**What is heart failure?**
Heart failure results from abnormally low pumping output of blood as the heart attempts to meet the needs of the body. Heart failure is very common, affecting some 22 million people worldwide, and over two million new cases are diagnosed each year. The risk of developing heart failure increases with age. The diagnosis of “heart failure” may sound frightening but it does not mean that the heart has stopped working, but rather the heart is weakened and doesn't pump blood as well as it should.

**What is the treatment for heart failure?**
Heart failure is treatable. Lifestyle changes, including eating less salt, getting good rest, and exercising in moderation are important treatments. A number of medications are typically used to increase the heart’s pumping ability. In some cases, surgery may be helpful.

**Implantable device therapy for heart failure**
Pacemaker therapy may help some patients with heart failure and abnormally slow or erratic heart beating called cardiac arrhythmia. A new treatment option called **cardiac resynchronization therapy (CRT)** involves the use of a pacemaker-like device and may be appropriate for a select group of heart failure patients with moderate to severe heart failure and abnormal uncoordinated activation of the main lower ventricular pumping chambers known as **ventricular dysynchrony**. Cardiac resynchronization therapy (CRT) restores a more normal coordinated pumping ability of the right and left ventricular chambers to increase the strength of the heart beat.

**How does the heart work in normal rhythm?**

**Natural Heart Function**
The human heart is an amazing pump. It has four chambers: two smaller, upper chambers called right and left atria, and two larger, lower chambers called the right and left ventricles. These four chambers work together to produce powerful contractions (heartbeats) to pump blood to your entire body every minute.

**Natural Heart Rhythm**
Each heartbeat is controlled by the heart’s electrical system. Each heartbeat is triggered by a small natural electrical impulse that can be measured on the skin surface using an "electrocardiogram" or ECG recording and is known as “**normal sinus rhythm**.” The impulse starts in the sinus node, located in the upper right atrium. This is known as the natural pacemaker region called the sinoatrial (SA) node. The signals then spread evenly over both upper chambers (atria) causing them to contract. The signal then spreads to the lower chambers (ventricles) through a special “electrical bridge” called the atrioventricular (AV-node) which separates the atria from the ventricles. Once the signal leaves the AV node, it spreads rapidly to both right and left ventricles causing a powerful coordinated heart beat.
**Symptoms that may be present with heart failure**
Symptoms of heart failure include shortness of breath, swelling of the feet and legs, lack of energy, feeling tired, difficulty sleeping at night due to breathing trouble and increased urination at night. Patients may develop confusion, or impaired memory or a cough with frothy sputum, and may need hospitalization for additional treatment.

**Classification of heart failure**
Most physicians will classify the severity of heart failure in one of four categories: New York Heart Association (NYHA) Functional Class I, II, III or IV. These classifications are a way of measuring a persons degree of heart failure based upon his or her activity limitations. Class I patients may not even know they have heart failure. They typically have little or no limitations as to what activity they can do. Class II heart failure patients have mild symptoms and usually only when involved in relatively strenuous activity such as mowing the yard, household chores, and long walks. Moderate to severe heart failure falls into either class III or class IV. These patients may have trouble breathing even with simple activities of daily living such as walking to the mailbox or climbing stairs. Class IV heart failure patients may also be bedridden for the majority of the day because they feel too weak to do simple activities such as walking room to room.

**What is Ventricular dysynchrony?**
Ventricular dysynchrony occurs in approximately 30% of patients with advanced (class III or class IV) heart failure. Normally two lower chambers of the heart (the ventricles) beat at the same time and are “synchronized.” When a heart failure patient has dysynchrony, the two lower chambers beat separately, and the heart is not able to pump blood efficiently to the body.

**How does cardiac resynchronization Therapy Work?**
Cardiac resynchronization therapy sends tiny electrical pulses to both right and left ventricles to make them beat at the same time. The cardiac resynchronization device is implanted under the skin in the chest and connected to leads (soft insulated wires) that are inserted through veins into the heart.

**What are the benefits of this therapy?**
The safety and effectiveness of cardiac resynchronization therapy has been evaluated in research studies worldwide dating back to 1998. The results of recent clinical trials in the United States have shown that perhaps two out of three patients who are candidates for CRT had an improved quality of life, or fewer symptoms associated with their heart failure when receiving CRT in combination with medical therapy and close follow-up relative to drug therapy alone. In particular cardiac resynchronization therapy has been shown to improve the NYHA functional class of many patients, improve the patients ability to exercise and reduce the time spent in the hospital for heart failure treatment. Current research is focusing on whether CRT can change the prognosis or help patients live longer.

**Who is a good candidate for this therapy?**
Patients with advanced heart failure (class III or class IV) with limiting symptoms despite comprehensive therapy including medications and close follow-up are candidates for cardiac resynchronization therapy. The benefits of CRT therapy generally far outweigh the associated risks, and vary with individual patients. The relative merits of this therapy, as well as alternatives, should be discussed with the medical team before implantation.
What is the procedure to implant the device like?

Cardiac resynchronization therapy involves a procedure to implant the resynchronization device under the skin in the chest. The connected to leads (soft insulated wires) are inserted through veins to the heart.

The limited surgery to implant the device takes place in the electrophysiology laboratory operating suite. The patient is in a comfortable sleeping state called deep conscious sedation with local anesthesia. The procedure time is variable, usually about three to four hours. The site where the device will be placed (usually just below the collarbone on the left or right side) is washed very well. Sheet-covers and clean towels are placed around the site to keep the area sterile, free of skin bacteria to avoid infection.

Once the site has been cleaned, draped and shielded, numbing medicine like Novocain is given to the skin at the site. After the skin at the site is completely numb, a small incision is made just below the collar bone and a small "pocket-pouch" about two inches across is made for the device under the thick part of the skin. The soft insulated leads are placed using the vein under the collar bone and positioned carefully in special strategic spots within the heart using X-ray equipment for guidance. Pictures using dye are usually necessary to assist the doctor for best lead positioning within the heart. After the system has been tested for best performance, the device is connected to the leads and placed in the pocket under the skin. The skin is sewn closed with special stitches, often of the type that dissolve, and the site is bandaged.

What should I expect just after the procedure?

It is common to be up after a night's rest following implantation. Many patients find that they do better with assistance and are "wobbly" the first time up out of bed. The implantation site may be tender a day or two after surgery and patients often take some pain medicine for this tenderness that generally disappears rapidly. The dressing usually is removed the day after surgery and tape, if present, should not be touched, but rather, allowed to rub or wear off over ten days after surgery. Skin discoloration, bruising and swelling at the site is normally expected and usually resolves over several days. There may be a bulge at the implantation site, particularly among slender patients that persists.

Patients are asked to keep the site dry, and not to shower for at least 7-10 days after surgery to avoid infection. Patients are encouraged to take sponge baths or regular baths during this time. Wide arm motion or heavy lifting on the side of the implant should be avoided for ten days after surgery to assist the healing process. Persistent drainage, increasing redness or pain over the implantation site should be reported to the clinic staff. Questions regarding healing, or symptoms of any type should be directed to the clinic so that the staff will be able to assist the patient as necessary.
After receiving cardiac resynchronization therapy, what can be expected?
Within weeks of receiving the implanted device, a heart failure patient may begin to feel more energetic. It is important to follow the advice from the medical team before starting new activity. The patient’s progress will be monitored in the device clinic and heart failure clinic. Adjustments in medication and device function are commonly necessary with time.

The medical team can readily assess and readjust device function painlessly during brief, routine office visits, using a handheld transmitter and receiver that communicates with the device using radio signals (telemetry) beamed through the skin.

Heavy direct blows to the implant site should be avoided since this may damage either the pacemaker or the nearby bones. You will receive an ID card in the mail to carry in your wallet for medical personnel and special situations like airport security. If you need special medical tests or surgery in the future, let your doctor know that you have the implanted device.

Periodic follow-up visits to the clinic to evaluate and optimize device performance and extend battery life will be recommended. In general these are infrequent, short, painless and extremely worthwhile.

Dr. Cockrell is the Director of the Arrhythmia Service at Washington Adventist Hospital and a practicing cardiologist at Cardiovascular Consultants, PA.

CARDIOVASCULAR CONSULTANTS, PA
7901 Maple Avenue, Takoma Park MD 20912, Tel 301-891-7000 ■ 15215 Shady Grove Road, Rockville, MD 20850, Tel 301-990-0040
www.CVCHeartCare.com