How the heart works

A person's heart is a strong, hard-working, muscular pump, usually slightly larger than their fist.

The heart has a right and left side, with an upper and lower chamber on each side. The upper chambers are called the **atria** *(a-tree-ah).* The lower ones are the **ventricles** *(ven-trih-kuls).*

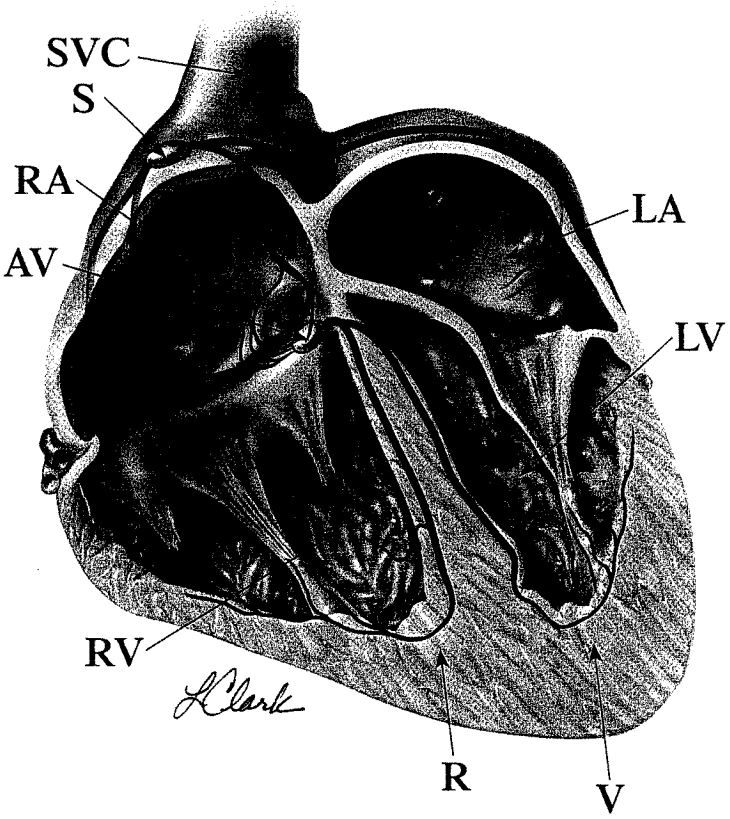
The atria basically hold blood. The ventricles pump it out of the heart.

First the blood comes into the right atrium, then it goes to the right ventricle. From there the blood is pumped to the lungs where it's refreshed with oxygen. The blood returns from the lungs to the left atrium, then flows to the left ventricle. The left ventricle pumps the blood out to the body. Because the left ventricle has to pump the hardest, it's the most muscular chamber.

As blood travels through the heart, it moves through a series of valves. They open and close to let blood flow in just one direction.

Each heartbeat begins when a specialized area of the right atrium (called the sinus node, S-A node or the heart's pacemaker) generates a small amount of electricity. Each electrical signal leaves the sinus node and spreads into the muscle cells of the heart's atria. This causes them to contract (beat).

Next the electrical activity moves into the junction between the atria and ventricles. There it passes through the atrioventricular node (A-V node). The A-V node acts as a relay station. It takes the signal coming from the atria, delays it slightly, then passes it into the ventricles, causing them to beat.



Drawing of the heart opened to show the major parts.

SVC = superior vena cava

S = sinus node

RA = right atrium

AV = atrioventricular node

RV = right ventricle

R & V = special conduction pathways to the right and left ventricles

LV = left ventricle

LA = left atrium

Tachycardia (fast heart rate)

A fast heart rate is called tachycardia. The definition of "too fast" usually depends upon the person's age and physical activity. A new born has tachycardia if the resting rate is more than 160 beats a minute. A teenager has it if the resting heart rate is more than 100 beats a minute. An exercising teenager may have a normal heart rate of up to 200 beats a minute.

Sinus tachycardia is a normal increase in the heart rate. It occurs with fever, excitement and exercise. No treatment is needed.

Conditions such as fever, dehydration, anemia (low blood count) or increased thyroid activity (rare in children) can cause this fast heart rate. In these cases, when the problem is corrected, the tachycardia goes away.

Tachycardias fall into two major categories. Ventricular tachycardia involves only the ventricles. Supraventricular tachycardia involves both the atria and the ventricles.

Supraventricular Tachycardia (SVT)

The most common abnormal tachycardia in children is supraventricular tachycardia (SVT). It used to be called paroxysmal (par-ok-sis-mal) atrial tachycardia (PAT) or paroxysmal supraventricular tachycardia (PSVT). The fast heart rate involves both the heart's upper and lower chambers. This isn't a life-threatening problem for most children and adolescents. Many people with it don't need medical therapy. Treatment is considered if episodes are prolonged or occur often.

Treating SVT usually has two parts. The first is stopping a current episode; the second is preventing recurrences.

The approach to preventing recurrences depends on the child's age. In some cases—especially those of infants—the child may need to enter the hospital for treatment and special studies.

Sometimes simple procedures can stop a fast heart rhythm. Holding the breath with straining of the abdomen, gagging or putting an ice-water-soaked washcloth on the face are examples. Your child's doctor can explain this to you in more detail. At other times intravenous medications may be needed to control or stop the tachycardia.

Another way to stop SVT may be the use of an intravenous medication called Adenosine.

On rare occasions doctors stop SVT by giving a small electrical shock to the chest wall. This is called electrical countershock or cardioversion. Your child will get a sedative or anesthetic just before this is done.

SVT may occur in very young infants with otherwise normal hearts. The heart rate is usually more than 220 beats a minute. Infants with an SVT episode may breathe faster than normal and seem fussy or sleepier than usual. This situation must be diagnosed and treated to return the heart rate to normal. Once the rhythm is normal, medication usually can prevent future episodes.

For many infants, SVT is a time-limited problem. Treatment with medications often stops after six to 12 months.

Sometimes SVT can be detected while a baby is still in the womb. Then the mother may take medications to slow her baby's heart rate.

If an older infant or child has SVT, the child may be aware of the rapid heart rate. This may be associated with palpitations, dizziness, lightheadedness, chest discomfort, upset stomach or weakness. Some children can learn ways to slow down their heart rate. Straining—such as closing the nose and mouth and trying to breathe out—may be successful. This is called a Valsalva maneuver.

Older children are more likely to have more episodes of tachycardia. They're more likely to need prolonged treatment. They also may need more diagnostic tests.

It's unusual to have episodes of SVT that keep a child from enjoying normal activities. Most people who have episodes of tachycardia stay well even though they may need to keep taking medicine. Some people will need periodic checkups, but most can enjoy unrestricted normal activities.

Supraventricular tachycardia (SVT) in childhood is usually associated with abnormal electrical conduction pathways or small, abnormal areas in the atria that cause many consecutive early heartbeats. Multiple types of SVT exist.

If an abnormal conduction pathway runs between the atria and ventricles, the electrical signal may arrive at the ventricles sooner than normal. This condition is called Wolff-Parkinson-White syndrome (WPW syndrome). It's named after the three people who first described it. WPW syndrome is recognized by certain changes on the ECG. WPW is often associated as a cause of SVT. Many people with WPW syndrome don't have symptoms or episodes of tachycardia.

Another common form of SVT is AV node reentry that involves the use of more than one pathway in the area of the AV node. It can feel the same as SVT related to an extra pathway, such as that seen with WPW.

Often medication can improve a child's episodes of SVT. Sometimes, though, such treatment doesn't work. Then your child will need more tests. Eliminating the abnormal pathway by passing energy through a catheter may be needed. Surgery is another option.

Ventricular tachycardia (VT)

Ventricular tachycardia (VT) is a fast heart rate that starts in the lower chambers (ventricles). This uncommon but potentially serious condition can threaten a child's life.

VT may result from serious heart disease; it usually requires prompt treatment. Ventricular tachycardia occasionally occurs in children with otherwise normal hearts. Often specialized tests, including an intracardiac electrophysiological procedure, may be needed to evaluate the tachycardia and the effect of drug treatment. Some forms of VT may not need treatment.

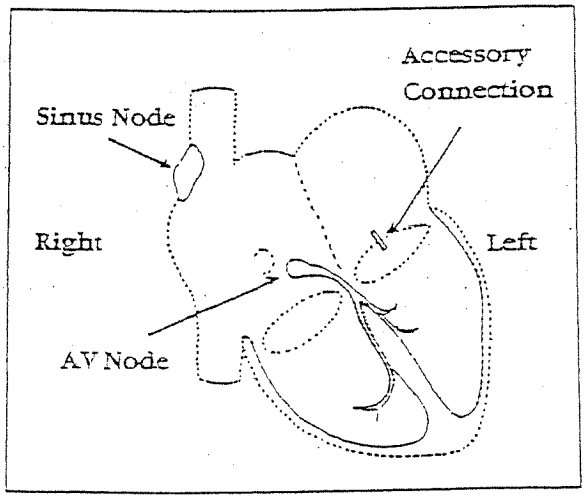
If treatment is required, it includes medicines and treating the cause, if possible. The type and length of treatment depends on what's causing the problem. In some people radiofrequency catheter ablation or surgery may be needed to control the tachycardia.

Tachycardias

There are MANY types of tachycardias. Some are only located in the upper chambers of the heart (for example, atrial tachycardia, atrial flutter), some are located only in the bottom chambers (ventricular tachycardia) and many involve both the top and bottom chambers. This packet will discuss the two most common forms of tachycardia.

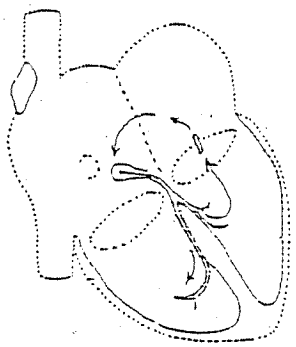
1. Remember from the discussion of the normal electrical system that the only way for the impulse to get from the top to the bottom of the heart is through the AV node. Sometimes, even if the heart is structurally normal (normal valves and chambers), there is a "short circuit" in the system. If you consider the AV node the normal electrical connection in the heart, these short circuits may be called "accessory" (extra) connections. They are tiny strands of muscle, smaller than a piece of hair, that bridge the areas where the atria meet the ventricles. This allows an electrical impulse to get from the top to the bottom through a route other than the AV node and can also conduct from bottom to top, allowing impulses to get BACK UP to the top from the ventricles after a normal heart beat.

The picture shows an "accessory connection" on the left side of the heart as an example. They can be almost anywhere on the right, left, or middle part of the heart where the top chambers meet the bottom chambers.

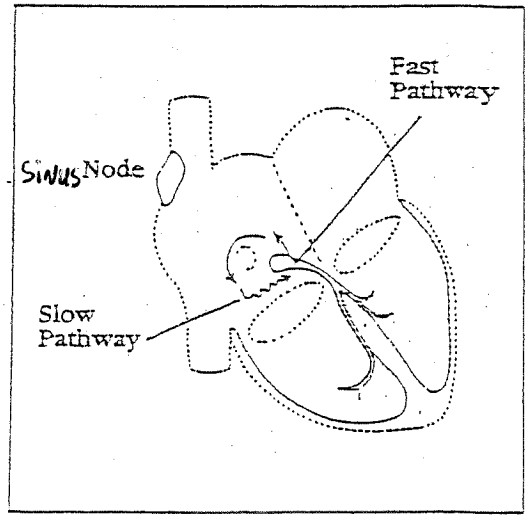


There are two main problems that accessory connections permit. The first involves conduction from TOP TO BOTTOM. If an abnormal atrial rhythm called atrial fibrillation occurs, the top of the heart beats very fast and irregularly (quivers like Jell-O, "fibrillates"), the accessory connection can allow rapid conduction to the ventricles causing ventricular fibrillation. This is very rare, but very dangerous and life-threatening. The second problem is with conduction from BOTTOM TO TOP. Remember, normal conduction does not allow this to happen. Sometimes, the accessory connection does and the electrical signal "re-enters" the top chamber of the heart. Once that happens, the normal conductor doesn't care where the impulse comes from and it conducts again to the bottom chambers. A tachycardia "circuit" can be set up, with a fast rhythm going TOP → BOTTOM → TOP → BOTTOM → TOP... until something makes it stop.

The picture that follows shows how this electrical circuit can be drawn in cartoon fashion to help you understand better.



2. The second common form of tachycardia uses an extra pathway of sorts, too, but different from the "accessory connection" discussed earlier. This extra pathway is close to the normal AV node conductor. The AV node conductor actually has two components to it, a "fast" pathway and a "slow" pathway. These pathways allow an electrical circuit to occur, causing tachycardia, as shown in the following picture. This tachycardia is called "AV node re-entry".



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