Keeping all appointments with your doctor is the best way to ensure your pacing system is delivering the best therapy for your heart's needs.

Q When are leads replaced?

A If the testing determines that there is any difficulty pacing or sensing, the doctor may choose to implant a new lead. Most times this is done at the time of a pacemaker replacement surgery, but not always.

Usually leads are not removed from the implant site when a new lead is implanted. Leaving previous leads in place is an accepted practice. If necessary, however, a lead may be removed but this may require a surgical procedure.

Q How do manufacturers ensure pacing lead performance?

A All pacing lead manufacturers use very strict standards during the lead design, manufacturing, and testing processes.

In addition, Medtronic sends physicians its Product Performance Reports periodically. These reports provide statistical performance data on both pacemakers and leads. This information helps your physician evaluate your lead's performance as well as your medical needs.

Q What kind of pacing lead or leads do I have?

A The Model numbers for your Medtronic pacing leads are printed on your ID card. They are:

Atrial:_____

and/or

Ventricular:_____

Q How can I learn more about my pacing leads?

A Your physician or cardiology nurse is best suited to answer questions about your pacemaker or leads.

Medtronic publishes a patient newsletter periodically. This newsletter contains educational articles of interest to pacemaker wearers. If you wish to receive a free subscription to this newsletter, please contact Medtronic at this address:

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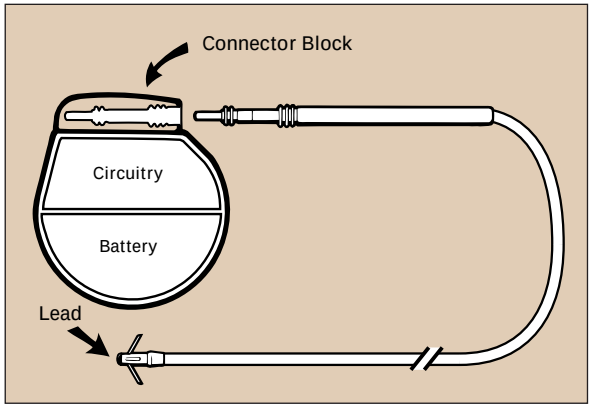
Restoring the Rhythms of Life

Common Questions About Pacing Leads

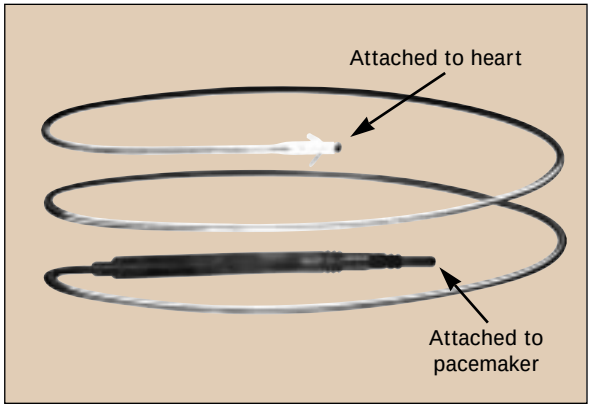
Medtronic

Q *What is a pacing lead?*

A A pacing lead and a pacemaker are the main parts of a pacing system. A pacing system can restore a healthy heart rhythm when a heart is beating too slowly or irregularly. The pacemaker consists of a battery that supplies energy for the pacemaker and electronic circuitry that transforms the energy into small electrical pulses. **A pacing lead** is the insulated metal wire that carries the electrical pulses from the pacemaker to the heart. The pacing lead also carries information about the heart's natural activity back to the pacemaker. From this information, the pacemaker determines if the heart is going to beat on its own or if the pacemaker must send electrical pulses to the heart to make it beat.



Battery, Circuitry, Lead

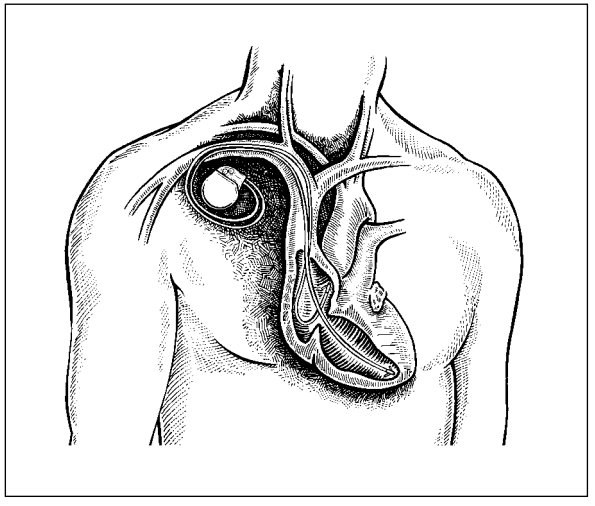


Pacing Lead

Q *How is a pacing lead implanted?*

A A lead can be implanted either by endocardial or epicardial implant. The most common method is the endocardial method which is relatively simple and can be performed under local anesthesia. The endocardial lead is inserted **into the inside of the heart via a vein**, usually in the chest area.

An epicardial lead (also called a myocardial lead) is **attached to the outside surface of the heart and requires general anesthesia.** This type of lead is most often used when other cardiac surgery is being performed and there is already access to the heart.



Endocardial Implant with Two Leads

Q *What is the useful life of a pacing lead?*

A It depends. Leads may need to be replaced sooner in some patients than in others. Leads must withstand the flexing motion that occurs each time the heart beats. A pulse rate of 70 beats per minute equates to over 100,000 heartbeats daily. The patient's heart condition, medical complications, anatomical differences and surgical technique can affect the lead's longevity.

Q *How is the performance of a pacing lead tested?*

A An electrocardiogram (ECG) is one way to check the pacing lead. An ECG shows if the lead is **sensing** (receiving information via the lead from the heart), and **pacing** (delivering the electricity from the pacemaker) the heart appropriately. Other testing can also be performed in the doctor's office to check the electrical conduction of the lead.

- Large TV or radio transmitting towers and power lines carrying over 100,000 volts (maintain a distance of 25 feet between you and towers or lines)

Q *Are screening devices a concern?*

A Airport screening devices are unlikely to affect your pacemaker, but they may detect the metal housing of your device and set off the security alarm. To obtain clearance, show your pacemaker identification card, request scanning with a hand-held screening device, or request a hand search.

There are a variety of anti-theft systems used in stores and libraries. Walk normally through the theft detectors and do not linger in adjacent areas.

Q *Are medical procedures safe?*

A Always be certain to tell any medical personnel about your pacemaker. With proper precautionary measures, most medical procedures are unlikely to interfere with your pacemaker. These include:

- Diagnostic X-rays, including routine chest X-rays, dental X-rays, and mammography. Mammograms require a tight enclosure of the breast by X-ray equipment and adjustments that lessen pressure on the pacemaker implant site are sometimes used to make the patient more comfortable.
- Dental procedures, including the use of dental drills and ultrasonic probes used to clean teeth.
- Therapeutic ultrasound and electrolysis, provided this equipment is not used directly over the implant site. Your technician should call Medtronic if there are questions.

Radiation therapy, Electrosurgery, Diathermy, External Defibrillation and Lithotripsy are procedures that produce high levels of EMI. A consultation with your physician will help to weigh the risks and benefits of such procedures.

Pacemakers can be reprogrammed before the procedure to lessen the chance of interfering with or damaging the pacemaker's function.

Warning: Magnetic Resonance Imaging (MRI) is not recommended for pacemaker patients.

Q *How can I learn more about my pacemaker?*

A Your physician or cardiology nurse is best suited to answer questions about your pacemaker.

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Restoring the Rhythms of Life

Common Questions About Electrical Interference and Your Medtronic Pacemaker

Medtronic

Q *What is EMI?*

A Things that use electricity and magnets have electromagnetic fields around them. These fields are usually weak and will not affect your pacemaker. However, **strong** electromagnetic fields have the potential to alter the function of your pacemaker. This is called EMI (electromagnetic interference). A strong magnetic field can "blind" the pacemaker to your heart rhythm and keep the pacemaker from treating you, or cause your pacemaker to send pacing beats when your heart does not need it. If you move away from the source of EMI, your Medtronic pacemaker will return to normal.

There are several safeguards built into your Medtronic pacemaker including electronic filters that differentiate between natural heartbeat signals and EMI signals, and the metal housing surrounding the pacemaker's battery and circuitry.

It is important to know which EMI sources do and do not affect your pacemaker.

Q *Are household appliances safe?*

A Properly maintained electrical household items are unlikely to interfere with your pacemaker. Safe appliances include:

- Microwave ovens
- Televisions, radios, video games, C-D players, stereos (see precaution for large speakers)
- Electric blankets and heating pads
- Tabletop appliances such as toasters, blenders, electric can openers, food processors
- Handheld items such as home (and salon) hair dryers, shavers
- Large appliances including washers, dryers, electric stoves
- Vacuum cleaners, electric brooms
- Outdoor equipment such as electric hedge clippers, leaf blowers, lawn mowers, snow blowers. (If gas powered, see precautions under automobile engine).

Remember, all household equipment should be kept in good repair. Proper maintenance greatly reduces the chance of electrical interference.

Q *May I use a cellular phone?*

A Cellular phones are unlikely to interfere with your pacemaker if proper precautions are followed:

- A distance of at least 6 inches should be maintained between a cellular phone and your pacemaker.
- When using a cellular phone, you should hold it to the ear opposite the side of the body in which the pacemaker is implanted.
- When set to receive calls, a cellular phone should not be carried in a pocket on the same side as the pacemaker.

For portable and mobile phones (phones transmitting above 3 watts), maintain a distance of at least 12 inches between the base of the antenna and the pacemaker and follow the above precautions as well.

Q *Can I use power tools safely?*

A Generally, yes. However, it is very important to remember the following guidelines:

- Keep all equipment in good condition to avoid electrical shock.
- It is best not to operate power tools alone.
- Be certain that the tool is properly grounded. If you use power machinery frequently, a ground fault interrupt system would be a wise investment. This inexpensive device is a good safety measure because it prevents a sustained electrical shock.
- Avoid using any power tool locked in the "on" position.
- Avoid using a chain saw because your hands and body come into close contact with the electric spark generating components, and the chain saw may cause bodily harm if you lose control of the saw.

Q *Can I work on an automobile engine safely?*

A Caution is necessary when near the coil, distributor, or spark plug cables of a running engine. Any adjustments to the distributor should be made when the engine is not running.

Q *Should I be concerned about EMI in my workplace?*

A Office and most shop equipment is unlikely to interfere with your pacemaker if it meets current electrical safety standards. This includes such items as:

- Computers, electric typewriters
- Copying machines, FAX machines
- Small wood- and metalworking shop tools

If you work in a heavy industrial environment, it is best to ask the advice of your physician about the possible risk of EMI. Some probable sources of EMI include:

- Electric arc welding equipment
- Dielectric heaters, used in industry to bend plastic
- Electric steel furnaces
- Large generators and power plants
- Large magnets, such as those used in some stereo speakers
- Antennas used to operate CB or ham radios and other radio transmitters

Q *How can I learn more about my pacemaker?*

A Your doctor or cardiology nurse is best suited to answer your questions about your medical condition.

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Restoring the Rhythms of Life

Medtronic Patient Registration and Your Identification Card

Medtronic

Q *Does my pacemaker need to be registered?*

A Yes, if the implant was done in the United States. The Food and Drug Administration (FDA) Device Tracking Regulation says that certain implantable medical devices must be tracked from the manufacturer to the attending physician and patient. This enables manufacturers to notify your physician of any relevant information concerning its devices.

Q *How is my pacemaker registered?*

A The process begins at the time of surgery when a registration form is completed and sent to the manufacturer. At Medtronic, the registration information becomes part of a computer database that is continually updated to ensure the information is accurate and current.

Q *What information is on the registration form?*

A It includes:

- model and serial numbers of devices
- your name, address, and phone number
- your social security number, if available
- date your device was implanted
- the hospital where the implant was performed
- the implanting doctor's name, address, and phone number
- your attending doctor's name, address, and phone number

Q *Why do you need my social security number?*

A It is a key piece of information and enables us to locate your address if for some reason we lose touch with you.

Q *Is my registration information confidential?*

A Yes. It is used for tracking your medical devices.

Q *What happens if I move or change doctors?*

A Please notify us as soon as possible. Your cooperation in keeping your information current will help us to better serve you and your doctor. Medtronic has a special patient toll-free telephone line for your convenience. It is 1-800-551-5544. If you prefer writing, our address is:

Medtronic, Inc.
Patient Registration, T140
P.O. Box 1399
Minneapolis, MN 55440-9048

Q *When do I receive my ID card?*

A After the registration information is in our database, a plastic identification (ID) card is mailed to you. The ID card lists your name and address, the model and serial numbers of your pacemaker and leads, the implant date, and your attending physician's name and telephone number. The card has a picture of an implanted pacemaker as well.

Your ID card is especially helpful if you are a pacemaker patient who travels by air. Although airport screening devices are unlikely to interfere with your pacemaker, they may detect the metal housing and set off the alarm. Therefore, it may be necessary to present your identification card to airline personnel to obtain clearance.

Q *Should I carry my identification card all the time?*

A Yes. Your ID card is designed to be carried with you so that this pertinent information about you, your pacemaker, and your physician is available quickly if there is a situation that requires medical care.

If you do not have your card, your physician or nurse can call Medtronic or the Medical Records Department of the hospital where the implant took place for the information. Call Medtronic later for a replacement card.

The six-language card (English, French, German, Spanish, Italian, and Japanese) below may help you when you are traveling overseas. Use it with your ID card to clear airport security.

I have an implanted heart pacemaker that may set off your metal detection device.

Je suis porteur d'un stimulateur cardiaque qui pourrait declencher votre détecteur de métaux.

Ich trage einen implantierten Herzschrittmacher, der Ihren Metalldetektor auslösen kann.

Ho un cardiostimolatore impiantato che potrebbe attivare il vostro rivelatore di metalli.

Tengo implantado un marcapaso cardíaco que puede activar el detector de metales.

私は、金属探知機に反応することのある体内植込型心臓ペースメーカを装着しています。

Pacemaker Sensing Check

Besides pacing your heart, your pacemaker monitors your natural heart rhythm (**sensing**) by receiving the electrical signals generated by a naturally occuring heart beat. Therefore, the pacemaker's able to help your heart when it is **not** beating normally, and leave your heart alone when it **is.**

During the pacemaker check-up, sensing is verified in either the atrium **or** ventricle for single chamber pacemakers, or both the atrium **and** the ventricle for dual chamber pacemakers.

Programming Check

The physician or technician check other program settings of your pacemaker. If your physician determines it is beneficial, your pacemaker settings can be changed by the programmer to address changes in your lifestyle or your medical condition.

Some pacemakers have rate responsive sensors that respond to changes in your body indicating a need for a faster heartbeat. If you have a rate responsive pacemaker, you may be asked to perform a physical activity to check the pacemaker's program settings and the pacemaker's ability to achieve higher **paced** heart rates.

The periodic comprehensive in-office pacemaker check is best suited to determine if your pacemaker is programmed for delivering the best therapy for you.

Q How can I learn more about my pacemaker?

A Your physician or cardiology nurse is best suited to answer questions about your pacemaker.

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Restoring the Rhythms of Life

Common Questions About Pacemaker Monitoring

Medtronic

Q *What is pacemaker monitoring and why is it important?*

A Pacemaker monitoring checks the many elements involved in pacemaker performance including the pacemaker's program settings, interaction with your heart, and battery status.

Pacemaker monitoring relies primarily on **Electrocardiogram (ECG)** testing. An ECG records the electrical activity of both your heart and pacemaker. An ECG can be done in the doctor's office, a hospital pacemaker clinic, or over the telephone.

Q *How often should my pacemaker be monitored?*

A **This is determined by your physician**. Your monitoring schedule will vary depending on the type of pacemaker you have, your medical condition, and the usual practice of your pacemaker clinic or doctor's office. Usually a pacemaker monitoring schedule is set up during your first visit to your doctor following the implantation of your pacemaker.

The frequency of monitoring will change during the lifetime of your pacemaker with more frequent checks as it nears its expected replacement time.

Q *What is telephone monitoring?*

A It is a convenient method of transmitting an ECG by telephone. Your ECG is picked up and sent through a special telephone transmitter. It converts your pulse and pacemaker data into a signal that is recorded by an ECG receiver in the monitoring technician's office. Your ECG is analyzed by the monitoring technician and then is sent to your physician.

Telephone monitoring may be provided by a trained technician or nurse in your physician's office or pacemaker clinic, or may be provided by a monitoring service company. The monitoring expense is usually submitted to the patient's insurance company.

If telephone monitoring is selected for you by your physician, a **prescription** will be written for the frequency of the monitoring. A monitoring schedule is then set up by the monitoring service and you will be phoned at scheduled times for an ECG transmission.

Your physician or monitoring service will arrange for you to receive the necessary equipment for telephone monitoring.

Q *Will my pacemaker be checked in the doctor's office and, if so, what may I expect?*

A In addition to regular pacemaker monitoring, a comprehensive office pacemaker check is usually done once a year for patients with single chamber pacemakers, and twice a year for patients with dual chamber pacemakers. This thorough office visit provides a more detailed analysis of your pacemaker's operation. The testing uses a piece of equipment called a **programmer**. The **programmer wand** is held over the skin of the pacemaker site. The programmer then receives information from the pacemaker.

A comprehensive in-office pacemaker check usually lasts about an hour or less. Typically you may expect the following:

ECG Recordings

As in pacemaker monitoring, an ECG will be recorded and interpreted by the technician or physician.

Magnet Check

A programmer magnet may be applied over your pacemaker causing it to pace at a set rate that disregards your heart's natural beat. During the magnet check, the technician can check some of the program settings of the pacemaker and the status of the pacemaker battery. **Not all pacemaker patients will have a programmer magnet applied.**

Thresholds Check

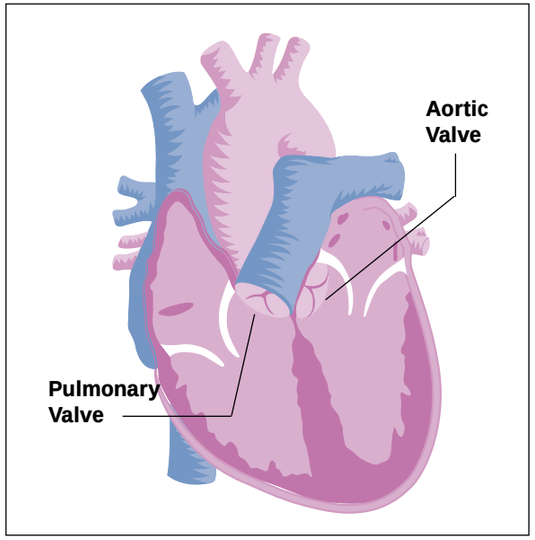
Another element of a comprehensive visit is the determination of **stimulation thresholds.** Stimulation threshold is the least amount of energy (battery power) necessary to make your heart beat consistently.

During a pacemaker check, either or both the **voltage** (amplitude of electrical stimulus) or the **pulse width** (duration of electrical stimulus) is lowered until the stimulation threshold is reached. Your pacemaker's voltage and pulse width settings are typically then reset at 2 to 3 times the measured stimulation threshold.

An appropriate stimulation threshold is important for consistent pacing, and to maximize the pacemaker's battery life.

The Semilunar Valves

Just like the AV valves, there are two semilunar valves. The **aortic valve** is located at the junction of the left ventricle and the aorta, the largest blood vessel in the body. The blood flows through the aortic valve into the aorta and then on to the rest of the body. The **pulmonary valve** is located at the junction of the right ventricle and the pulmonary arteries and allows the blood to flow toward the lungs. After blood is pumped forcefully by the ventricles through the semilunar valves out of your heart and into the arteries, the semilunar valves close to prevent blood from flowing back into your heart.



Semilunar Valves

Q What is the function of blood vessels?

A The blood vessels — arteries, capillaries, and veins — are an extensive network of elastic tubes that carry blood to and from the heart and throughout the body. The blood vessels are the transportation system of the human body.

ARTERIES are thick, muscular tubes that carry blood away from the heart. Arteries, except for the pulmonary artery, transport blood that has just circulated through the lungs and is therefore rich in oxygen.

CAPILLARIES are tiny vessels whose walls are so thin that oxygen, nutrients, and waste products flow through them. The network of capillaries is so extensive that if they were laid end to end, they would extend about 60,000 miles. Capillaries nourish virtually every cell in the body. This is amazing when you consider that the average person has about 500 trillion cells!

After flowing through the capillaries and exchanging oxygen and nutrients for waste and carbon dioxide, the blood supply needs to be refreshed. Your blood must flow back to the heart.

VEINS, except for the pulmonary vein, are the vessels that return used blood back to the heart to begin another heartbeat cycle.

Remarkably, the heart and blood vessels circulate blood throughout the body more than 100,000 times per day!

Q How can I learn more about my heart?

A Your physician or cardiology nurse is best suited to answer your questions about your heart.

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Restoring the Rhythms of Life

The Function of the Heart and Circulatory System

Medtronic

Q *What is the circulatory system?*

A Your **circulatory system** ensures every cell in your body receives a constant supply of blood. The blood delivers nutrients and oxygen to your cells, and removes waste products and carbon dioxide. The **heart** ensures that blood flows constantly by pumping it through the **blood vessels.** Blood vessels are tubes of all different sizes that transport blood to and from the heart. Together, the heart and blood vessels make up the **circulatory system.**

Q *What is the heart's function?*

A The function of the heart is simple. It keeps blood circulating throughout the body by:

- Pumping blood through your **lungs** to make certain that the blood supply is constantly refreshed with oxygen and carbon dioxide is removed, and
- Pumping blood through your **body** to meet its demand for oxygen and nutrients.

The heart is an amazing pump. An average person has 40 million heartbeats a year. Through powerful contractions (heartbeats) the heart circulates your entire blood supply each and every minute. It is very sensitive to your body's needs, adjusting its rate of pumping to the demand of your body's cells. For example, with a faster heart rate during strenuous exercise, the heart can increase the amount of blood up to four times the amount it pumps at rest, within only a matter of seconds.

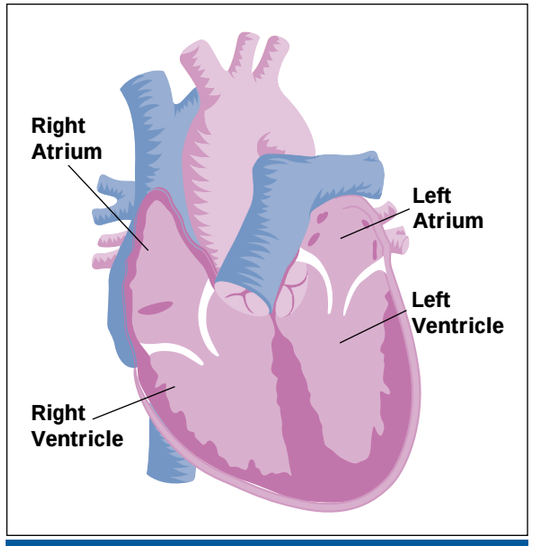


Diagram of the Heart showing blood flow

Q *How is the heart structured?*

A The heart is a hollow, muscular organ, about the size of your fist and weighing approximately one pound. It is located behind and slightly to the left of the breastbone.

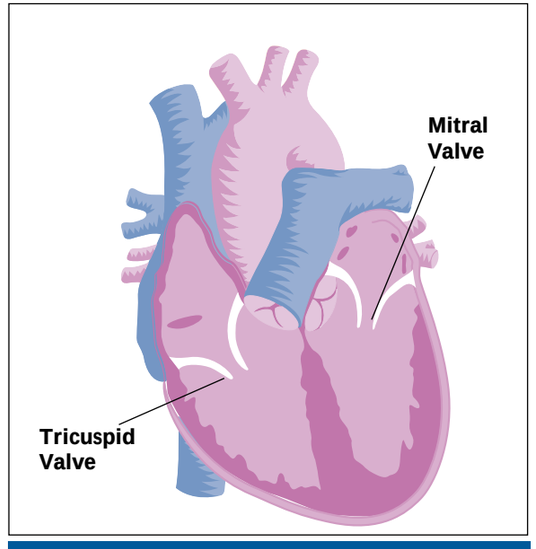
The heart has a muscle wall that separates it into a left and right side. The left and the right sides are further divided horizontally. This creates four separate heart **chambers.** The two upper chambers are the atria (**right atrium** and **left atrium**) and the lower chambers are the **right ventricle** and the **left ventricle.**

Q *How does the blood flow through the heart?*

A The right half of the heart circulates blood through the lungs to be refreshed with oxygen. Then the oxygen-rich blood returns to the left half of the heart and is pumped to the rest of the body.

The Atria

Oxygen-rich blood returns from the lungs and flows into the left atrium. At the same time, oxygen-depleted blood returns from the rest of the body and flows into the right atrium. When the atria are filled, the blood is released by the **atrioventricular valves** to allow the blood to proceed to the ventricles.



Atrio ventricular valves

The Atrioventricular (AV) Valves

The AV valves are located between the atria and the ventricles. All heart valves have either two or three flaps of tissue, called **leaflets,** which open and close. Healthy valve leaflets ensure that blood flows in only one direction through the heart. The closed AV valves prevent blood from flowing backward into the atria when the heart beats.

The AV valve between the right atrium and right ventricle is called the **tricuspid valve.** The AV valve between the left atrium and left ventricle is called the **mitral valve.**

The Ventricles

The two heavily muscled lower chambers of the heart are the right ventricle and left ventricle. The right ventricle pumps blood through the lungs where it is replenished with oxygen. The left ventricle pumps blood already full of oxygen through the arteries to the rest of your body.

When the ventricles are nearly full, the AV valves close and the rising pressure inside the ventricle quickly causes two other heart valves to open. These are the **semi-lunar valves,** located at the junction of the ventricles and the great arteries.

Q *How do dual chamber pacemakers function?*

A Dual chamber pacemakers typically use two leads, one placed in the right atrium and the second one placed in the right ventricle. The electrical pulses delivered to the heart are timed so that the atria are stimulated to contract just before the ventricles. The timing ensures the atria and the ventricles are beating “in sync” with one another.

Q *How do rate responsive pacemakers function?*

A Your normal heart rhythm slows down or speeds up many times during the day. The heart beats slower while you are resting or sleeping. Exercise or emotional excitement, require a greater amount of blood to be circulated and your heart beats faster. A rate responsive pacemaker uses a special sensor(s) that recognize body changes and help the heart-beat speed up. **Rate responsive pacemakers can be single chamber or dual chamber devices.**

Dual Chamber Pacemaker/Two Leads

Q *How can I learn more about the heart and pacemakers?*

A Your physician or cardiology nurse are best suited to answer questions about your heart and pacemaker.

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Restoring the Rhythms of Life

Common Questions About Pacemakers

Medtronic

Q *What is a pacemaker?*

A Pacemakers are implanted medical devices that have improved the lives of hundreds of thousands of people. Pacemakers are prescribed for people whose hearts are beating too slowly or irregularly. A pacemaker stimulates the heart muscle with precisely timed discharges of electricity which cause the heart to beat in a manner very similar to a naturally occurring heart rhythm.

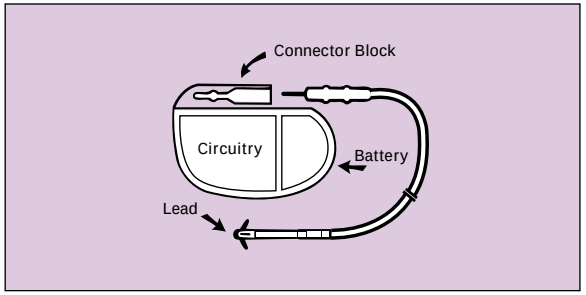
Q *What are the parts of a pacemaker?*

The Pulse Generator

The pulse generator contains a) a battery that supplies the electrical energy and b) circuitry that transforms the energy into small electrical impulses. The circuitry controls the timing of the electrical impulses delivered to the heart. In addition, the pacemaker has a connector block to attach the pacing lead(s) to the pulse generator.

The Lead

The pacing lead is an insulated wire that carries the electrical impulse **to** the heart and information about the heart's natural activity **back** to the pulse generator. One end of the lead is connected to the pulse generator at the connector block. The other end of the lead is usually inserted through a vein and placed in the right ventricle or the right atrium of the heart. One lead or two leads are used depending on the type of pacemaker prescribed by the physician.



Battery, Circuitry, Lead

Q *How does a pacemaker function?*

A There are two essential functions of a pacemaker: **pacing** and **sensing.**

Pacing is when a pacemaker sends electrical impulses to your heart to start a heartbeat. The pacemaker paces the heart when the heart's own rhythm is interrupted, irregular, or too slow.

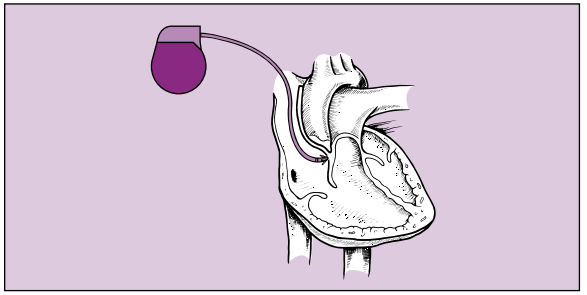
A pacemaker also has the ability to **sense** (monitor) the heart's natural electrical activity. If a pacemaker senses a natural heartbeat it will not pace the heart.

Q *Are there different types of pacemakers?*

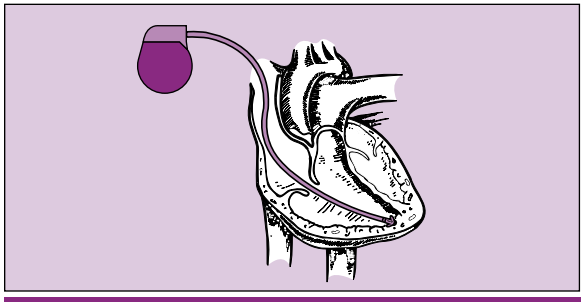
A Yes. Pacing therapy is diverse because the underlying heart conduction disorders that result in rhythm disturbances are different. The types of pacemakers available today are:

- Single Chamber Pacemakers
- Dual Chamber Pacemakers
- Rate Responsive Pacemakers

The type of pacemaker prescribed by a physician varies with the rhythm or conduction problem being treated and with the patient's lifestyle considerations.



Single Chamber Pacemaker/One Lead in Atrium



Single Chamber Pacemaker/One Lead in Ventricle

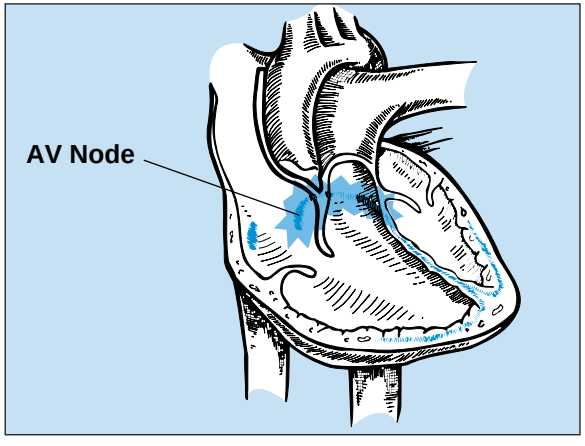
Q *How do single chamber pacemakers function?*

A A single chamber pacemaker typically uses one lead placed either in the right atrium or right ventricle to pace the heart. Single chamber pacing in the **ventricle** (lower chamber) is a common pacemaker therapy, and it is prescribed to treat a variety of conduction disorders.

Many patients are treated with atrial pacing. In this case, the lead is placed in the right **atrium** (upper chamber). The pacemaker then stimulates the atria to contract. The impulse continues to the ventricles to complete the heartbeat.

HEART BLOCK

The electrical signal from the SA node must pass through the AV node and continue on through the conduction pathways in the ventricles. The impulse may become slowed, irregular, or stopped at the AV node. This condition is called **heart block** because the electrical impulse is blocked from proceeding normally from the atria to the ventricles. Heart block is described as first, second, or third degree. How slow the ventricular rate becomes depends on the degree of heart block.



The electrical signal is slowed, stopped, or becomes irregular between the AV node and the conduction pathways in the ventricles.

Q Are there conduction disorders that result in a heartbeat that is too fast?

A Yes. Another conduction problem is **tachycardia** (pronounced tack-ee-car-dee-ah), which is an abnormally fast heart rate. In tachycardia, the heart pumps quickly but inefficiently. With tachycardia, as with bradycardia, the heart is not meeting the body's blood circulation demands. Tachycardia may originate in either the atria or ventricles and the location affects how it is treated.

Q How can I learn more about my heart and its conduction system?

A Your physician or cardiology nurse is best suited to answer questions about your heart.

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Restoring the Rhythms of Life

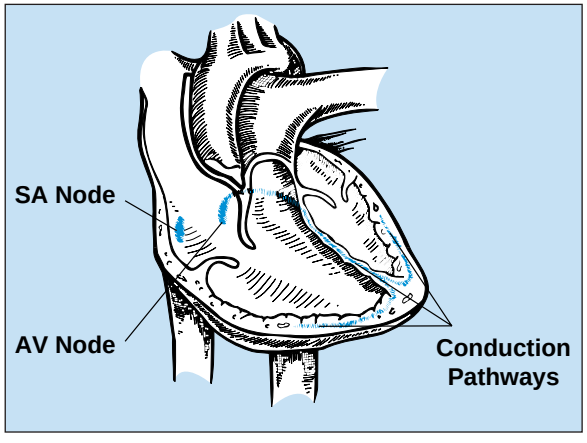
The Heart's Conduction System

Medtronic

Your heart has the remarkable ability to beat rhythmically. The healthy heart beats approximately 100,000 times a day and pumps about five quarts of blood each minute, or 75 gallons of blood every hour. Its steady rhythm sends oxygen-rich blood and nutrients to all your body's cells with every heartbeat.

Q *What makes the heart beat?*

A Your heart has its own electrical conduction system. Special tissues generate electrical signals that travel along pathways through the heart every time it beats.



The heart's electrical signal travels from the SA node to the AV node and through the conduction pathways of the heart.

THE SINOATRIAL (SA) NODE

Your heart's natural pacemaker is called the **sinoatrial** or **SA node** and is located in the upper right chamber of the heart **(right atrium).** The SA node produces very small electrical impulses which vary in rate depending upon your body's demands for oxygen- and nutrient-rich blood.

Typically the SA node initiates 60 to 80 heartbeats a minute in an average person at rest. It also responds to the need for a faster heart rate. If you are exercising or excited, your body will require greater blood circulation. A healthy SA node responds to these changes in the body and increases your heart rate accordingly.

THE ATRIOVENTRICULAR (AV) NODE

After the electrical impulse leaves the SA node, it travels through the upper half of the heart, causing the **atria** to contract, and then to a junction called the **atrioventricular** or **AV node**. From there, the impulse travels down the **conduction pathways** in the bottom half of the heart, causing the **ventricles** to contract. This synchrony of contractions forces the blood out of the heart and into the body.

If the heart's own electrical conduction signal is interrupted, delayed, or stopped, heart rhythm disturbances may result.

Q *What are the causes of heart conduction or rhythm problems?*

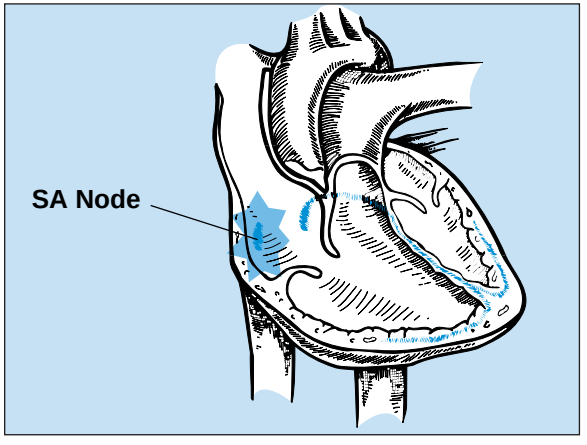
A There are many reasons why a heart's conduction system may become impaired. Perhaps a hereditary heart defect has affected the heart's rhythm. Certain illnesses or certain cardiac drugs may hinder the heart's naturally occurring rhythm. The conductive tissue of the heart may lose some of its ability to transmit electrical impulses because of the aging process. Sometimes a heart attack may leave scar tissue that prevents an electrical signal from proceeding through the heart. Any of these causes may result in **symptomatic bradycardia** (pronounced bray-dee-car-dee-ah). Symptomatic bradycardia is the most common reason for pacemaker therapy.

Q *What is bradycardia?*

A Bradycardia is a broad term meaning a heart rate that is too slow. Dizziness, fatigue, or fainting spells may result if your heart is unable to circulate enough blood for your body's needs.

Bradycardia may be caused by the following heart conduction problems:

SINOATRIAL (SA) NODE DISEASE



The electrical signal is stopped between the SA node and AV node.

Rhythm disorders that involve the SA node are classified under the broad term **Sick Sinus Syndrome.** If the SA node, your heart's natural pacemaker, loses the ability to initiate a heartbeat or increase the heart rate, the heart may not be able to respond effectively to the body's changing circulation demands. In response to Sick Sinus Syndrome, other tissues in the heart often take over the job of the SA node, but at an inconsistent rate or a rate that is too slow or too fast for normal activities.