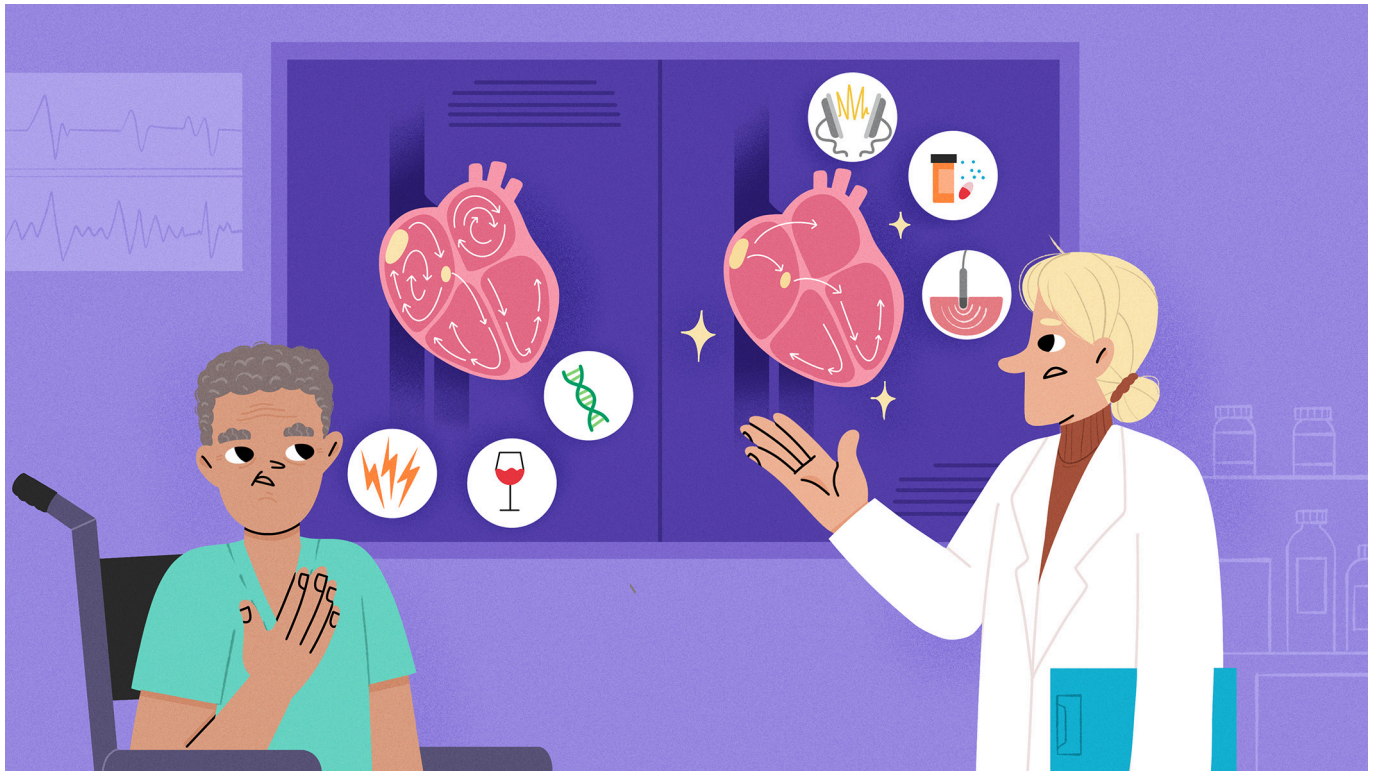




ATRIAL FIBRILLATION—WHEN THE HEART SKIPS MORE THAN A BEAT

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YOUNG REVIEWERS:



ARISHA
AGE: 12



DOMINIK
AGE: 14

The heart is a very important muscle that works nonstop to pump blood and deliver essential nutrients and oxygen to every part of the body. This paper looks at how the heart functions normally, and what happens when it works abnormally as is the case with a condition known as atrial fibrillation (AF). AF is a common condition that develops when the heart beats irregularly and out of sync. AF can increase a person's chance of developing serious issues like heart failure or stroke. This paper also looks at how AF can be diagnosed, what causes AF, and the different ways it can be treated.

THE HEART AND HOW IT WORKS

The heart is a strong, essential muscle. Your heart is about the size of your fist and it works all day, every day, without ever taking a break. Its

job is to move blood, which carries oxygen and nutrients, to every part of your body, from your head to your toes.

The heart is made up of four parts, called chambers. There are two chambers on the top (called the atria) and two on the bottom (called the ventricles). In between the chambers, there are structures called valves, which act like doors that can open and close to keep blood flowing in one direction without going backward. Blood flows into the heart through the atria, drains into the ventricles, and then the ventricles push the blood out to the lungs or the rest of the body. Blood travels within special tubes called blood vessels. Blood vessels are very important because they carry blood to all body parts and control how much blood goes where. There are three main types of blood vessels: arteries, which carry blood away from the heart; veins, which bring blood back to the heart; and capillaries, which are where nutrient and oxygen exchange take place (Figure 1).

Figure 1

Diagram of the heart and its major components. The heart is composed of four chambers: two atria and two ventricles, which are separated by valves. There are also major blood vessels that bring blood into the heart and pump it away from the heart.

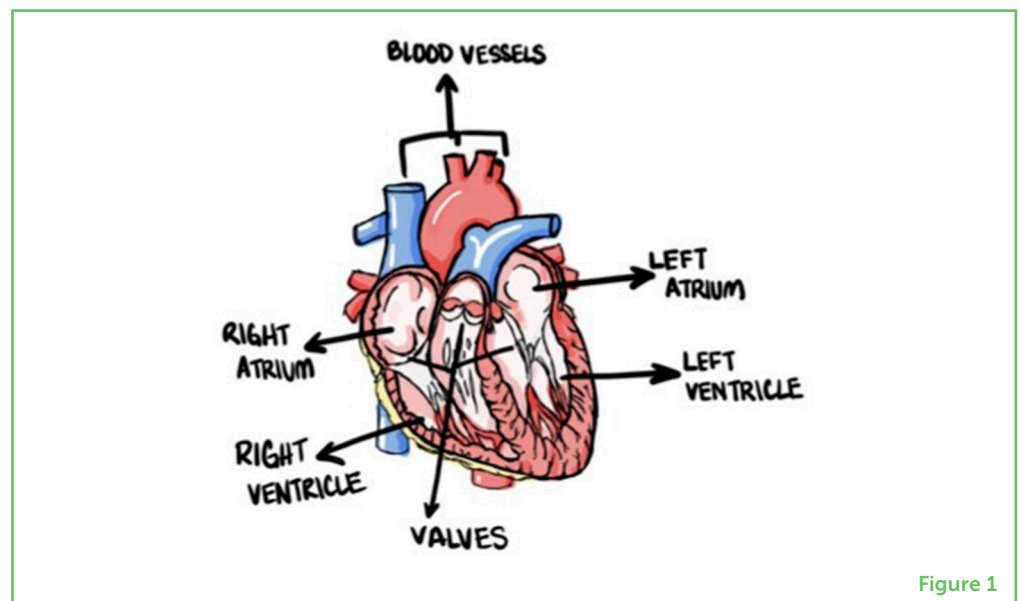


Figure 1

PACEMAKER CELLS

A special group of cells in the heart that control when the heart squeezes (contracts) and relaxes—these cells control how fast or slow someone's heart beats.

Inside the heart, there is a special group of cells called **pacemaker cells** that control the heartbeat [1]. These cells send signals that tell the heart when to squeeze (contract) and relax. When the heart contracts, it pushes blood out to the rest of the body. In some situations, like during exercise, the muscles need more oxygen. To help with this, the heart beats faster and pumps more blood around the body. This delivers extra oxygen to the muscles to help the body keep moving and stay strong.

WHAT HAPPENS DURING ATRIAL FIBRILLATION?

To move blood around the body efficiently, the heart needs to keep a steady, regular beat. Sometimes the heart's rhythm can get mixed up, and it can beat irregularly. The most common type of irregular

ARRHYTHMIA

An irregular heart beat.

ATRIAL FIBRILLATION

A condition of the heart that develops when the heart beats irregularly and out of sync.

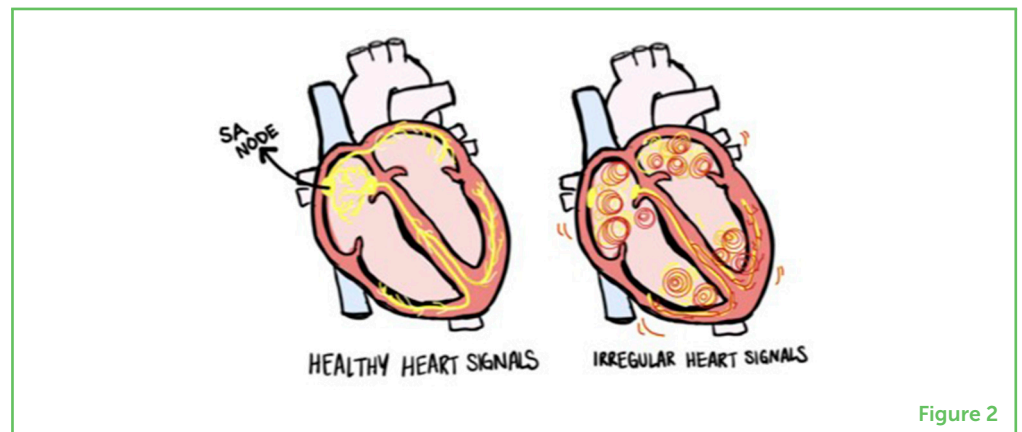
Figure 2

In a healthy heart, the sinoatrial node (SA node) is a group of specialized heart cells called pacemaker cells, which send out electrical signals in an organized and unidirectional way. In comparison, in AF, these signals become chaotic, causing the atria to beat rapidly and irregularly—with signals being sent in many directions.

PALPITATION

The feeling of having a “fast-beating” or “pounding” heart beat.

heartbeat, or **arrhythmia**, is called **atrial fibrillation** (AF). In AF, the atria beat too fast and fall out of sync with the ventricles. Normally, the heart’s pacemaker cells send clear electrical signals to tell the heart exactly when to squeeze and pump blood. In AF, these signals get scrambled and become chaotic, causing the atria to beat super fast, sometimes 300–500 times a minute, and out of rhythm with the ventricles [2]. This is like a drummer playing out of time with the band—it messes everything up! (Figure 2).



AF is becoming more common worldwide, partly because people are living longer, and more individuals have health conditions that raise the risk [2]. Several factors can make AF more likely, including older age, being male, or having a family history of heart problems. In some cases, AF runs in families due to genes passed down from parents. Health and lifestyle factors like being overweight, having high blood pressure or cholesterol, diabetes, or smoking also increase the risk of AF. Additionally, certain medical conditions, such as sleep apnea (when breathing stops briefly during sleep), thyroid problems, sepsis (when the body overreacts to a serious infection) or kidney disease can make AF more likely.

AF needs something to set it off and certain conditions to keep it going. Triggers can include stress, drinking too much caffeine or alcohol, dehydration, or inflammation in the body. These triggers can cause the cells near the veins in the heart to send out mixed-up electrical signals. These jumbled signals take over, making the atria beat irregularly. If the heart has been damaged, like from scarring, stretching, or stiffening caused by high blood pressure or other heart problems, AF can become a long-term issue.

When AF happens, you might feel like your heart is racing or fluttering inside of your chest. This feeling is called a **palpitation**. You might also feel tired, dizzy, or out of breath because your body does not get all the oxygen it needs when your heart is not pumping efficiently. One of the biggest dangers of AF is that it can cause blood to pool inside the heart instead of flowing smoothly [2]. When blood pools, clots can form. If

ELECTROCARDIOGRAM (ECG)

A non-invasive test that records the rhythm of the heart beat and overall health of the heart.

CARDIOVERSION

A treatment for atrial fibrillation that can be done to reset an abnormal heart rhythm back to normal, typically using medicine or an electrical shock.

a blood clot breaks loose and travels to the brain, it can block blood flow and cause a stroke. A **stroke** is very serious because the parts of the brain that are not getting enough oxygen can become damaged. AF can also make the heart work harder than it should. Over time, this extra strain can weaken the heart, leading to a condition called heart failure. In heart failure, the heart has a hard time pumping enough blood to meet the body's needs. That is why it is so important for doctors to catch and treat AF early, to prevent these serious problems before they happen.

Doctors use special tools to figure out if someone has AF [2]. First, they might listen to the heart with a stethoscope to check for unusual sounds. Then, they often use a test called an **electrocardiogram**, also known as an ECG. This test records the electrical signals in the heart and shows if its rhythm is normal or jumbled. Sometimes doctors have patients wear a small, portable heart monitor that tracks their heartbeat over a day or two. These tools help doctors figure out what is going on in the heart so they can decide the best way to help.

HOW CAN WE TREAT ATRIAL FIBRILLATION?

The type of treatment offered to a patient with AF will depend on many things [2]. The doctor and patient will carefully consider the patient's lifestyle and preferences, any other heart problems the patient may have, and the patient's overall health. As we previously discussed, other illnesses such as lack of blood flow, worsening heart problems, or a bad infection can also cause irregular heartbeats. In these cases, part of the treatment plan can include treating the main problem first and then focusing on normalizing the heart rate.

Generally, the goal is to fix the irregular heartbeat and keep it normal, to help people feel better and improve their daily lives. This type of therapy is called rhythm control and can involve treatment options such as medication, a special shock called cardioversion to reset the heart rate, or a procedure called catheter ablation [2].

Medications

There are many types of antiarrhythmic drugs (AADs) that can be used to treat AF. These medications work by calming down the electrical signals in the heart to prevent it from beating out of synch or too quickly. For example, amiodarone is a common AAD that can block certain pathways of the heart cells that cause the electrical signals to move too quickly or in the wrong direction [3].

Cardioversion

Cardioversion is a procedure that quickly resets the heart rhythm using an electric shock, or sometimes by using medicines [4]. For electrical cardioversion, patches connected to a machine are placed

CATHETER ABLATION

A type of treatment for atrial fibrillation that uses thin wires and energy (either hot or cold) to destroy tiny areas of the heart that is causing irregular heart rhythms.

on the patient's chest to record the heart rhythm and deliver a quick electric shock when an irregular rhythm is sensed. In comparison, cardioversions using medicine take more time to work. However, when medications are delivered directly into the patient's vein *via* an IV in the forearm or hand, they will similarly reset the heart rhythm.

Catheter ablation

Catheter ablation is a procedure that involves inserting a thin, flexible tube called a catheter into a blood vessel in the shoulder, neck, or groin [5]. The tube is used as a guide and access point to the heart. AF usually starts in the pulmonary veins, which are the blood vessels that drain blood from the lungs to the heart. These veins are the targets of the ablation procedure. During ablation, doctors create small scars in the heart that block irregular heartbeats. Two of the most common ways they make these scars involve using extreme cold, which is called cryoablation, or using heat (also called radiofrequency) energy [5].

IN CLOSING...

The heart is an incredibly important muscle that works tirelessly to pump blood and sustain life. Conditions like AF can have major impacts on how well our hearts work and on our overall health. There are several effective treatments for AF, including medicines and procedures that reset the heart rhythm. In addition to these treatment options, staying active, managing stress, and eating well are also important ways to protect this super-powered pump and support a healthy heart.

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SUBMITTED: 10 March 2025; **ACCEPTED:** 24 October 2025; ;
PUBLISHED ONLINE: 20 November 2025.

EDITOR: Pradeep Nair, Indo Pacific Studies Center, Australia

SCIENCE MENTORS: Katarzyna Bulek and Archana Kumari

CITATION: Santos FB, McKenzie MP, Mena AM, O'Neill H and Jolly U (2025) Atrial Fibrillation—When the heart Skips More Than a Beat. *Front. Young Minds* 13:1591081. doi: 10.3389/frym.2025.1591081

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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I am in 8th grade and enjoy reading, listening to music, and spending time with my family and friends. I have been playing the violin for 4 years and recently started playing tennis. My favorite subject in school is math and my favorite colors are light pink and purple. I act in musicals during the summer and attend the student council and orchestra club at my school.



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My name is Dominik, and I am currently in 9th grade. I am curious and passionate about science. In my free time, I enjoy figure skating, skiing, and fishing.

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Hannah O'Neill is a medical student at the University of Limerick School of Medicine in Ireland. She is from Dublin, Ireland, where she received her Bachelor of Science degree in biomedical and molecular diagnostics at Technological University Dublin. She graduated in 2023 and began her medical degree that same year. She is particularly interested in the field of obstetrics and gynecology and hopes to pursue a career in this someday. She works as a home health care assistant at the weekends and in her free time she loves running and spending time with family and friends.



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