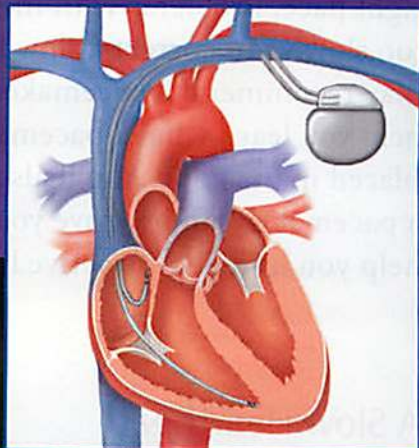
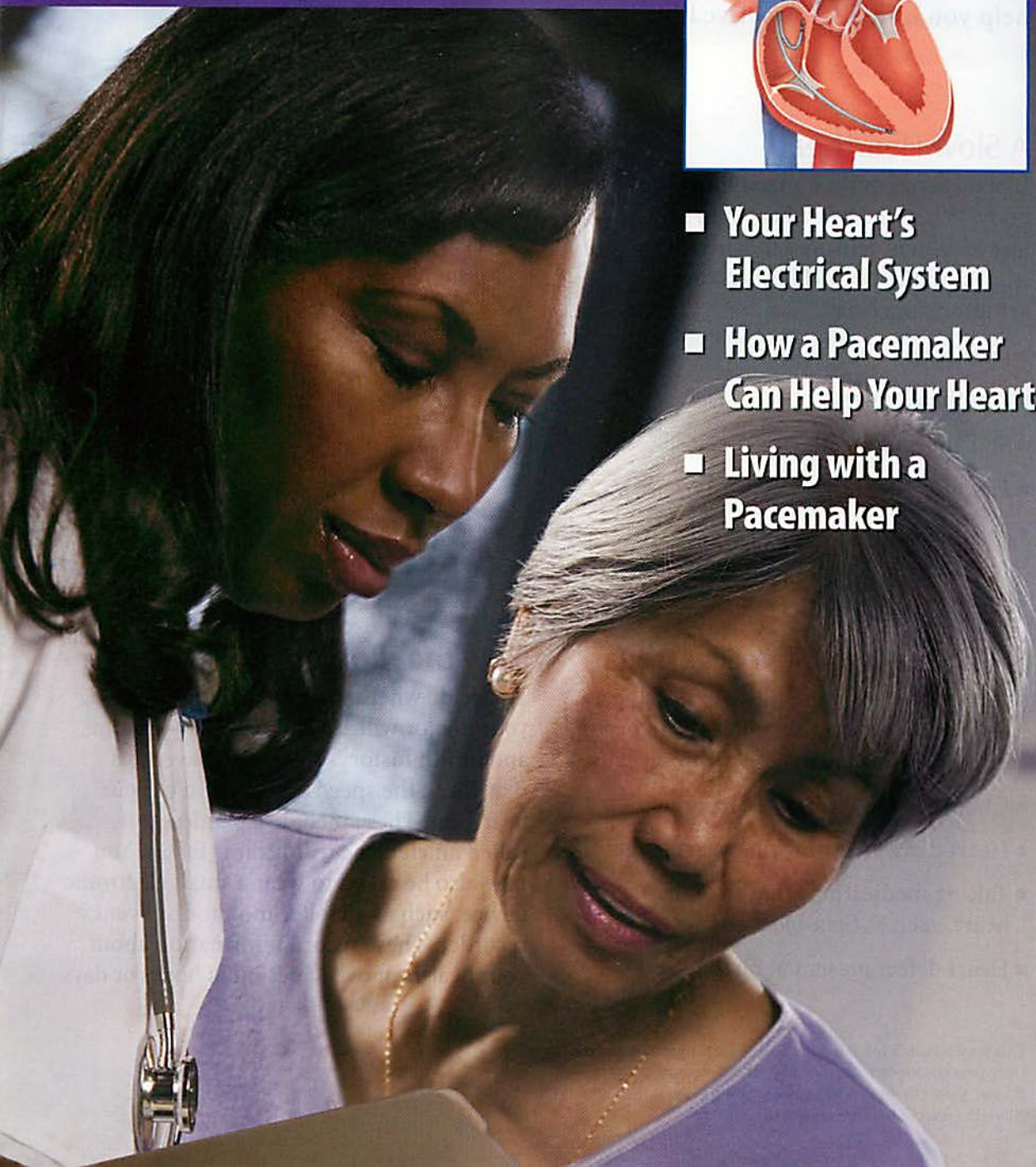


Understanding Pacemakers



- **Your Heart's Electrical System**
- **How a Pacemaker Can Help Your Heart**
- **Living with a Pacemaker**



Why You Need a Pacemaker

Your heart has an electrical system that keeps it beating at the right pace. Problems with this system can make your heart beat too slowly. To correct a slow heartbeat, your doctor may recommend a pacemaker. This booklet will help you learn what a pacemaker is and how it's placed in the body. You'll also find out how a pacemaker can improve your health and help you lead a more active life.

A Slow Heartbeat

Blood carries oxygen throughout the body. When the heart beats too slowly, less oxygen is delivered to where it's needed in the body. This can cause symptoms such as:

- Dizziness
- Lightheadedness
- Shortness of breath
- Fatigue
- Fainting spells (syncope)



Feeling lightheaded is a common symptom of a slow heartbeat.

What Causes a Slow Heartbeat?

Older people are more likely to develop a slow heartbeat. But the problem can occur at any age. Below are some common causes:

- Changes in the heart due to aging
- Heart disease or previous heart surgery
- Taking medications that slow the heart, such as beta-blockers
- Heart defect present at birth

How the Problem Is Diagnosed

To decide whether a pacemaker is needed, your doctor will ask about your symptoms and health history. You'll also have tests that check the speed and rhythm of your heartbeat. These include a painless test called an **electrocardiogram (ECG)**. You may also be asked to wear a small electronic device, such as a Holter monitor or event recorder. These record information about your heartbeat over a period of hours or days.

This booklet is not intended as a substitute for professional medical care. Only your doctor can diagnose and treat a medical problem.

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How a Pacemaker Can Help

A pacemaker does exactly what its name says: It helps keep your heart beating at the right pace. This reduces symptoms of a slow heartbeat. It can also let you take medications that would otherwise slow your heartbeat too much. Best of all, a pacemaker can improve your lifestyle by letting you be more active. Keep in mind, though, that having a pacemaker is a lifelong commitment. You'll need to see your doctor for regular checkups. You'll also need to take good care of your heart. But these things are more than worth it to keep your heart working well.

A pacemaker can help you be more active.

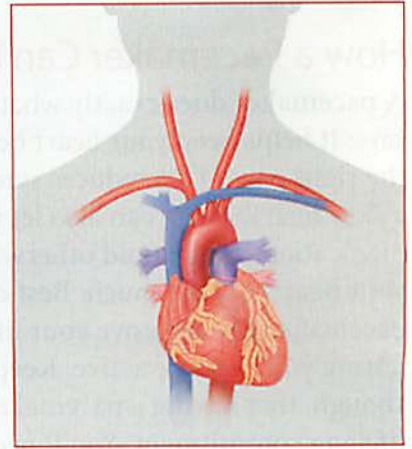


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Your Heart's Electrical System

Your heart is a muscle that pumps blood throughout the body. It does this using an electrical system that tells your heart when to **contract** (squeeze). If there's a problem with this electrical system, your heart may not beat as fast or as often as it should. This means that the heart can't pump as much blood as the body needs. When that happens, you can have symptoms such as lightheadedness and fatigue.



Signals Tell the Heart to Beat

Each heartbeat starts with an electrical signal. The signals are sent and received by special electrical cells within the heart called **nodes**. As the signals move through the heart, they tell the chambers that pump blood (called **atria** and **ventricles**) when to contract. When you're active, the signals from the nodes speed up to pump blood faster. When you're resting, the signals return to a normal pace.

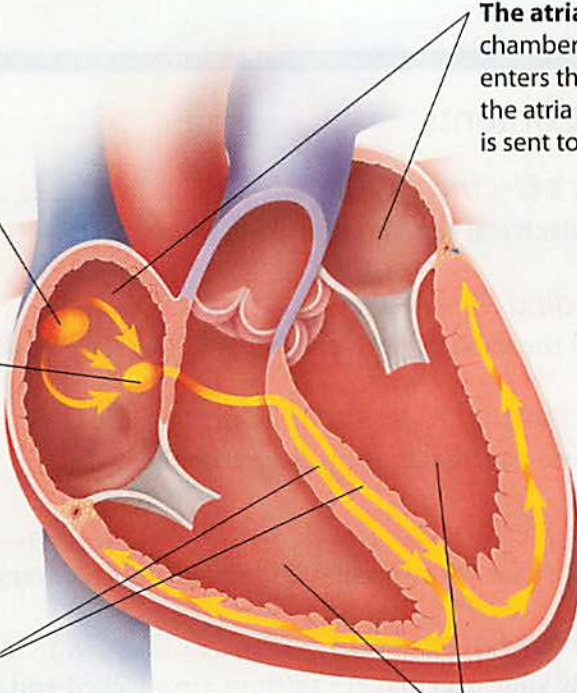
The SA (sinus) node is the heart's natural pacemaker. It starts each heartbeat by sending an electrical signal that tells the atria to contract.

The AV node receives the signal from the SA node after it passes through the atria. It then guides the signal to the ventricles.

The bundle branches are pathways of cells that carry the signal through the ventricles. As the signal moves through the ventricles, they contract.

The atria are the upper chambers where blood enters the heart. When the atria contract, blood is sent to the ventricles.

The ventricles are the heart's lower chambers. They contract to pump blood out of the heart.



Problems with Electrical Signals

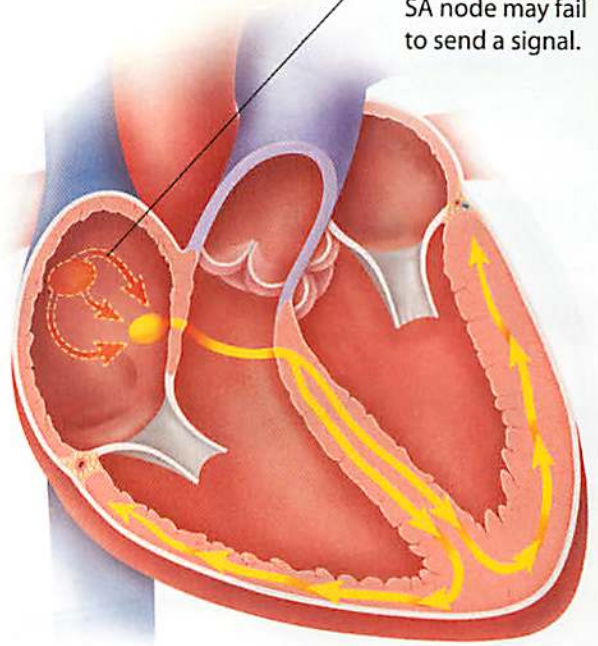
A slow heartbeat is often due to problems with the SA node or AV node. In some cases, the heartbeat is slow only once in a while. In others, the heart may beat slowly all the time. And sometimes the heart fails to raise the heart rate during increased physical activity. If either of the nodes fails to send a signal, the heart may go into an “escape rhythm.” This means it continues to beat, but at a slower and less reliable pace.

Sick Sinus Syndrome

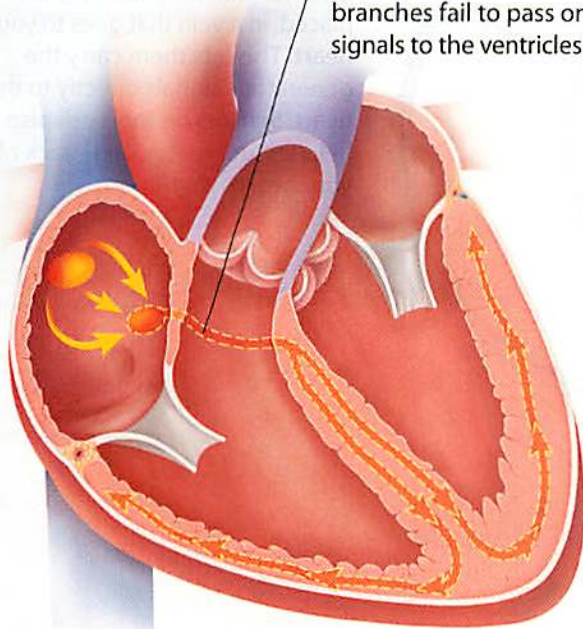
The main problem that affects the SA node is called sick sinus syndrome. It can cause any of the following:

- **Sinus bradycardia** occurs when the SA node sends out signals too slowly.
- **Sinus pause** occurs when the SA node fails to send a signal. Without a signal, the atria don't contract.
- **Tachy-brady syndrome** occurs when the SA node sends out signals that cause the heartbeat to alternate between very fast and too slow.

With sick sinus syndrome, the SA node may fail to send a signal.



With heart block, the AV node or bundle branches fail to pass on signals to the ventricles.



AV Block (“Heart Block”)

Heart block occurs when the AV node has problems passing on electrical signals to the ventricles. It can be caused by problems with either the AV node or the bundle branches. If the ventricles don't receive a signal, they don't contract. This may happen only once in a while. Or, the signal may be blocked all the time.

Understanding Pacemakers

A pacemaker is a small, lightweight electronic device that helps correct a *slow* heartbeat. It does this using a tiny computer to send electrical signals to your heart. The signals tell the chambers in your heart when to contract. This keeps your heart beating at the right pace. Sensors in the pacemaker also keep track of your activity level and can adjust the signals as needed.

The Parts of a Pacemaker

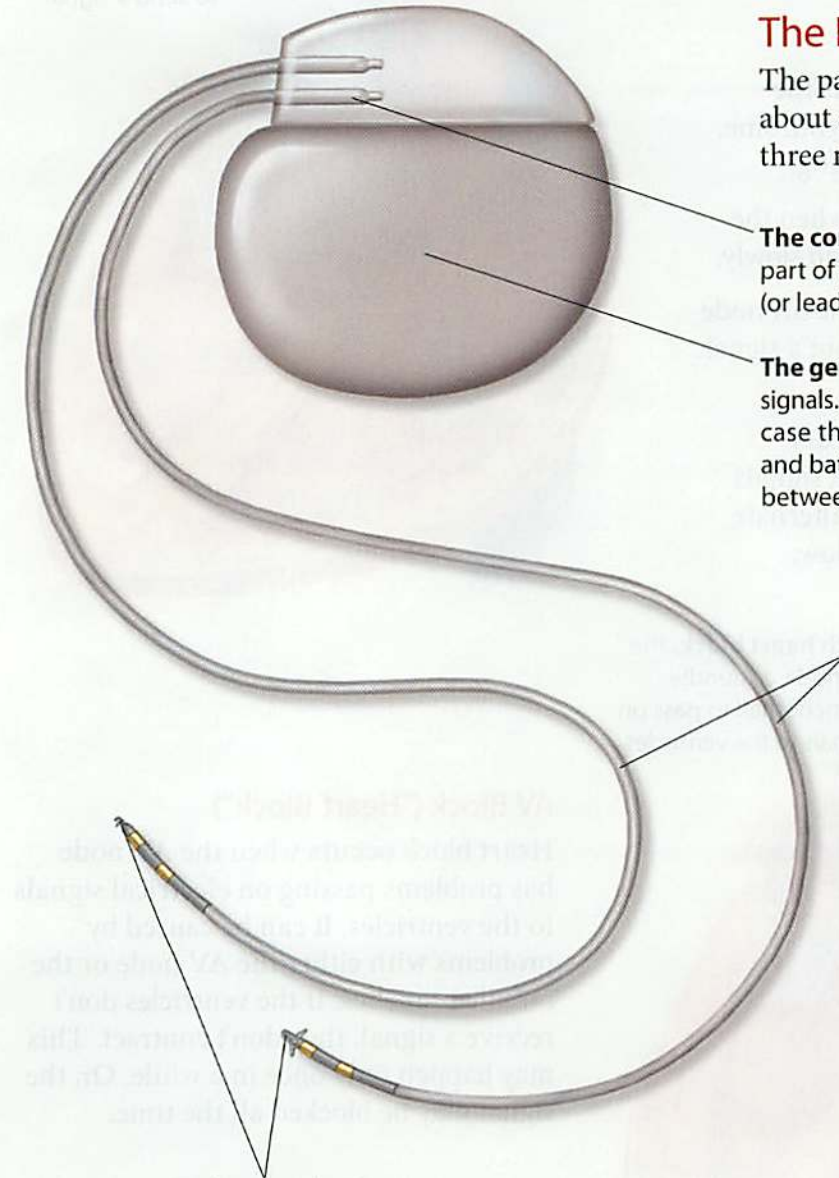
The pacemaker at left is shown about actual size. Below are the three main parts:

The connector or "header" is the part of the generator where the lead (or leads) are attached.

The generator sends out electrical signals. It has a smooth, lightweight case that contains a tiny computer and battery. It is placed in a "pocket" between your skin and chest muscle.

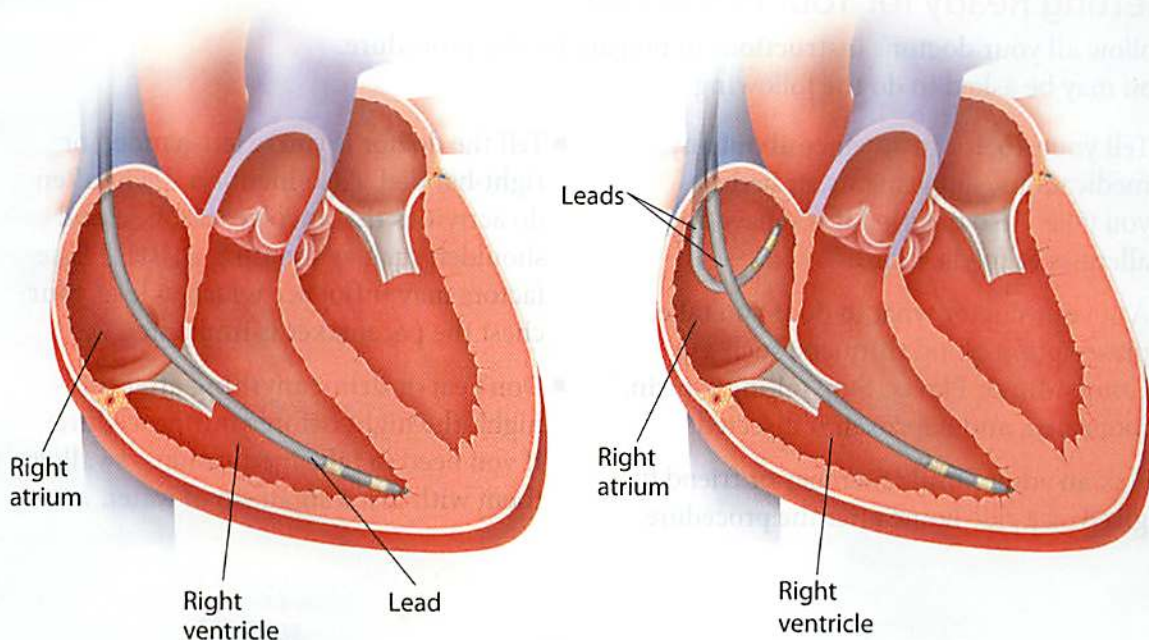
Leads are wires covered by soft, flexible material. They are placed in a vein that goes to your heart. This lets them carry the generator's signals directly to the heart. Sensors on the leads also help the generator keep track of your heart's rhythm.

Anchors on the tips of the leads attach the leads to the heart muscle.



Types of Pacemakers

Your doctor will choose the type of pacemaker that's best suited for your condition. All pacemakers have the same basic design. The main difference is the number of leads that go to the heart. Most pacemakers have one or two leads. If you have a condition called advanced heart failure, you may be given a pacemaker with two or three leads (called a biventricular pacemaker).



A single-chamber pacemaker has one lead. The lead is usually attached to the right ventricle (the exact placement inside the ventricle may vary).

A dual-chamber pacemaker has two leads. One attaches to the right atrium. The other attaches to the right ventricle. Having two leads helps coordinate the signals that tell these chambers when to contract.

How a Pacemaker Adapts to Your Needs

When you're active, your heart beats at a faster pace to meet the body's need for more blood and oxygen. However, problems with the heart's electrical system can prevent the heart from speeding up. To fix this problem, all pacemakers have a **rate-responsive** feature. This means they can automatically adjust your heart rate as needed. The pacemaker speeds up when you're active, and returns to a normal pace when you're resting.

The Implantation Procedure

Placing a pacemaker inside the body is called **implantation**. This is not the same as open heart surgery. Instead, it's a relatively minor procedure done in an operating room or cardiac catheterization lab. A pacemaker can be implanted in either side of the chest, but is most often placed on the left side. The procedure usually takes 1 to 2 hours.

Getting Ready for Your Procedure

Follow all your doctor's instructions to prepare for the procedure. You may be asked to do the following:

- Tell your doctor in advance about any medications, supplements, or herbs you take. Also mention if you have any allergies to medications.
- Ask your doctor what to do if you take prescription blood thinners, such as Coumadin or Plavix. Stop taking aspirin, ibuprofen, and naproxen if directed.
- Ask an adult family member or friend to give you a ride home after the procedure.
- Tell the doctor if you're left-handed or right-handed. Also mention if you often do activities that involve the chest and shoulder, such as shooting a rifle. These factors may influence which side of your chest the pacemaker is implanted in.
- Don't eat or drink anything after midnight, the night before your procedure. If you need to take medications, swallow them with just a small sip of water.

Before Implantation

On the day of your procedure, be sure to arrive at the hospital on time. Here's what to expect:

- You'll be asked to sign some forms and change into a patient gown.
- You'll be given an IV to provide fluids and medication. You may also be given medication to help you relax.
- The skin where your pacemaker will be implanted is washed and may also be shaved.

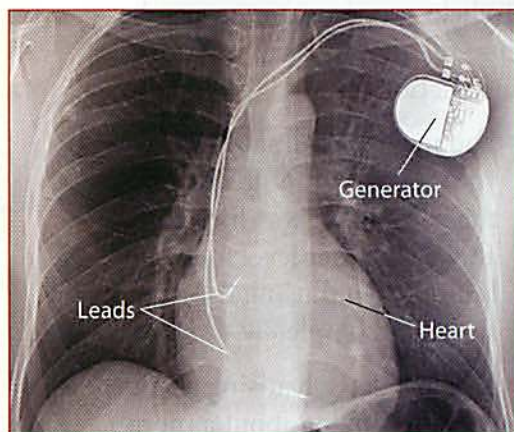
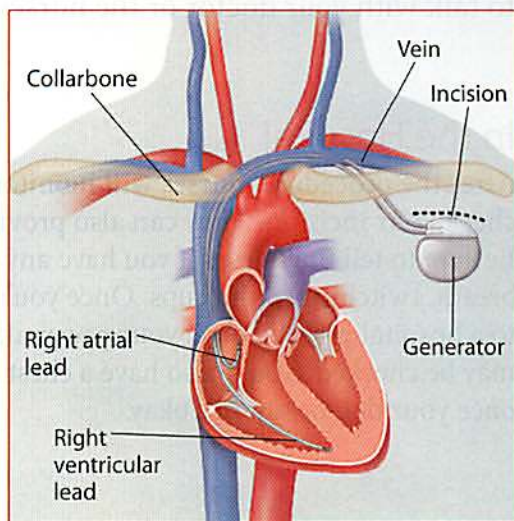


Your doctor or other specialist will talk with you about the pain medications used during the procedure.

During the Procedure

The most common method for implanting a pacemaker is called endocardial (“inside the heart”) implantation. This means that the leads run directly from the generator to the inside of your heart. In rare cases, the leads are attached to the outside of the heart. To implant the pacemaker:

- **Medications are given** to prevent pain. A local anesthetic is used to numb the site where the pacemaker is implanted. You may also be given medications to help you relax or sleep.
- **An incision is made** beneath your collarbone. A small “pocket” for the generator is then created. The incision also lets your doctor access a vein that leads to your heart.
- **The leads are guided through a vein** into your heart. An x-ray monitor helps your doctor guide the leads into place.
- **The leads are attached to the heart** using small anchors on the tips of the leads. Electrical measurements are done to find the best area for placement.
- **The generator is attached to the leads.** Once the leads are secure, the generator is placed in the pocket beneath your skin.
- **The incision is closed** with sutures, surgical glue, or staples. You’ll then be taken to a recovery area.



X-ray showing an implanted pacemaker.

Risks and Complications

Although complications are rare, implantation does have certain risks:

- Bleeding
- Infection or nerve damage at the incision site
- Severe bruising or swelling at the incision site
- Puncture of the lung or heart muscle
- Tearing of the vein or artery wall
- Clotting or air bubbles in the vein
- Heart attack, stroke, or death (very rare)

After the Procedure

In most cases, you'll stay in the hospital overnight after your procedure. Before you go home, you'll receive discharge instructions. These tell you how to care for your incision. They also list precautions that will help protect your pacemaker as you heal. If you have any questions, be sure to talk with your doctor or the nurses.

In the Hospital

After the procedure, nurses will monitor your heart signals and check your incision. They can also provide medications for pain. Be sure to tell the nurses if you have any chest pain, shortness of breath, twitching, or hiccups. Once you're stable, you'll be moved to a hospital room. There, your pacemaker's functions and settings may be checked. You'll also have a chest x-ray. You can go home once your doctor says it's okay.

Recovering at Home

To help speed your recovery, be sure to follow all your doctor's instructions.

- You may be told not to raise your arm (on the side where the pacemaker was implanted) above shoulder level for a time. But don't stop using the arm or shoulder completely.
- You may have bruising at the incision site for about a month. This is normal. It will go away as the incision heals.
- You can often get back to your normal routine soon after implantation. Ask your doctor when you can return to work.
- You may be instructed not to drive for a certain amount of time. Your doctor will tell you more about this.



If directed, avoid raising your arm above your shoulder at first. Ask family members for help reaching high shelves.

Caring for Your Incision

It's normal to have some pain and stiffness around your incision for a few days. Over-the-counter pain medications can often help. If needed, your doctor may also prescribe pain medications. To care for the incision, use these tips:

- Change or remove the dressing as instructed by your doctor.
- Keep the incision clean and dry. You may be told to take sponge baths at first. You can begin showering when your doctor says it's okay.
- Don't scrub the incision as you bathe. Also, don't let water spray directly on the incision.
- Pat the incision dry. Don't use lotion, ointment, or powder on the incision while it heals.
- Call your doctor if you notice any changes in the incision, such as signs of infection (see below).



Check your incision each day for changes. Call your doctor if you notice any signs of infection (see below).

When to Call Your Doctor

Call your doctor if you have any of the following after your procedure:

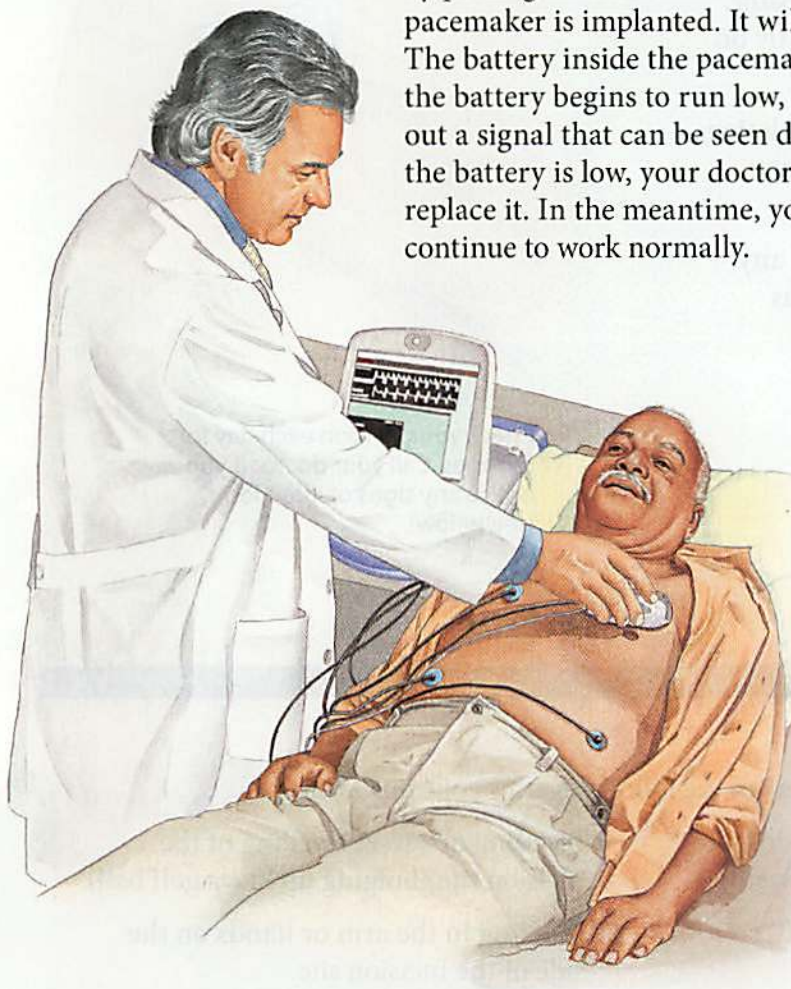
- Signs of infection at the incision site, such as increasing redness, swelling, warmth, or drainage
- Fever over 100°F (37.7°C)
- Pain around your pacemaker that gets worse, not better
- Chest pain or shortness of breath
- Bleeding or severe swelling of the incision site (bulging up like a golf ball)
- Swelling in the arm or hands on the side of the incision site
- Twitching chest or abdominal muscles
- Frequent or constant hiccups

Checking Your Pacemaker

To ensure your pacemaker is working well, you'll need to visit your doctor or pacemaker clinic a few times each year. During these visits, the pacemaker's functions and battery level are checked. If needed, your pacemaker's settings can also be adjusted. This helps fine-tune the signals so the pacemaker is always doing its best for your heart.

Seeing Your Doctor

During office visits, your doctor will check information that's stored on your pacemaker's computer. This is done by placing an electronic wand over the skin where the pacemaker is implanted. It will not cause any pain. The battery inside the pacemaker is also checked. If the battery begins to run low, the pacemaker sends out a signal that can be seen during these tests. And if the battery is low, your doctor will schedule a time to replace it. In the meantime, your pacemaker will still continue to work normally.



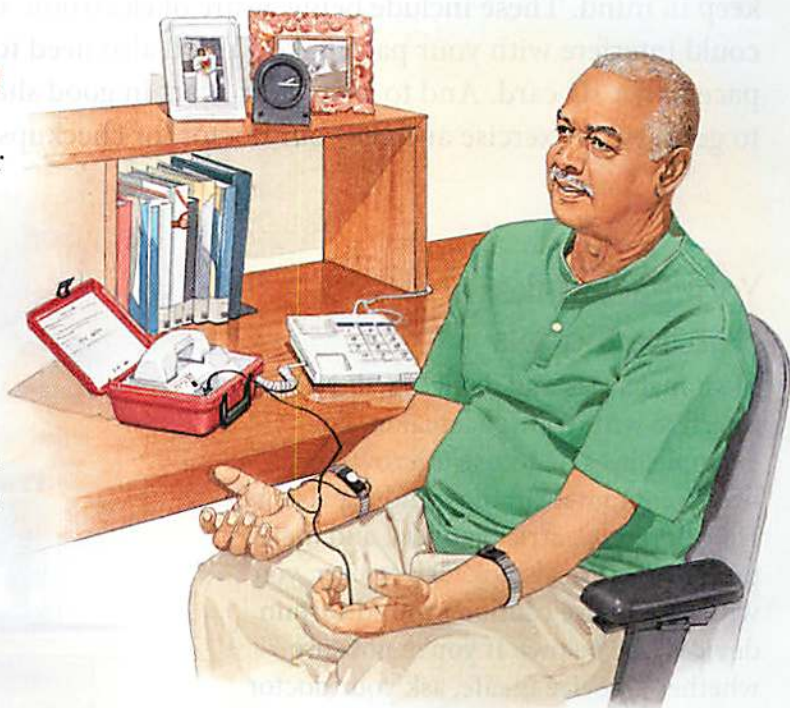
Making Adjustments

Over time, your pacemaker's settings may need to be adjusted. This is done using a process called "programming." Be sure to tell your doctor how the pacemaker is working for you. Are you able to do all the activities you want? Do you often feel tired? To adjust the settings, your doctor uses an electronic wand that is placed over your pacemaker. Radio signals from the wand give the computer inside your pacemaker the new settings.

Pacemaker adjustments are made painlessly from outside your body.

Checking Your Pacemaker from Home

In certain cases, your doctor may recommend checking your pacemaker from home. To do this, you use a device that lets you send signals from your pacemaker over the phone. Your doctor or a technician then reviews this information and decides if your pacemaker settings need to be adjusted. Be aware, though, that this service is not available in all areas.



How Long Will My Pacemaker Last?

Pacemakers are very reliable. The batteries usually last 5 to 10 years. In rare cases, the leads may also wear out and need to be replaced.

Replacing the Battery

Your pacemaker's battery is sealed inside the generator. So replacing the battery also means replacing the entire generator. This is done with a procedure that is simpler and shorter than the initial implantation. Once the old generator is removed, the new generator will be placed in the same "pocket" in your chest. You can go home the same day.

Replacing Leads

To replace leads, you'll have a procedure that is very similar to the one used to implant the pacemaker. In some cases, though, the new leads may need to be placed in a different vein on the opposite side of the chest. This means that the generator will also have to be moved to the opposite side of the chest.

Living with a Pacemaker

Living with a pacemaker isn't hard. It's safe for you to do almost any activity you like. There are a few things, though, that you'll need to keep in mind. These include being aware of electronic signals that could interfere with your pacemaker. You'll also need to carry a pacemaker ID card. And to keep your heart in good shape, be sure to get regular exercise and see your doctor for checkups.

Your Pacemaker and Outside Signals

Most machines and devices will NOT interfere with your pacemaker. For example, it's safe to use microwave ovens, computers, radios, and televisions. Hair dryers, electric blankets, and most power tools are also okay. However, you will need to use caution around certain devices (see below). If you're not sure whether a device is safe, ask your doctor or call the pacemaker manufacturer.



Using a microwave oven will not interfere with your pacemaker.

Signals That Can Cause Problems

A few things can create signals that may interfere with your pacemaker. In general, these signals won't permanently damage your device—or harm your heart. You should contact your doctor, though, if any of following cause symptoms:

- **Cellular phones** should be kept 6 inches away from your generator (indoor cordless phones are okay). As you talk, hold the cell phone to the ear on the opposite side of your pacemaker. Carry the phone on the opposite side as well.
- **Electromagnetic anti-theft systems** are often located near store entrances and exits. Walking through one is okay. But avoid standing or leaning against one.
- **Very strong magnets** should be avoided. Never have an MRI test (which uses strong magnets). You should also avoid standing near large speakers, such as those used for music concerts.
- **Strong electrical fields** can be created by radio towers and heavy-duty power equipment (such as an arc welder). Car engines also create an electrical field while they're running. So avoid leaning over the hood of a running car.

Carry an ID Card

You'll receive an ID card that contains important information about your pacemaker. (Ask your doctor if you should also wear a medical alert bracelet.) Show the ID card to any healthcare provider you visit. You may also need to show the card to security staff at times. This is because pacemakers tend to set off the security devices found in stores and libraries. Likewise, be sure to show your card to security guards at the airport. This lets them know to follow special procedures that prevent the security wand from interfering with your pacemaker.



Show your pacemaker ID card to security staff at the airport.

Exercise Regularly

Having a pacemaker doesn't mean you can't be active. In fact, you may find that exercising is even easier with a pacemaker. For best results, try to be active at least 30 minutes each day. Most activities are fine. But talk with your doctor if you play contact sports or do weightlifting. In some cases, these could damage your pacemaker. And if you're not sure where to begin, ask your doctor for advice. He or she can help design an exercise program that fits your needs.



Regular exercise is great for your heart and overall health.

Keep Seeing Your Doctor

To get the best results from your pacemaker, keep seeing your doctor for regular checkups. These let your doctor review your heart's electrical activity. They also make sure the pacemaker is doing all it can for your heart. And if you have any symptoms that concern you, be sure to give your doctor a call.

Feeling Good Again

A pacemaker is a small device, but it can make a big improvement in how you feel. By keeping your heart beating at the right pace, a pacemaker can allow you to be more active. It can also help you feel more confident about your heart and your health. This makes it easier to focus on the things in life that mean most to you.



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