metoprolol (Toprol, Lopressor)], and calcium channel blockers such as verapamil (Calan) or diltiazem (Cardizem), are used to help slow the heart rate during atrial fibrillation. These medications do not control the heart rhythm, but do prevent the ventricles from beating too rapidly.

**Anticoagulant medications**

Anticoagulant or antiplatelet therapy medications, such as warfarin (Coumadin) or aspirin, reduce the risk of blood clots and stroke, but they do not eliminate the risk. Regular blood tests are required when taking Coumadin to evaluate the effectiveness of the drug. Talk to your doctor about the anticoagulant medication that is right for you.
**Lifestyle Changes**

In addition to taking medications, there are some changes you can make to improve your heart health.

- If your irregular heart rhythm occurs more often with certain activities, tell your doctor. Sometimes, this may be mean that your medications need to be adjusted.
- Quit smoking.
- Limit your intake of alcohol. Moderation is the key. Ask your doctor for specific alcohol guidelines.
- Limit the use of caffeine. Some people are sensitive to caffeine and may notice more symptoms when using caffeinated products (such as tea, coffee, colas and some over-the-counter medications).
- Beware of stimulants used in cough and cold medications, as some of these medications contain ingredients that may increase the risk of irregular heart rhythms. Read medication labels and ask your doctor or pharmacist what type of cold medication is best for you.

**Procedures**

When medications do not work to correct or control atrial fibrillation, or when medications are not tolerated, a procedure may be necessary to treat the abnormal heart rhythm, such as: electrical cardioversion, pulmonary vein antrum isolation procedure, ablation of the AV node followed by pacemaker placement, or surgical ablation (Maze procedure or minimally invasive surgical treatment).

**Electrical Cardioversion:** A cardioversion electrically “resets” the heart. Medications alone are not always effective in converting atrial fibrillation to a more normal rhythm. Sometimes cardioversion is used to restore a normal heart rhythm and allow the medication to successfully maintain the normal rhythm. Cardioversion frequently restores a normal rhythm, although its effect may not be permanent.

After a short-acting anesthesia is given that puts the patient to sleep, an electrical shock is delivered through patches placed on the chest wall. This shock will synchronize the heartbeat and restore a normal rhythm.

**Catheter Ablation:** Catheter ablation may be an option for people who cannot tolerate medications or when medications are not effective in maintaining a normal heart rhythm. The two types of ablation procedures include pulmonary vein antrum isolation or ablation of the AV node. Both are performed by an electrophysiologist (doctor who specializes in treating heart rhythm conditions).

**Pulmonary vein antrum isolation (PVAI):** Research has shown that almost all atrial fibrillation signals come from the four pulmonary veins. During the PVAI procedure, special catheters (long, flexible tubes) are inserted through the veins in the leg and guided to the heart. Two of these catheters are inserted into the right atrium through a small hole in the atrial septum (the thin wall between the right and left atria).

During the procedure, intracardiac echocardiography is used. A very small ultrasound device mounted on a catheter allows the doctor to see the septum clearly during the procedure.

One catheter in the left atrium is used to map or locate the abnormal impulses coming from the pulmonary veins. The other catheter is used to deliver the radiofrequency energy to ablate, or create lesions, outside the pulmonary veins.

Over a period of 2 to 3 months, the lesions heal and form small scars. Once the scars form, they block any impulses firing from within the pulmonary veins, thereby “disconnecting” them or “isolating” them from the heart, allowing the SA node to again direct the heart rhythm.

Because it takes several weeks for the scars to heal, many people continue to have abnormal or irregular heartbeats. This is expected, and often people continue to take their antiarrhythmic medications for the first 2 months after the procedure (as prescribed).