Cardiac Resynchronization Therapy (CRT)

- Heart Failure and Electrical Problems
- How CRT Helps
- Getting a Biventricular Pacemaker or ICD
What Is CRT?

When you have **heart failure**, your heart is weakened and doesn’t pump as well as it should. This means parts of the body don’t get enough blood and oxygen. Heart failure causes symptoms such as having less energy and being short of breath. These symptoms interfere with daily life. CRT (cardiac resynchronization therapy) is a treatment that may help. For many heart failure patients, CRT reduces symptoms and improves quality of life.
**Devices That Help Your Heart Beat**

With CRT (also called biventricular pacing), a small electronic medical device is placed under the skin. This device helps a weakened heart maintain a healthy heartbeat. So, the heart pumps more effectively. Depending on your condition, you will have one of these devices:

- A **biventricular pacemaker** helps the heart beat on time. This improves the amount of blood pumped out of the heart with each beat.

- A **biventricular ICD** (implantable cardioverter defibrillator) also helps the heart beat on time. In addition, this device protects against fast, life-threatening heart rhythms.

**Benefits of CRT**

CRT won’t replace your other treatments. Rather, it’s part of a complete heart failure treatment plan. CRT helps a weakened heart pump more blood with each beat. So, more blood and oxygen go to the rest of the body. This decreases heart failure symptoms. The device is put into your body during a low-risk procedure. Once you have the device, you may notice some or all of these improvements:

- Being able to return to daily activities such as walking, carrying grocery bags, and climbing stairs.

- Having more energy to be active and do the things you enjoy.

- Breathing more easily when you lie flat, so you sleep better at night.

- Having less swelling in your ankles, feet, and abdomen.

- Making fewer visits to the hospital due to heart failure symptoms.

- Having fewer side effects from your heart failure medications.
How Your Heart Works

The heart is a muscle that works like a pump. It pumps blood to the lungs, where the blood receives oxygen. Oxygen-rich blood travels back to the heart. The heart then pumps this blood to the organs, limbs, brain, and all the other parts of the body. The body uses the oxygen in the blood. Then, the blood returns to the heart and the process starts over.

A Healthy Heart

The walls of the heart are made of strong muscle. These walls contract (squeeze) to pump blood into and out of the heart. In a healthy heart:

- Four chambers hold the blood as it moves through the heart. The upper chambers are the right atrium and the left atrium. The lower chambers are the right ventricle and the left ventricle.

- Valves separate the chambers. These valves act like one-way doors, keeping the blood moving forward as it travels from chamber to chamber.

- Nodes (groups of electrical cells) create electrical signals that tell the heart when to contract and relax. These signals travel through the heart walls along pathways of electrical cells called bundle branches.
How the Heart Pumps Blood

Blood enters the heart through the atria (the upper chambers). The atria contract to pump blood into the ventricles (the lower chambers). As this happens, the ventricles relax so they can fill with blood. Then the ventricles contract and the atria relax. Blood is pumped out of the heart, to the lungs and the rest of the body. The process starts again with the next heartbeat.

**Between contractions, the heart rests**

- Oxygen-poor blood enters the right atrium from the body.
- Oxygen-rich blood enters the left atrium from the lungs.

**The ventricles contract**

- Oxygen-rich blood is pumped to the rest of the body.
- Oxygen-poor blood is pumped to the lungs.

**The atria contract**

- Oxygen-poor blood is pumped into the right ventricle.
- Oxygen-rich blood is pumped into the left ventricle.
When Heart Failure Occurs

In people with heart failure, the heart can’t move as much blood as it should with each beat. This causes blood to back up into the lungs and throughout the body. Certain parts of the body don’t get enough blood to work normally, which causes the symptoms you feel.

When the Heart Weakens

With heart failure, the heart enlarges and the muscle weakens. The weakened muscle doesn’t pump enough blood forward when the ventricles contract. Less blood travels to the lungs and the rest of the body with each heartbeat. The ejection fraction (EF) is a measure of how much blood pumps out of the heart with each beat. When your heart is weak, the ejection fraction is lower than normal.

When Your Body Gets Less Blood

Because a weakened heart muscle moves less blood with each pump, fluid backs up into the lungs and throughout the body, causing swelling. Less blood moving through your body also means your organs get less oxygen. Because of this, the organs don’t work as well. This may result in symptoms all over your body:

- **Your brain** may receive less blood, making you feel confused or dizzy.
- **Your lungs** may fill with fluid, making you short of breath.
- **Your kidneys** may not be able to rid your body of excess fluid. This fluid can back up into other parts of your body.
- **Your abdomen, ankles, and feet** may collect excess fluid, causing swelling.
Your Heart’s Electrical System

The heart has an electrical system that controls the heart’s pumping. This system conducts (sends) electrical signals through the heart muscle. The signals tell the heart’s chambers when to contract. Heart failure can cause problems with these signals. This means the chambers may not contract when they should. Some people have electrical problems even before heart failure develops. Heart failure makes these problems worse.

In a Healthy Heart
Electrical signals tell each of the heart’s chambers when to contract. These signals travel smoothly through healthy muscle. They keep the contractions of the right and left ventricles synchronized (timed correctly). When contractions are synchronized, a healthy amount of blood is pumped from the ventricles to the lungs and the rest of the body.

In a Weakened Heart
When you have heart failure, the heart muscle is damaged. Electrical signals may not travel as well through this damaged muscle. Because of this, the ventricles’ contractions aren’t synchronized. When the ventricles don’t contract together, not as much blood is pumped out. Less blood goes to the body, which makes heart failure symptoms worse. The heart works harder to try to pump more blood with each contraction. This can weaken the heart even further.
How CRT Works

When you have heart failure, the right and left ventricles don’t contract together. CRT makes sure the contractions are timed correctly. To do this, a biventricular pacemaker or ICD is connected to your heart. The device sends electrical impulses to the right and left ventricles. These impulses resynchronize the ventricles (make them contract together again). So, more blood is pumped out of the heart.

What the Device Looks Like

This biventricular ICD is shown slightly smaller than actual size. Most pacemakers are a little smaller than ICDs.

The **generator** is a smooth, lightweight metal case containing a tiny computer and a battery. The case is often made of titanium. The generator sends out electrical impulses.

The **leads** are wires covered by a soft, flexible material. Most biventricular pacemakers and ICDs have three leads. The leads carry electrical impulses from the generator to the heart.

On an ICD, this lead also has the ability to protect you from a life-threatening heart rhythm.
Biventricular Pacemakers
Biventricular pacemakers ensure that contractions of the heart’s chambers are timed correctly. In most cases, one lead senses the heart’s electrical signals in the right atrium. Based on the timing of these signals, the other two leads send electrical impulses to the right and left ventricles. These impulses synchronize the chambers’ contractions. So, blood is pumped out of the heart more efficiently.

Biventricular ICDs
Dangerously fast heart rhythms sometimes develop in damaged heart muscle. To protect against this, you may be given a biventricular ICD. Like a biventricular pacemaker, an ICD sends electrical impulses to synchronize the right and left ventricles. The ICD can also correct a life-threatening rhythm. It does this by interrupting a heart rhythm that’s too fast, returning the heartbeat to normal.

How the Device Is Put into the Body
The device is placed in your body during a process called implantation. Here’s how it’s done:

- First, an incision is made in the skin below the collarbone. This creates a small “pocket” to hold the device.
- A lead is threaded through the incision into a vein in the upper chest. With the help of x-ray monitors, the lead is then guided into a vein on the back surface of the left ventricle. Contrast dye may be injected into the vein to make the pictures on the monitors clearer.
- The process is repeated to guide leads into the right ventricle and, in most cases, the right atrium. These leads are attached to the heart muscle so they’ll stay in place.
- The generator is attached to the leads. Then, the generator is placed in its pocket under the skin.
- In rare cases, the left ventricular lead can’t be inserted through the vein. If this happens, your doctor may suggest another procedure called epicardial implantation. The chest is opened so the lead can be inserted from outside the heart. Your doctor can tell you more if this is needed.
Implanting the Device

Implantation of a biventricular pacemaker or ICD is not open heart surgery. It’s a less involved procedure that’s done in an operating room or cardiac cath lab. It takes 2 to 4 hours. In most cases, the device is implanted near the left shoulder.

Before Surgery
You’ll be given instructions on how to get ready for the procedure. Before your surgery:

- You may have an electrocardiogram (ECG or EKG) and an echocardiogram (echo). These tests tell your doctor more about your heart’s function.
- Tell your doctor about all prescription medications you take. Also tell your doctor about all over-the-counter medications, herbs, or supplements you use. You may be asked to stop taking certain medications before your procedure.
- Do not eat or drink anything after the midnight before your procedure.
- Your doctor or another specialist will talk to you about the pain medications that will be used during the procedure.

The Day of Surgery
You’ll likely be admitted to the hospital for implantation. You can expect the following:

- The skin where the device will be implanted is washed. Any hair may be removed from the skin.
- You will be given medications to prevent pain. You may be awake but have medication to relax you. Or, you may be completely asleep.
- Medications and fluids will be given to you through an IV.
- Your body will be draped with sheets during the procedure. Only the area where the device is being implanted is exposed. This helps keep the implantation site sterile (germ-free).

Risks and Complications

- Bleeding or severe bruising
- Infection or nerve damage 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 (rare)
After Surgery
Nurses will monitor your health and give you medication to control pain. Most patients go home the day after the procedure. Once you’re home:

- Take care of your incision and change the dressing as instructed. Avoid getting the area wet as directed by your doctor. Every day, check your incision for redness and other signs of infection.

- You may be told to limit movement of your arm on the side where the device has been implanted. You may also be instructed not to raise that arm above the shoulder for a certain amount of time. Your doctor will tell you more.

- You can go back to work when your doctor says it’s okay. In most cases, it’s safe to return to your normal routine soon after surgery. You may even feel well enough to do things you couldn’t do before the implantation. Check with your doctor to make sure it’s okay to do these activities.

Follow-Up
At first, you’ll need frequent follow-up visits. These will decrease over time. Here are some things you can expect during the first few months:

- Your doctor may check your incision to be sure it’s healing well.

- Your device may be reprogrammed (have its settings adjusted). Using test results, your doctor will find the best settings for your heart.

- Your symptoms may get better right away. Or, changes may be gradual. Talk to your doctor about any changes in your symptoms.

When to Call Your Doctor
Call if you have any of these during the week after the procedure:

- Signs of an infection, such as: a fever above 101°F (38.3°C); redness, swelling, or warmth at the incision site; drainage from the incision

- Worsening of heart failure symptoms, or new symptoms

- Bleeding from the incision site
Replacing the Battery
During your appointments, your device's battery level will be checked. If it's low, there's still plenty of time to replace the battery before it wears out. Most batteries in biventricular pacemakers and ICDs last several years. If the battery wears out, the entire generator is replaced. This is done during a procedure that's usually simpler and shorter than the original implantation.

Caring for Your Device
A few times each year, your biventricular pacemaker or ICD must be checked. This will ensure the device is working correctly. Settings may be adjusted so the device can best help your heart. You may be glad to know that very few things interfere with your device. In the rare case that an outside signal does affect it, the device won't be damaged. If you ever suspect a problem, call your doctor.

Making Adjustments
During visits to your doctor or heart failure clinic, your device's settings will be checked. Certain tests, such as an ECG or echocardiogram, may be done to make sure the device is helping your heart as much as it can. From time to time, the settings may be adjusted. This is done using an electronic wand connected to a computer. The wand is simply placed on the skin over the device.
Most Outside Signals Are Safe
Biventricular pacemakers and ICDs are well protected. Most machines and devices will not interfere. For instance, microwave ovens and other appliances should not cause problems. Neither should computers, hair dryers, power tools, radios, televisions, electric blankets, or cars.

Things That Cause Problems
A few things create signals that might interfere with your device. These include:

- **Electromagnetic anti-theft systems.** These are often near entrances or exits in stores. Walking past one is okay, but avoid standing near or leaning against one.

- **Strong electrical fields.** Some things that cause these are radio transmitting towers and heavy-duty electrical equipment (such as arc welders). These should be avoided. A running engine also makes an electrical field. It’s okay to ride in a car, but avoid leaning over the open hood of a running car.

- **Cellular phones, if held too close to your device.** (Indoor cordless phones are okay.) When using a cellular phone, hold it to the ear on the opposite side of your device. When not using it, carry the phone on the side away from your device.

- **Very strong magnets.** You should never have an MRI (a medical test that uses magnets). Problems may also be caused by magnets in hand-held security wands (such as ones used at airports).

Carrying an ID Card
Your device comes with an ID card. This contains important information about the device. You’ll be given a temporary card when the device is implanted. A permanent card will be mailed to you in about 6 weeks. Show the ID card to any doctor, dentist, or other medical professional you visit. Also show it to security guards at the airport. This way, they know to follow special procedures that prevent the security wand from interfering with your device.
Staying Healthy

When CRT is helping your heart beat, you may have more energy. This makes it easier for you to stay active. Being active exercises your heart and can help you feel better overall. And keeping up with the other parts of your treatment plan can help you live longer and more comfortably.

Keeping Active

You may find you can do more now than you could before you started CRT. Stay as active as feels comfortable to you. Try these tips:

■ Plan activities like a walk around the block. If the weather is bad try walking indoors, such as at a shopping mall. Light gardening and swimming are other options that may work for you. Talk to your healthcare provider about safe choices.

■ Involve family and friends in your activities. You can enjoy yourself and help your heart at the same time!

■ Stay aware of your limits. Even with CRT, you may still have some heart failure symptoms. Stop and rest if you feel tired or short of breath. If you can’t hold a conversation during activity, you’re pushing yourself too hard.

Signs of Overexertion

Stop exercising and call your doctor if you feel any of these symptoms:

■ Chest pain or discomfort

■ Burning, tightness, heaviness, or pressure in your chest

■ Unusual aching in your arm, shoulders, neck, jaw, or back

■ Trouble catching your breath

■ A racing or skipping heartbeat

■ Extreme tiredness (especially after exercise)

■ Lightheadedness, dizziness, or nausea
**Trying a Cardiac Rehabilitation Program**

Cardiac rehabilitation (rehab) is a supervised, personal exercise program designed to improve your heart’s health. This program often takes place at the hospital or another medical center. During cardiac rehab you are shown how to exercise in ways that help your heart the most. While you exercise, your heart rate and blood pressure are watched closely. Ask your healthcare provider about rehab programs that might be right for you.

**Continuing with Your Treatment Plan**

CRT is one treatment for heart failure. But even if you’re feeling better, you must continue with the other parts of your treatment plan. Doing so will help your heart, which helps you feel your best. Your treatment plan may include some of these:

- **Dietary restrictions.** You will likely be told to limit salt (sodium). This helps reduce swelling. Reading food labels can help you choose foods low in salt. You may also be told to limit fluid intake or to follow other dietary restrictions based on other health problems. If you have any questions about what’s safe to eat or drink, talk to your doctor.

- **Medications.** Take all of your medications as prescribed by your doctor. Now that you’ve started CRT, you may have fewer side effects from medications. So, your doctor may change your medications or dosages. This may improve your quality of life, and could even help you live longer.

- **Weighing yourself.** Rapid weight gain or swelling can be a sign that fluid is backing up in your body. Weigh yourself at the same time every morning, wearing the same clothes. Do this after urinating and before eating. Call your doctor if you gain 2 or more pounds in a day, or if you gain 3 to 5 pounds in a week.

- **Controlling risk factors.** You may be able to help your heart by controlling certain risk factors (things that make heart problems more likely). For instance, your doctor may ask you to quit smoking or to lose excess weight. Keeping blood pressure and cholesterol levels under control also helps. Work with your doctor to treat any risk factors you have.
Part of a Complete Treatment Plan

CRT may help you have more energy and feel better overall. But understand that CRT is only part of a successful treatment plan. You still need to take your medications, follow prescribed dietary restrictions, and keep an eye on your symptoms. Most importantly, work closely with your healthcare team. This will ensure that your treatment plan is helping your heart as much as it can.