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Cardiac Resynchronization Therapy

A Better and Longer Life for Patients With Advanced Heart Failure

Srinivas Iyengar, MD; William T. Abraham, MD



Heat failure is a condition in which the heart muscle cannot function properly. It can result from the heart muscle becoming stiff over time or from a gradual weakening that results in a decreased ability to pump blood to the body. The weakening of the heart muscle, called systolic heart failure, is most commonly a result of processes such as heart attacks, heart valve abnormalities, uncontrolled hypertension, and viral illnesses, although a number of other conditions can cause the heart to weaken as well.

What Is the Treatment for Heart Failure?

Treating the underlying cause of the heart failure is the first step of management, whether it is through medicine or surgery to repair a blocked artery or a damaged heart valve or by controlling blood pressure. Even if the cause of the heart failure is unknown (idiopathic), the medical regimen used is the same as for the other causes of heart failure. A sensible diet with salt and fluid restriction, exercise, and medications such as angiotensin-converting enzyme (ACE) inhibitors and beta-blockers, often with diuretics (sometimes called water pills), are

therapies aimed at relieving the stress the weakened heart is undergoing.

What Can Be Done for Patients Who Have Symptoms of Heart Failure Despite Treatment?

In cases in which an individual is still suffering from the symptoms of heart failure (such as shortness of breath at rest or with minimal activity, fluid retention despite diet control and diuretic use, and worsening or nonimproving heart pump function with evidence of electrical abnormalities on electrocardiogram [ECG]), he or she might be a candidate for biventricular pacing or cardiac resynchronization therapy (CRT).

CRT involves a pacemaker with 3 wires (see the Figure). A CRT pacemaker helps the failing heart pump blood more effectively. CRT has been proved over the past 10 years to help improve a patient's quality of life, increase the ability for daily activity, and even increase the lifespan of people suffering from heart failure.

How Does CRT Work?

The heart has 4 chambers: 2 upper ones (right and left atria) and 2 lower

ones (right and left ventricles). CRT works by electrically stimulating both the left and right sides of the heart, specifically the left and right ventricles, so that the heart can pump more effectively. The left ventricle side of the heart is the larger side and pumps blood to the brain and body; it is the side that is usually weakened in heart failure. Weakening of the left ventricle eventually leads to an electrical imbalance between the right and left sides of the heart (as well as an imbalance in the left ventricle itself). This results in an inability of the left ventricle to pump enough blood and in worsening of the symptoms of heart failure. CRT corrects this imbalance and helps the left and right sides of the heart to resume beating in unison. By doing so, a greater quantity of blood is pumped out to the body, and symptoms are improved.

Who Is a Candidate for CRT?

Patients who have been diagnosed with heart failure from a weakened heart muscle, who have worsening symptoms despite diet and optimal medical therapy, and who show elec-

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From the Division of Cardiovascular Medicine, Ohio State University, Columbus.

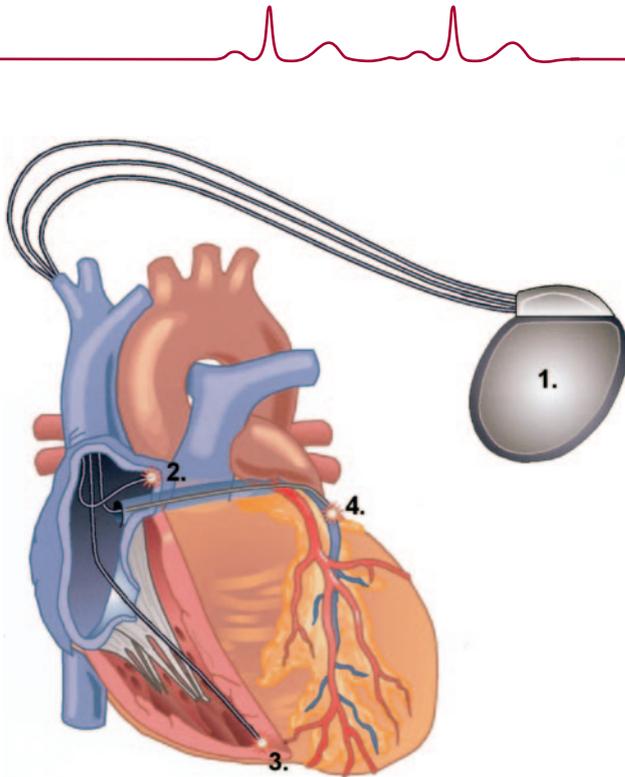
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CRT. 1, Pacemaker generator; 2, right atrial pacer wire; 3, right ventricular pacer wire; and 4, coronary sinus ("left ventricular") pacer wire.

trical abnormalities on their ECG can be evaluated for CRT (see the Table).

Contemporary medical evidence has shown that patients with heart failure from a weakened heart muscle might also benefit by adding a component to the CRT pacemaker called a defibrillator (also called an implantable cardioverter-defibrillator, or ICD). The ICD component functions by electrically jolting the heart back to a normal rhythm if any lethal heart rhythms might occur. Your cardiologist will be able to decide which device is most beneficial for you given your medical condition. (For additional information

Indications for CRT

- Worsening symptoms of heart failure (for example, shortness of breath, fluid retention, fatigue) despite optimal medical therapy, exercise, and diet
- Decreased function of the heart muscle documented by an imaging test of the heart (echocardiogram or ventriculogram)
- Evidence of electrical abnormalities in the heart rhythm (for example, a "widened" QRS complex seen on an ECG)

on ICDs, please see: Reiffel JA, Dizon J. The implantable cardioverter-defibrillator: patient perspective. *Circulation*. 2002;105:1022–1024.)

How Is the CRT Pacemaker Placed?

A specialized cardiologist, either an electrophysiologist or a cardiothoracic surgeon, generally inserts the CRT device. The pacemaker device itself is the size of a half-dollar coin and is usually placed under the collarbone in the left upper shoulder (although it can be placed on the right side as well). The device is inserted under local anesthesia with x-ray guidance directly into veins that lead into the heart chambers. If it is anticipated that there may be difficulty in placing the leads or if another surgery is required (for example, coronary bypass surgery), a surgeon can place the leads on top of the heart in the operating room under general anesthesia.

What Happens After the CRT Pacemaker Is Implanted?

The procedure to place the CRT pacemaker usually takes 2 to 3 hours. The

patient will stay overnight in the hospital after the procedure is performed. During the hospitalization, the device will be tested electronically by taking readings and performing an echocardiogram to obtain a sonar picture of the heart. If the device is working properly and the patient is doing fine, he or she can go home the next day.

Patients who have had a CRT pacemaker placed should avoid extreme arm motions and lifting, such as raising the arm on the side in which the pacemaker was implanted above the head, shoveling snow, and golfing for at least 6 weeks after implantation. Microwave ovens will not damage the pacemaker, although cell phones should be used on the opposite side from where the pacemaker was placed.

At discharge, patients should have a scheduled appointment with either the implanting physician or a pacemaker clinic to check for proper functioning of the pacemaker.

How Long Until CRT Works?

Two thirds of patients who have undergone CRT implantation have reported an immediate improvement in their symptoms. It should be stressed, however, that nearly a third of patients who undergo implantation of a CRT pacemaker do not improve. The reasons for this are still being investigated. A majority of patients do derive some benefit from this form of therapy, and it is instituted only after other conventional forms of treatment have already been implemented.

For More Information:

For additional information, visit www.americanheart.org/chf or www.abouthf.org.

Disclosure

Dr Abraham has received research grants from Medtronic and Biotronik; has served on the speakers' bureaus of and/or received honoraria from Medtronic, Guidant, and St. Jude; and has served as a consultant to or on the advisory boards of Medtronic and St. Jude.