

# PACEMAKER

## Why do I need a pacemaker?

- If your heart's electrical conduction is interrupted for any reason, changes in the heart rate and rhythm occur that make a pacemaker necessary.
- Pacemakers are used to treat bradycardias, that is, slow heart rhythms that may occur as a result of disease in the heart's conduction system (such as the SA node, AV node or His-Purkinje network).
- Pacemakers are sometimes also used to treat syncope (unexplained fainting spells), heart failure and hypertrophic cardiomyopathy
- The decision to use such a device, as well as which specific type, will depend upon multiple factors, including: The exact nature and underlying cause of your arrhythmia, whether the condition is temporary or permanent, the anticipated frequency of pacing, and any underlying cardiac conditions.

## What is a Pacemaker?

- When people refer to a pacemaker, they are actually discussing a pacing system, which includes the pacemaker and leads.
- A pacemaker (the generator) is the small device that is implanted under the skin, most often below the collarbone on the left or right side of your chest.
- The pacemaker continuously monitors your heart, and if it detects a slow heart rate, it sends out small undetectable electrical signals to correct it.
- The leads are thin, soft, insulated wires about the size of spaghetti noodles. The leads carry the electrical impulse from the pacemaker to your heart and relay information about the heart's natural activity back to your pacemaker.
- There may be several such wires, or leads, placed within the heart, most commonly in the right atrium and right ventricle; one type of pacemaker is "leadless" and does not have any wires.



### Types of pacemakers

The type of device chosen will be based on your personal history. There are: Biventricular Pacemaker, Single Chamber Pacer, Dual Chamber Pacer, and His Bundle or Left Bundle Branch (physiologic) Pacer.

#### Single Chamber Pacemaker

Uses one lead in the upper (1) or lower chamber (2) of the heart

#### Dual Chamber Pacemaker

Uses one lead in the upper chamber (1) and one lead in the lower chamber (2) of the heart

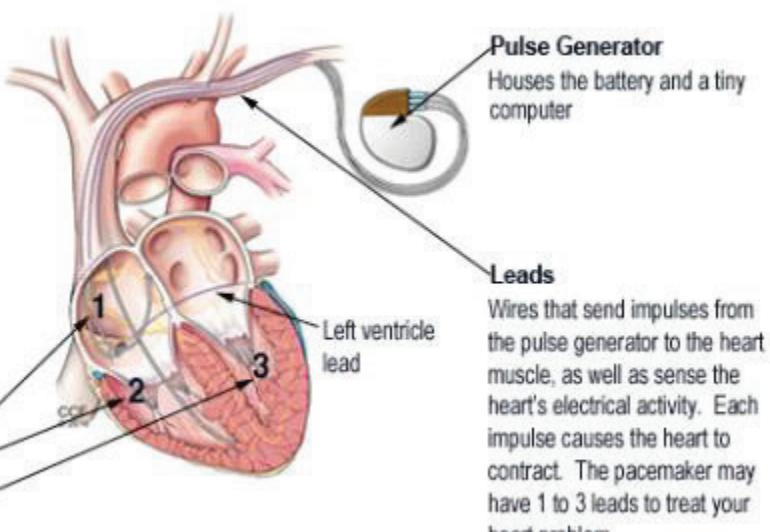
#### Biventricular Pacemaker (pictured here)

Uses three leads, placed in the:

1 Right atrium

2 Right ventricle

3 Left ventricle  
(via the coronary sinus vein)



### **Single Chamber Pacemaker**

For single chamber pacing, either the right atrium (upper chamber) or the right ventricle (lower chamber) is paced.

- Only one pacing lead is used.
- Reasons for a single chamber: generally indicated for patients with chronic atrial fibrillation with concomitant symptomatic bradycardia such as seen with AV block or complete heart block for definitive rate control measure.

### **Dual Chamber Pacemaker**

For dual chamber pacing, both the right atrium and right ventricle are paced. This requires two pacing leads.

- One lead is placed in the right atrium, and the other lead is placed in the right ventricle.
- Reasons for a dual chamber include: sinus node malfunction with either too slow heart beat or pauses, maybe useful for patients with medically refractory, symptomatic hypertrophic cardiomyopathy, and for persons with intermittent (paroxysmal) atrial fibrillation who are also experiencing sinus node dysfunction (tachy-brady syndrome) or who require AV node ablation.

### **Biventricular Chamber Pacemaker**

One lead is placed in the right atrium, other lead is placed in the right ventricle and a third lead is placed in a branch of the coronary sinus vein allowing for stimulation of the left ventricle.

- This is a variation of the standard pacemaker, used for ventricles that don't contract at the same time. This lack of synchrony between the ventricles can worsen heart failure.
- A biventricular pacemaker paces both ventricles at the same time, increasing the amount of blood pumped by the heart by increasing contraction efficiency.
- The majority of heart failure patients with slow conduction will benefit from this therapy
- This type of treatment is called cardiac resynchronization therapy (CRT).

There is also a newer, better way to achieve contraction of the ventricles. It is called His Bundle or Left Bundle Branch pacing and can be done with any of the above types of pacemakers.

### **His Bundle Pacing Background**

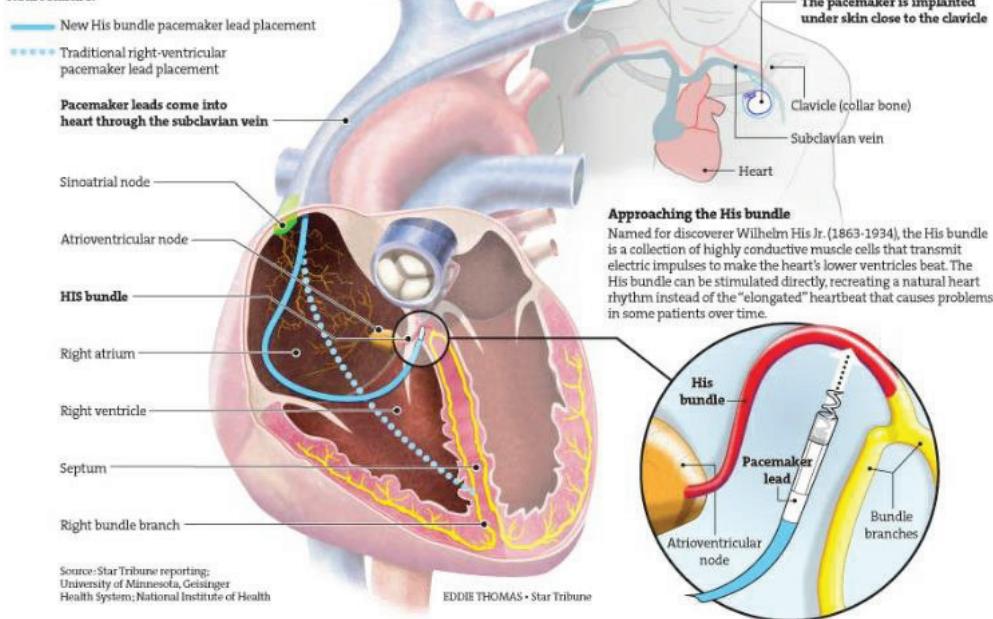
- First and foremost, it replicates human physiology.
- Traditionally, pacemakers are implanted with a lead (wire) positioned to deliver the electrical impulses to the heart's right ventricle (RV) to regulate a slow or irregular heart rhythm.
- However, long-term RV pacing creates a non-physiologic activation pattern and may lead to worse systolic (contraction) and diastolic (relaxation) function
- His bundle pacing (HBP) directly engages the His-Purkinje system (HPS), utilizing your normal and natural pacing physiology to maintain synchronous ventricular activation
- By stimulating the His-Purkinje network, HBP engages electrical activation of both ventricles and may avoid marked dyssynchrony (the difference in the timing, or lack of synchrony, of contractions in different ventricles in the heart).
- His-bundle pacing preserves synchronous ventricular activation, which could lessen ventricular dysfunction relative to RV pacing.
- Experience does matter. Although His Bundle pacing is relatively new (2016), I have performed over 150 implants implanting approximately 5 pacemakers per month using HBP technique. I am encouraged by the results seen in my patients using His-bundle pacing.

## Lead Placement

- The lead that would be intended for ventricular pacing, which would normally be placed in the right ventricle, will be placed on the lower septal part of the right atrium or in the upper septal part of the right ventricle to pace the bundle of His.
- Limitations: Permanent HBP can be challenging due to the limited availability of delivery tools, particularly in patients with an enlarged right atrium and a displaced tricuspid annular region or right pectoral implants.

## A BETTER WAY TO PACE HEART

Pacemakers restore normal heartbeats in millions of people, but the widely used technique of connecting the pacemaker wire to a spot in the lower right ventricle triggers heart failure in a surprising number of patients, recent studies show. A small-but-growing number of doctors are using a new implant technique called His bundle pacing to avoid pacing-induced problems. In His bundle pacing, the doctor puts the right-ventricular lead in the right atrium, millimeters from the heart's natural conduction system. This creates a natural heartbeat, avoiding the dyssynchrony in heart chambers that leads to pacing-induced heart failure.



## How does a Pacemaker work?

A pacemaker is designed to mimic the heart's natural pacemaker, the sinus node. The pacemaker has two main purposes — pacing and sensing.

### Pacing

- A pacemaker will send an electrical impulse to the heart when the heart's own rhythm is too slow or is interrupted. This electrical impulse starts a heartbeat.

### Sensing

- A pacemaker will also “sense” (monitor) the heart's natural electrical activity. When the pacemaker senses a natural heartbeat, it will not deliver a pacing pulse.

## **Rate**

- I also determine the minimum rate (lowest heart rate) to set your pacemaker.
- When your heart rate drops below the set rate, the pacemaker generates (fires) an impulse that passes through the lead to the heart muscle. This causes the heart muscle to contract, creating a heartbeat.
- In addition, most pacemakers have sensors that detect body motion or breathing rate, which signals the pacemaker to increase your heart rate during exercise to meet your body's increased need for blood and oxygen.

## **Risks**

Complications from having surgery to implant your pacemaker are uncommon, but could include:

- Infection where the pacemaker was implanted
- Allergic reaction to the dye or anesthesia used during your procedure
- Swelling, bruising or bleeding at the generator site, especially if you are taking blood thinners
- Damage to your blood vessels or nerves near the pacemaker
- Collapsed lung
- Life-threatening complications of pacemaker implantation are rare.

## **How is the pacemaker placed under my skin?**

### **Pre-Procedure**

- One of our nurses will take you to a procedure room and myself or one of my nurse practitioner's will discuss the procedure with you and review your medical history.
- If you are a woman of childbearing age, a urine pregnancy test will be performed.
- You will be asked to sign a consent form.
- After you change into a hospital gown, an intravenous line (IV) will be placed in your forearm. A blood pressure monitor will be placed on your arm, and ECG stickers will be placed on your chest to monitor your heart rhythm. Large sticky patches will be placed on your chest and back.

### **During the Procedure**

- You will be positioned in a comfortable upward position on the procedure bed.
- The nurses will clean the site where your device is with sterile soap and a sterile drape will be positioned from your chin to your toes.
- You will be given sedating medication through your IV. Local anesthesia will be injected under the skin where the Pacemaker will be placed.
- After you receive medication to numb your skin, I will make a 1.5-2-inch incision, usually on the left side of your chest.
- The lead(s) is inserted through the incision and into a vein, then guided to the heart with the aid of the fluoroscopy machine. The lead tip attaches to the heart muscle, while the other end of the lead (attached to the pulse generator) is placed in a pocket created under the skin in the upper chest.
- After the leads are in place, they are tested to make sure they function properly and can increase your heart rate. This lead function test is called "pacing." Small amounts of energy are delivered through the leads into the heart muscle. This energy causes the heart to contract. Once the leads have been tested, I will connect them to the pacemaker.
- After the pacemaker implant procedure, I use an external device (programmer) to program final pacemaker settings.
- The procedure usually takes 1 to 2 hours, and most patients go the same day or the next AM.

- Once the procedure is complete, you will be taken to your hospital room or the recovery room.

#### **What will I feel?**

- You will feel an initial burning or pinching sensation when I inject the local numbing medication. Soon the area will become numb.
- You may feel a pulling sensation as I make a pocket in the tissue under your skin for the pacemaker.
- When the leads are being tested, you may feel your heart rate increase or your heart beat faster.
- You should not feel pain after the local anesthetic takes effect.

#### **After the Procedure**

- You may eat as soon as you are awake following the procedure.
- A nurse educator will discuss your discharge and follow-up instructions.
- You will receive a temporary identification card for your new device. This card has vital information and you should always carry it .
- The device company will mail you a permanent card within a few weeks of your surgery to replace your old card.

#### **What should I expect?**

- In your hospital room, a special monitor, called a telemetry monitor, will continually monitor your heart rhythm.
- The telemetry monitor consists of a small box connected by wires to your chest with sticky electrode patches.
- The box displays your heart rhythm on several monitors in the nursing unit. The nurses will be able to observe your heart rate and rhythm.

#### **What tests will be done after the procedure?**

- A chest X-ray will be done after the pacemaker implant to check your lungs as well as the position of the pacemaker and lead(s).

#### **Will I have to stay in the hospital?**

- Most likely you will be eligible to discharge same day, about 4 hours after the procedure.
- If you do not meet the criteria for same day discharge then you will be monitored overnight.

#### **What will happen at my follow up appointment in the device clinic?**

- A device technician will place a small device, known as a programmer, directly over the pacemaker.
- The programmer allows the technician to change the pacemaker settings and to check the pacemaker and lead function.
- You may feel your heartbeat faster or slower. Although this is normal, please tell the nurse what symptoms you are experiencing.
- The results of the device check are reported to me, who then determines the appropriate settings for the pacemaker.
- Home going instructions including incision care, activity guidelines and follow-up schedule also are reviewed.

## Remote Surveillance

You will require periodic surveillance of the implanted device.

- The status of the pacemaker will be regularly checked or "interrogated" (often done remotely using a telephone or a secure web-based system) to provide information regarding the type of heart rhythm, the functioning of the pacemaker leads, the frequency of utilization of the pacemaker, the battery life, and the presence of any abnormal heart rhythms.
- Remote transmissions are made at scheduled intervals or at unscheduled times if your pacemaker sends an alert, or you can send a transmission if you have a concern.
- Remote technology means fewer trips to the doctor's office, more timely care, but you'll still need to be seen by me in person for at a minimum once a year for scheduled checkups.

## How long will my device last?

The pacemaker runs on a battery.

- Depending on the type of pacemaker you have, the battery lasts 5 to 15 years.
- When the batteries start to wear out, they do so in a very slow and predictable fashion, allowing enough time to be detected and pulse-generator replacement planned.
- Replacing the pulse generator usually requires a simple procedure in which a skin incision is made over the old incision, the old generator is removed, and a new generator is implanted and joined with the existing leads, assuming the existing leads are functioning normally.

## Special precautions

It's unlikely that your pacemaker would stop working properly because of electrical interference. Still, you'll need to take a few precautions:

- **Cell phones.** It's safe to talk on a cell phone but avoid placing your cell phone directly over your pacemaker implantation site when the phone is turned on. Try to keep your phone 6 inches away. Although unlikely, your pacemaker could misinterpret the cell phone signal as a heartbeat and withhold pacing, producing symptoms, such as sudden fatigue.
- **Security systems.** Passing through an airport metal detector won't interfere with your pacemaker, although the metal in it may sound the alarm. But avoid lingering near or leaning against a metal-detection system. If security personnel insist on using a hand-held metal detector, ask them not to hold the device near your pacemaker any longer than necessary or ask for an alternative form of personal search. To avoid potential problems, carry an ID card stating that you have a pacemaker.
- **Medical equipment.** If a doctor is considering any medical procedure that involves intensive exposure to electromagnetic energy, tell him or her that you have a pacemaker. Such procedures include magnetic resonance imaging, therapeutic radiation for cancer treatment and shock wave lithotripsy, which uses shock waves to break up large kidney stones or gallstones. If you're having surgery, a procedure to control bleeding (electrocautery) also can interfere with pacemaker function.
- **Power-generating equipment.** Stand at least 2 feet (60 centimeters) from welding equipment, high-voltage transformers or motor-generator systems. If you work around such equipment, your doctor can arrange a test in your workplace to determine whether it affects your pacemaker.

Devices that are unlikely to interfere with your pacemaker include microwave ovens, televisions and remote controls, radios, toasters, electric blankets, electric shavers, and electric drills.

## Patient Post-Device Instructions:

### Activity:

- Activity as tolerated. No lifting greater than 10 pounds (a gallon of milk is about 10 lbs.) with the affected arm (on the side of the device) for 4 weeks.
- Avoid lifting/reaching above your head with this arm for 4 weeks. This allows the newly implanted leads in your heart to firmly secure to the heart.
- You may not drive for 24 hours after the procedure

### Wound/Site Care:

- Keep incision site clean and dry. Remove the outer bandage 2 days after the procedure.
- Leave the steri-strips in place. Allow the steri-strips to fall off, do not pull them off. They will be removed at your clinic visit in 1-2 weeks.
- You may have Dermabond (liquid skin adhesive) over your incision. Do not scratch, rub or pick at the incision.
- If the dressing becomes saturated, please remove the original dressing and apply a clean thin dressing/gauze bandage over the incision. Please allow the incision to get as much exposure to air as possible to promote healing.
- You may shower 2 days after your device was implanted. Mild soap (optional) may be applied, although be sure this is thoroughly rinsed off, and then gently pat the area dry with a clean towel. Do not allow the stream of water to beat directly on the incision. Keep your incision clean and dry.
- No baths, swimming or submerging in water until cleared by your provider at your clinic visit in 1-2 weeks.
- Do not apply powders, lotions or home remedies to your incision.
- Women should consider putting a flannel sleeve or padding around their bra strap to prevent irritation of the incision until it is fully healed.
- Look at incision daily for any signs or symptoms of infection. Call immediately if there is any drainage containing pus, significant redness, foul smell or warmth at site.

Pain: Tylenol as needed for pain, follow manufacturers guidelines for recommended daily allowances. A prescription has been provided to you for stronger pain relief if needed. Only fill this if necessary.

Hours: If you have any questions or concerns during the work week please call our office at 435-215-0400 and ask the staff to send a message to Dr. Cooley's staff pool to get a return to your call. We are allowed 24 hours for a return call. If your concern is emergent, please inform the scheduler of your symptoms/issues. If you have questions that are on the weekends or past 5 PM during the weekdays, please call the on-call physician for Electrophysiology at 435-215-0400.

**Arm Immobilizer:** We've provided you with an arm immobilizer. Generally, you should wear this when you sleep. This simply is a reminder not to lift your arm above your head. If you are a calm sleeper and generally sleep in one position through the night this may not be necessary. Please use your discretion. If you don't think you will use this, please let our staff know.

### Miscellaneous:

If you're having concerns through the night or the next day please call the office at 435-215-0400. If it is after hours the on-call electrophysiology physician can be contacted at 435-215-0400 and should call you back. Please do not hesitate to go to the emergency room if you feel it is necessary.