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NOTES

WEIGHT & TEMPERATURE CHART
Yale-New Haven Hospital performs the entire spectrum of open-heart operations for both adults and children with an unsurpassed level of quality and safety. Our cardiac team includes some of the most experienced and award-winning cardiac surgeons in the world, as well as a dedicated team of experienced cardiologists, anesthesiologists, cardiac nurses, physician assistants and nurse practitioners.

Our cardiac surgeons perform state-of-the-art minimally invasive and traditional operations for the full range of cardiac diseases and conditions, including:

- Aortic aneurysmal disease
- Arrhythmias (abnormal heart rhythm), including pacemaker and defibrillator insertion
- Coronary artery disease
- Heart failure, including artificial heart or ventricular assist devices (VADS) and heart transplantation
- Valvular disease (i.e., stenosis and regurgitation)

Our survival statistics for coronary artery bypass and valve operations consistently exceed national and regional norms. YNHH cardiac surgeons work closely with internists, anesthesiologists, cardiologists and vascular surgeons in pre- and post-operative care. Our faculty performs cutting-edge research in aortic surgery, cardiac transplantation and mechanical cardiac assist devices, as well as vascular biology and transplantation immunology, including coronary arteriosclerosis.
Your heart
Your heart is a muscular pump that moves blood throughout your body. In an adult at rest, the heart pumps about 5 to 6 liters of blood per minute. At peak exercise, it is capable of pumping up to 30 liters of blood per minute! It sends oxygen-rich blood under high pressure through muscular vessels called arteries. Thin-walled vessels called veins return oxygen-depleted blood back to the heart and lungs to be recharged with oxygen.

The four cardiac chambers
Your heart consists of four chambers. The two “upper” chambers are called atria and passively collect blood from the body (right atria) and lungs (left atria). The two more muscular “lower” chambers are called ventricles and pump blood to the lungs (right ventricle) and body (left ventricle). The left ventricle pumps oxygen-rich blood through a thick tube called the aorta, and the right ventricle pumps oxygen-depleted blood to the lungs through a thinner-walled tube called the pulmonary artery.

The aorta
The adult aorta is a muscular-walled tube that is about the same diameter as a garden hose in most adults and carries oxygen-rich blood from the left ventricle to the rest of the body. The aorta is divided into four major segments: the ascending aorta, the aortic arch, the descending thoracic aorta and the abdominal aorta.
The four cardiac valves

The heart has four one-way valves within it that keep blood moving forward.

The tricuspid valve permits oxygen-depleted blood returning from the body to flow from the right atrium into the right ventricle.

The pulmonary valve permits oxygen-depleted blood to be ejected from the right ventricle into the lungs to be replenished with oxygen.

The mitral valve permits oxygen-rich blood from the lungs to flow from the left atrium into the left ventricle.

The aortic valve permits oxygen-rich blood to be ejected from the left ventricle through the aorta to the rest of the body.
What is coronary artery disease?
What is coronary artery disease?

Coronary artery disease (CAD) is the narrowing and sometimes complete blockage of the arteries that feed oxygen-rich blood to the heart muscle.

How does coronary artery disease affect your heart?

CAD slows and blocks the delivery of oxygen to your heart muscle. This causes the oxygen-starved muscle of your heart to become damaged. If damaged enough, the muscle can die, which can result in a heart attack, or myocardial infarction (MI). When the heart muscle is no longer healthy, it cannot function efficiently to pump blood throughout the body.

What causes coronary artery disease?

CAD is generally caused by the buildup of plaque in the coronary arteries.

Risk factors that you can change

- Being overweight
- Diet high in fats
- High blood pressure
- High cholesterol
- Sedentary lifestyle
- Smoking
Risk factors that you can’t change

- Age (risk increases with age)
- Diabetes (poor control further increases risk)
- Genetics (family history)
- Male gender
- Post menopause

What are the symptoms?

Every person is unique and will experience his or her own symptoms. Some people may have no symptoms at all. These are some of the more common symptoms:

- Arm, jaw or back pain
- Chest burning or pressure
- Chest pain that characteristically worsens with activity (angina)
- Excessive sweating
- Heartburn-like symptoms
- Shortness of breath

How is coronary artery disease diagnosed?

Diagnostic tests include:

- Cardiac catheterization
- Cardiac magnetic resonance imaging (MRI)
- Computed tomography (CT) angiogram
- Electrocardiogram (ECG)
- Nuclear myocardial perfusion imaging
- Stress echocardiogram
- Stress test (exercises or pharmaceutical)

How is coronary artery disease treated?

CAD can be treated in multiple ways:

- Coronary artery bypass grafting surgery (CABG)
- Coronary stents
- Lifestyle changes, including exercise, weight loss, healthy diet and smoking cessation
- Medications that help lower your cholesterol, prevent blood clots and control your blood pressure
Coronary artery bypass grafting (CABG) is performed in the operating room by your surgeon and will involve the use of general anesthesia. The surgical team includes many professionals, such as the anesthesia team, surgical technologists, operating room nurses, perfusionists, physician assistants and physicians. Coronary bypass will create new channels of blood flow to your heart by taking healthy blood vessels from elsewhere within your body and laying them down as the new pipelines to bypass your blocked coronary arteries. The most common blood vessels used as the new pipework come from your chest wall, leg, and, sometimes, your arm. They are:

**Internal mammary arteries:** Located inside your chest wall on the left and right sides.

**Saphenous veins:** Located on the inside part of your legs. These can usually be removed though small incisions with the use of a special scope, through a procedure known as endoscopic vein harvesting.

**Radial arteries:** Located in your forearms. They can be removed either with an incision going down your forearm or through small incisions using an endoscope.

In many cases, the heart is temporarily stopped during surgery in order for the surgeon to construct the coronary artery bypass grafts. A heart-lung machine is used to completely and safely take over for your heart and lungs during this time. This machine will supply fresh, oxygen-rich blood to your entire body during surgery. In some cases, the surgeon may prefer to perform this operation without stopping the heart on the heart-lung machine. This type of beating-heart surgery is often referred to as *off-pump* CABG.

The incision for CABG is made down the center of your chest and is called a sternotomy. This means the breastbone (sternum) will be divided so that the surgeon can access the surface of your heart. In some cases, CABG can be performed through a small incision called a thoracotomy, which is made between the rib spaces.

### Benefits and Risks

Risks of coronary artery bypass surgery include bleeding, infection, stroke, organ failure and death. Most patients can be classified as low-, medium-, or high-risk surgical patients based upon their overall general health and coexisting illnesses.

The benefits of coronary artery bypass surgery have been well evaluated. It is a long-term treatment for CAD. It provides new blood flow to your heart and should effectively treat symptoms associated with CAD. Restoring blood flow to your heart muscle also reduces the risk of damage to your heart muscle and, in some cases, may help remodel an already damaged heart.
What is valvular heart disease?
The heart has four one-way valves that keep the blood moving forward. The valves are comprised of “leaflets,” which are much like swinging doors that open only one way to prevent the blood that moves through them from leaking backward. Malfunction of these valves occurs when one or more of them leak or become so narrow that they prevent blood from easily passing through.

What does valve disease do to your heart?

First, it helps to understand the two types of cardiac valve disease:

**Stenosis:** In valvular stenosis, the leaflets do not open all the way. The blood must pass through a much smaller opening, restricting blood flow.

**Regurgitation:** Also known as “insufficiency,” regurgitation occurs when blood leaks backward across the valve.

With both valvular stenosis and regurgitation, the heart must work harder to move the appropriate amount of blood forward. The heart tries to compensate for this by enlarging. Left untreated, this enlargement impairs heart function, leading to heart failure.
What causes valve disease?

- Bacterial infection
- Birth defect (congenital)
- Buildup of calcium or plaque on the leaflets
- Rheumatic fever in the past
- Tissue degeneration

What are the symptoms?

- Ankle and/or leg swelling
- Chest pain or tightness
- Fainting spells
- Fatigue
- Lightheadedness
- Palpitations
- Shortness of breath either on exertion or at rest

How is valve disease diagnosed?

Usually, valvular disease is first suspected when your physician hears a murmur while listening to your heart with a stethoscope. An echocardiogram, a non-invasive ultrasound test, is then performed to confirm the diagnosis.

How is valve disease treated?

Mild or moderate forms of valve disease can often be treated with medicine. However, with certain valvular diseases, severe dysfunction and/or heart enlargement, cardiac surgery is usually recommended. If you need surgery, your cardiologist and cardiac surgeon will determine which valves are faulty and whether they can be repaired or require replacement. Your doctors will take into account several different factors in making their surgical recommendation, including your age, other medical problems and lifestyle.

How is valve replacement surgery performed (aortic, mitral, tricuspid, pulmonic)?

All four heart valves can be replaced with an artificial (prosthetic) valve. This generally requires that your surgeon carefully removes the leaflets of your natural valve and anchor a prosthetic valve in its place using sutures. All valve replacements can be performed through a standard incision dividing your breastbone, although there are certain valves that can be replaced through smaller incisions. All surgical valve replacements require use of the heart-lung machine, which takes over the function of your heart and lungs so that your heart can be temporarily stopped to allow your surgeon to safely replace your valve.

There are two major classes of artificial valves: biologic valves, made out of animal or human tissue, and mechanical valves, made out of fabric and metal. Mechanical valves are extremely durable, but generally require that you take a blood thinner called Coumadin for the rest of your life. Biologic valves do not require Coumadin, but they are less durable, generally lasting between 10 and 15 years. Worn-out valves often require another operation to replace them.
Major complications associated with valve replacement surgery include bleeding, infection, stroke, heart failure and death. For most otherwise healthy patients, the overall risk of a major complication is about 5 percent.

**How is valve repair surgery performed (mitral, tricuspid)?**

The mitral and tricuspid valves can often be repaired rather than replaced. With valve repair, your surgeon will try to restore your valve’s function using one of a variety of repair techniques designed to allow your valve leaflets to close properly. Most of these repair techniques involve the placement of an artificial, prosthetic ring around the valve opening. These rings do not require long-term use of Coumadin.

Valve repair is generally preferable to valve replacement. Its advantages include maintenance of the normal geometry of the heart, avoidance of long-term Coumadin use, and reduced risk of prosthetic infection.

The major complications associated with valve repair surgery are similar to those of valve replacement.
What is a thoracic aortic aneurysm?
The aorta is the largest artery in your body. It serves as the major thoroughfare through which your heart pumps blood to the rest of your body. Approximately the diameter of a garden hose in an average-sized adult, the aorta extends from the base of your heart upward toward your head and arches downward through your torso toward your pelvis, where it divides into two major arteries to supply your lower extremities. The section of your aorta that travels in the chest is called the thoracic aorta. The section of aorta traveling in your abdomen is termed the abdominal aorta.

A thoracic aortic aneurysm (TAA) occurs when any portion of the aorta within the chest cavity enlarges, much like an inflating balloon. The primary risks of an enlarging aortic aneurysm are tearing of the aortic wall, referred to as dissection, and bursting or rupture. Aortic dissections or ruptures are often fatal events. The risk of dissection or rupture increases with the size of the aneurysm.

There are two major types of aortic aneurysms based primarily on their shapes: fusiform and saccular.

Fusiform aneurysms are symmetric enlargements that extend evenly around the entire aortic wall.

Saccular aneurysms are uneven bulges of a portion of the aortic wall, resembling a blister or weakened area of an inner tube.
What are the causes and risks for developing a TAA?

- Advanced age
- Atherosclerosis ("hardening of the arteries")
- Bicuspid aortic valve (two valve leaflets instead of the normal three)
- Chest trauma (e.g., from a car accident)
- Connective tissue disorders (e.g., Marfan syndrome)
- Family history of aneurysms
- Gender (more common in men than women)
- Heart disease
- High blood pressure (hypertension)
- High cholesterol
- Smoking
- Some infections (e.g., syphilis, tuberculosis)

What are the symptoms of a TAA?

Symptoms directly related to a TAA generally do not occur until the aneurysm is of a significant size and are often related to its location. Typical symptoms include:

- Pain in the center or upper chest region is often associated with aneurysms located in the upper portion of the thoracic aorta, also referred to as the ascending aorta. A rupture or tear in this region usually requires emergency surgery.

- Pain in the back is often associated with aneurysms located in the lower portion of the thoracic aorta, also referred to as the descending thoracic aorta. A rupture or tear in this region can often lead to lower extremity numbness or paralysis as well as damage to the abdominal organs. A rupture or tear in this region can sometimes be treated with a stent or catheter-based procedure, but may also require urgent surgery.

Other symptoms include:

- Unexplained hoarseness or coughing
- Shortness of breath
- Difficulty swallowing
- Pulsing sensation within the chest

If you experience symptoms, you should inform your physician so that its cause can be investigated.

How are TAAs diagnosed?

TAAs can often be detected on plain chest x-rays. TAAs are most accurately assessed using computed tomography (CT) or magnetic resonance imaging (MRI) scans. Other studies that may also detect a TAA include an echocardiogram (i.e., cardiac ultrasound) and aortogram (i.e., dye injected into the bloodstream and imaged with x-rays).

What is an aortic dissection?

An aortic dissection is simply a tear in the wall of the aorta. When this occurs, blood, which is under high pressure, leaks within the layers of the aortic wall. This disruption substantially weakens the aortic wall, rendering it prone to rupture, and can cut off blood flow to important blood vessel branches, interrupting blood supply to vital organs. This condition is a life-threatening emergency and requires immediate medical and surgical attention.
How are TAAs treated?

Small aneurysms carry a relatively low risk for rupture and are often simply monitored with CT scans or MRI studies every 6–12 months to assess aneurysm enlargement, if any. Additionally, blood pressure-lowering medications are often prescribed to decrease the pressure on the wall of the aortic aneurysm to limit its growth and risk of rupturing or tearing. Lowering your blood cholesterol levels through medications or diet, and stopping smoking are also recommended.

Larger aneurysms, particularly those that are 5 centimeters or more in diameter, are at a much higher risk of dissection or rupture, and surgery is usually recommended.
Ascending TAA repair

Repair of the ascending thoracic aorta is performed through the standard breast-bone-splitting incision, or sternotomy. The heart-lung machine is used to take over your heart and lung function, allowing the heart to be stopped to interrupt blood flow through the aneurysm temporarily. The aneurysmal aorta is then removed and replaced with a synthetic tube made of Dacron, which has lifelong durability and does not require any special medications. Sometimes, when the aneurysm extends deeply into the base of the heart, the aortic valve and the surrounding aortic tissue, also known as the aortic root, also needs to be replaced. Major risks associated with this operation include bleeding, infection, stroke, heart failure and death. The overall risk of suffering a major complication in an otherwise healthy patient is about 5 to 7 percent.

Descending TAA

Repair of the descending thoracic aorta is generally performed through an incision between the ribs on the left side of the chest. It also requires the use of the heart-lung machine, although the heart itself may not need to be stopped. In some cases, a much less invasive repair can be performed using a stent-graft, which is delivered with a catheter placed through one of your leg vessels. Stent-grafts resemble stents used to open coronary artery blockages, but they seal off the aneurysm to blood flow. This type of aneurysm repair has the benefits of less blood loss, less pain and disfigurement, fewer complications and shorter hospitalizations.

Major risks associated with this operation include bleeding, infection, stroke, heart failure, paraplegia and death. The overall risk of suffering a major complication in an otherwise healthy patient varies according to the extent of the aorta being replaced, but generally ranges between about 5 and 15 percent.

Your surgeon will usually obtain some tests in preparation for these operations, including a coronary angiogram to make sure that you do not have coronary artery disease, and an echocardiogram to make sure that your heart function is adequate and that you do not have any heart valve disease.
What is atrial fibrillation?
Atrial fibrillation is a relatively common but abnormal heart rhythm consisting of an irregular and unusual rapid beating of the heart. Although atrial fibrillation is not usually a life-threatening condition, the heart pumps blood less efficiently when it is in atrial fibrillation.

ECG tracing of a normal heart rhythm

In atrial fibrillation, the tracing shows tiny, irregular “fibrillation” waves between heartbeats. The rhythm is irregular and erratic.
What does atrial fibrillation do to your heart?

In atrial fibrillation, the upper chambers of your heart, called the atria, quiver rather than beat in a coordinated fashion. This situation results in blood pooling in the atria, making it more prone to forming blood clots. The lower, main pumping chambers of your heart, called the ventricles, beat irregularly and usually too quickly. The ventricles have less time to fill completely with blood and the heart therefore pumps less efficiently. Atrial fibrillation is associated with a five-fold increased risk of stroke and two-fold increased risk of death over time.

What causes atrial fibrillation?

Atrial fibrillation is caused when extra locations in the atria create “extra” electrical waves, which interfere with the normal clock-like conduction system of the heart.

Common risk factors and causes of atrial fibrillation include:

- Chronic lung disease
- Diabetes
- Excessive alcohol or caffeine consumption
- Heart disease, including valve disease, coronary artery disease, inflammation, prior heart attack or congestive heart failure
- High blood pressure
- Obesity
- Thyroid disease
What are the symptoms?

Atrial fibrillation does not always cause symptoms, but common symptoms associated with atrial fibrillation include:

- Fatigue
- Palpitations
- Shortness of breath
- Dizziness
- Fainting spells

How is atrial fibrillation diagnosed?

Atrial fibrillation is diagnosed primarily by an electrocardiogram, which measures the electrical impulses created by your heart’s conduction system. A Holter monitor is a device that continually records these impulses over one or more days and can detect atrial fibrillation when it occurs only occasionally. There are three major categories of atrial fibrillation:

**Paroxysmal atrial fibrillation:** In paroxysmal atrial fibrillation, the episodes of atrial fibrillation occur occasionally, last less than seven days at a time, and stop on their own without medical treatment.

**Persistent atrial fibrillation:** In persistent atrial fibrillation, the episodes last more than seven days and stop only after medical treatment.

**Long-standing persistent atrial fibrillation:** In long-standing persistent atrial fibrillation, atrial fibrillation is continuous for at least one year.

How is atrial fibrillation treated?

There are two parts of medical treatment for atrial fibrillation. In general, medical treatment is used first before more invasive procedures are considered. The first part of medical therapy involves the use of medications to suppress the occurrence of atrial fibrillation episodes. There are many different medications with different side effects, but they are generally safe when administered by a qualified physician. The second part entails the use of a blood thinner called Coumadin, which impairs your blood from clotting normally. This is necessary to prevent the formation of blood clots within the quivering chambers of your heart that can lead to stroke or other serious complications.

In many cases, medical treatment for atrial fibrillation is ineffective or carries so many side effects as to be highly undesirable or unsafe for the patient. In this case, more aggressive treatment for atrial fibrillation involves destroying, or ablating, those regions of the heart that create the extra electrical impulses responsible for atrial fibrillation. Ablation can be conducted with a catheter inserted into your heart through one of your leg vessels or with surgery. These two approaches have their own advantages and disadvantages that your doctors can discuss with you.
In surgical ablation, an energy source is used to burn regions of the heart that are known to create the extra electrical impulses that cause atrial fibrillation. These ablations can be performed through a standard breastbone incision or through smaller incisions through the ribs. The approach is often determined by whether there are other cardiac procedures that need to be performed at the same time (e.g., valve replacement, coronary artery bypass). In most cases, your doctor will obtain an echocardiogram and coronary angiogram to make sure that you do not have significant valve or coronary artery disease that would also need to be addressed.

In many cases, a small portion of the left atrium in which blood clots tend to form can be removed from the heart at the time of the ablation, possibly lowering the risk of stroke.

Major risks associated with this operation include bleeding, infection, stroke, cardiac injury, heart failure, nerve damage and death. In most otherwise healthy patients, the risk of suffering a major complication is about 2 to 3 percent.
What is congestive heart failure?
Heart failure is a common, costly, and disabling disease. It affects nearly five million adults in the United States alone, with approximately 500,000 new cases diagnosed annually. While nearly 2 percent of all adults will experience heart failure, this rate rises from 6 to 10 percent in adults over the age of 65. It is the leading cause of hospitalization in patients over the age of 65.

What is congestive heart failure?
Congestive heart failure (CHF) is a medical condition in which the heart can no longer pump blood properly throughout the body.

What causes congestive heart failure?
CHF can occur after a condition damages the heart in some way, weakening the muscle.

Conditions that can cause heart failure include the following:

- Abnormal heart rhythms (arrhythmia)
- Cardiac valve disease
- Congenital heart disease
- Coronary artery disease (CAD)
- Dysfunctional heart muscle of unclear cause (idiopathic cardiomyopathy)
- High blood pressure
- Other illness
How is congestive heart failure diagnosed?

**CHF is diagnosed by means of several tests:**

**BLOOD TESTS** check for the presence of a chemical called B-type natriuretic peptide (BNP). It is produced by the heart in large quantities when the heart is overworked. An elevated BNP level suggests congestive heart failure.

A **CHEST X-RAY** shows a picture of the size and shape of your heart and lungs. This may reveal an enlarged heart or excess fluid in the lung space.

An **ECHOCARDIOGRAM** uses sound waves to produce a picture of your heart and can show how well it pumps. It measures the percentage of blood pumped out from the main pumping chamber (ventricle) with each heartbeat. This percentage is known as the ejection fraction and is normally around 55 percent. The ejection fraction is reduced in heart failure and can be as low as 10 percent.

An **ELECTROCARDIOGRAM** (ECG) measures the electrical impulses/activity of the heart. This can be used to detect rhythm disturbances (arrhythmias) or damage caused by a previous heart attack, both of which can contribute to heart failure.

**CARDIAC CATHETERIZATION** is a test in which a thin, flexible tube is inserted into a blood vessel in the groin or wrist and guided into the heart. A dye is then injected that makes the coronary arteries visible, allowing for identification of narrowed vessels found with coronary artery disease (a cause of heart failure). It can also help show how strong your left ventricle is (main pumping chamber) and how healthy your heart valves are.

**MYOCARDIAL BIOPSY** is a test in which a small, flexible biopsy device is inserted into a vein in the neck or groin and takes small pieces of your heart muscle for microscopic examination. This biopsy can determine certain muscle diseases that cause heart failure.

In a **RIGHT HEART CATHETERIZATION**, a thin flexible tube is inserted into a blood vessel in the neck or groin and guided into the right-sided chambers of the heart, measuring the pressures within. It is used to help determine the severity and cause of heart failure.

**RADIONUCLIDE VENTRICULOGRAPHY** or **MULTIPLE-GATED ACQUISITION SCANNING** (MUGA) involves the injection of a small amount of radioactive dye into a vein. Special cameras are used to measure how much blood is ejected with each heartbeat.

CHF is classified on a scale of I to IV. Class I is the mildest. You can do everyday activities without feeling fatigued or short of breath. Class IV is the most severe, causing you to feel short of breath at rest.

What are the symptoms?

Symptoms of CHF include shortness of breath with activity or lying flat, feeling tired, poor appetite, swollen feet and ankles, swollen abdomen, waking up at night from sleep unable to breathe, sudden weight gain from fluid retention and the sensation that you can feel your heart beating (palpitations).
How is congestive heart failure treated?

CHF can be treated in several ways, depending upon the severity of your symptoms and what your physician feels is right for you.

Home monitoring/lifestyle changes

- At home, track your blood pressure, pulse rate and weight in a notebook. If you find you are gaining two to three pounds over one or two days, call your physician. This is a sign your body is holding onto fluid.
- Limit salt intake
- Limit taking in fluids if you are very swollen
- Do not smoke
- Maintain an active lifestyle as your symptoms permit; exercise is beneficial
- Try to lose weight if you are overweight
- Allow time for rest during the day

Medications/surgical devices

Your physician will prescribe medicine to treat your heart failure. The medicine is used to help your heart pump better, slow down your heart rate to keep it from working too hard, rid you of extra fluid, replace lost potassium, and keep your blood from clotting.

Examples of some commonly used medications are Carvedilol (beta-blocker), Lisinopril (ace-inhibitor), Lasix (diuretic), Spironolactone (potassium-sparing diuretic), potassium and Warfarin (anticoagulant).

Some operations and procedures may be used to treat your heart failure. Your physician may feel they may be helpful based on your symptoms. They include:

- Coronary bypass surgery to increase blood flow to your heart if you have a blockage in your coronary arteries
- Heart valve surgery if a malfunctioning heart valve is causing your heart failure
- Pacemaker implantation to help regulate abnormal heart rates or assist in getting both sides of your heart to contract at the same time to improve blood flow
- Defibrillator implantation to stop any life-threatening heart rhythms with an electrical pulse or shock

If your heart failure is severe enough, your physician may talk to you about cardiac transplantation or ventricular assist device implantation.

How are operations for congestive heart failure performed?

Cardiac transplantation

Cardiac transplantation is a procedure in which the failing heart is replaced with a healthy heart from a donor. This operation is reserved for those patients whose heart failure is considered end-stage with less than one year to live. Transplantation is performed in about one percent of patients diagnosed with heart failure.

Benefits and risks

Patients derive tremendous benefit from heart transplantation, with an improved quality and extension of life. As with any operation, there are risks involved. These risks include infection, bleeding, stroke, rejection of the new heart, side effects from the post-transplant medication regimen, and an increased risk of certain types of cancer due to the immunosuppressant medications.
Ventricular assist device implantation

A ventricular assist device (VAD) is a mechanical device used to partially or fully take over the work of a failing heart. It helps the struggling heart pump blood from the main pumping chamber (left ventricle) to the rest of the body.

A left ventricular assist device (LVAD) is the most common type of VAD used today. It pumps blood from the left ventricle to the aorta. It is used to support the patient until he/she receives a transplant/recovers or is left in place permanently if the patient is not a candidate for transplantation.

A right ventricular assist device (RVAD) is typically used for short-term right ventricular support. The RVAD helps the right ventricle pump blood to the pulmonary artery and lungs, where it is oxygenated.

Benefits and risks

Implantation of a VAD can help end-stage heart failure patients in several ways. First, it significantly improves the symptoms associated with heart failure. Second, it can buy time while the patient waits for a heart transplant or, if he or she is not a transplant candidate, may improve the quality of and duration of life. Finally, improved blood circulation provided by the VAD can help the patient get healthier and become better prepared for undergoing an eventual transplant.
Preparing for surgery
Before your operation, you will meet with your surgeon and surgery team members. This appointment will prepare you for your operation and provide you with the opportunity to ask any questions you may have. Many patients find it helpful to write down their questions ahead of time.

The preoperative visit

This appointment is scheduled at the hospital prior to your surgery date. At this visit, you will meet with a nurse practitioner or physician’s assistant and an anesthesiologist who will obtain a thorough history and perform a physical exam. Preoperative tests usually include:

- Blood work
- EKG
- Chest x-ray
- Urinalysis

During the preoperative visit, the nurse or physician assistant will review your medications and indicate which, if any, should be discontinued before your operation. These may include:

- Aspirin
- Coumadin (Warfarin)
- Plavix or any other similar blood thinners
- Blood pressure medications known as ACE inhibitors
- Certain diabetes medications
- Vitamins/supplements
- Insulin (you will be given clear instructions as to how much insulin to take the day prior and morning of surgery)
Preoperative Information

Blood Donation
You may be able to donate blood for your own use in case you need it during or after your operation. This is called *autologous* blood donation, meaning it is your own blood. Your cardiac surgeon will determine if it is safe for you to donate blood based on your medical condition and the timing of your operation. To donate blood, you will need to make an appointment with the blood bank several weeks prior to your operation.

Smoking
It is in your best interest to stop smoking prior to your operation. Smoking increases your risk of suffering a complication, such as pneumonia, after your operation. Ask your doctor or nurse for information and medicine to help you quit.

Alcohol
As with smoking, alcohol in excess can complicate matters after surgery.

Healthcare decision making: Advance Care Directives
A *healthcare proxy* is a document that allows you to designate a person to make healthcare decisions on your behalf in the event you are unable to make decisions for yourself. Your proxy should be someone you trust enough to make informed treatment decisions on your behalf.

A *living will* is a document that outlines the medical care you would want to receive in the event you became sick and unlikely to recover.

If you already have these documents, please bring them to the hospital on the day of your operation and have them placed in your chart.

The hospital can assist you in completing one or both of the forms if you do not already have them. It is important that you have your healthcare instructions in place before surgery.

The night before surgery
Your surgeon may request that you cleanse yourself with an antibacterial soap the night before and morning of your operation. You may eat and drink up until midnight the night prior to your operation. In the morning, you may take the medications you were instructed to take with a small amount of water.

The day of surgery
You will receive instructions from the hospital as to what time you should arrive on the day of your operation and where to check in. It is best to leave most valuables at home. There is no need to bring toiletries or additional clothing on the day of surgery. Your family can bring these in during your recovery period.

When you arrive at the hospital, you will be taken to the waiting area, where a nurse will explain the operation. You will also meet with your anesthesiologist. If any additional blood work is necessary, it will be drawn at this time.

When the operating room is ready, a bed will be sent for you. At this time, your family will be shown to the waiting room, where volunteers will be ready to greet them. Once the operation is over, your surgeon or a member of the surgical team will speak with your family and provide them with details of the operation. Families often find it less stressful to wait at home during the operation. If your family would like to leave the hospital, they can leave a cell phone number with the staff.
In the Cardiothoracic Intensive Care Unit (CTICU)
After your operation, you will be transported to the Cardiothoracic Intensive Care Unit (CTICU). You will be cared for by a team of doctors and nurses who are specially trained in the care of cardiac surgery patients. You may receive visitors once the nurses have completed the admission process (approximately 30–45 minutes). There is a phone in the waiting room and an intercom at the door of the CTICU for visitors.

How will I feel, and what will I hear?

You and your family will hear sounds and alarms that come from machines in the CTICU. These noises are quieter at nighttime so you can sleep/rest.

When you wake up, your nurse will tell you that your operation is over. Your nurse will also ask you to follow simple commands like wiggling your toes and squeezing your hands. You may feel confused and drift in and out of sleep – a common side effect of the anesthesia and pain medication. You will have several tubes and intravenous (IV) lines in place, including a breathing tube in your throat and a bladder catheter to drain your urine.

How long will I stay in the CTICU?

In most cases, patients remain in the CTICU from one to two days before moving to the Step-Down Unit.
Pain management: It is normal to feel some degree of discomfort after your operation. This may vary from patient to patient and is related to your level of activity. Your nurse will ask you to rate your pain level and work with you to make you more comfortable by repositioning you in bed and/or offering pain medicine.

Breathing tube: When you wake up after your operation, you will have a breathing tube in your throat that is connected to a machine called a ventilator to assist you with breathing. The tube will be removed when the anesthesia has completely worn off and you are able to breathe safely on your own. While the tube is in place, you will not be able to speak, eat or drink. You will be able to communicate with your nurse and family by nodding your head.

Anesthesia also makes your stomach go to sleep. Your nurse will watch your abdomen/stomach closely to determine when it is “awake” and you are ready for ice chips and sips of water. It is important to drink slowly to avoid nausea. Your diet will increase to solid food as tolerated, usually by the first day after surgery.

Deep breathing and coughing: You will be given a “coughing pillow.” Hugging the pillow against your chest incision while you take deep breaths and cough will help protect your wound and decrease the discomfort. You will also be given an incentive spirometer to keep your lungs clear and prevent pneumonia.

Monitors: There are monitors in your room and at the main desk to display your vital signs, cardiac rhythm and other important information.

Chest tubes: You will have two to four chest tubes at the bottom of your incision to drain blood and fluid from the area around your heart and lungs. These tubes will also help to re-expand your lungs. The tubes are usually removed in two days. You may receive pain medication before the tubes are removed.

Intra-aortic balloon pump: Based on your condition, you may or may not require this temporary pump, which is used to help support your cardiac function as your heart recovers from the operation. This device may stay in place for one to two days or until your heart becomes stronger.

Bladder catheter: A bladder catheter called a Foley catheter is inserted at the time of your operation to drain your urine.

Venodyne boots: Venodyne boots are soft sleeves worn on your lower legs and fastened with Velcro tabs. The sleeves inflate and deflate to help prevent blood clots from forming while you are in bed.

Blood glucose checks: The stress of surgery can cause blood glucose (blood sugar) levels to rise. Studies show that checking blood sugar can lower the chance of developing an infection and other complications following surgery. Depending on the levels you may require insulin. This is usually temporary and does not mean you will become a diabetic.

Pacing wires: While you are in the operating room, your surgeon may place temporary pacing wires on your heart. This is a preventive measure to regulate your heart rhythm in the early post-operative period and does not mean that you will need a permanent pacemaker.

Visitors: While you are in the operating room, your family will be directed to the CTICU waiting room. There is a computer screen in the room where your visitors may track your status. The surgeon or the nurse associate will speak to your family in the waiting room after your operation. It is very important to us that you and your family stay informed.

Activity: While you are in bed, your nurse or PCA will turn you to change your position every two hours. This helps to prevent redness and skin sores. You will slowly increase your activity levels to walking three to four times a day with assistance. It is important that you try to increase your activity levels each day you are in the hospital. A physical therapist will be available to assist you with these goals.
**Attending physician:** The attending physician is the doctor responsible for your care while you are on this unit. Your attending physician will see you daily and examine you to discuss your progress and to notify you of plans for tests, changes in treatment, or transfer to the Step-Down Unit.

**House staff:** The house staff is a team of fellows, residents, interns, PAs (physician assistants), APRNs (advanced practice registered nurses) and medical students from Yale Medical School. The house staff is in the CTICU 24 hours a day and will visit you many times each day.

**CTICU nursing staff:** CTICU nurses have special training in caring for heart patients. They will care for you throughout your entire stay in this unit, making sure you receive the medications, treatments and diagnostic tests ordered by your doctor.

**Intensivist staff:** Intensivists are doctors who have special training in critical care medicine. These doctors will work closely with your surgeon to provide the best quality of care for you while you are in the CTICU.

**Respiratory therapists:** Respiratory therapists are skilled in caring for patients with heart and lung problems. As members of your healthcare team, they will work with your nurse to provide your respiratory care. This will include managing your breathing machine and oxygen therapy.

**Patient care associates** (PCAs): Patient care associates assist your nurse in caring for you.

**Business associates** (BAs): Business associates manage the main desk on the unit. They answer and direct all phone calls.

**Pharmacists:** A pharmacist rounds with the rest of your care team and assists in reviewing and prescribing your medications.

**Religious ministers:** A board-certified chaplain is always available to support patients and families during their hospital stay. A Catholic priest is usually available Monday through Thursday. Eucharistic ministers visit daily and offer communion to patients who want and are able to receive communion. Worship and prayer sessions are available during the week, holy days and other days of remembrance. The chapel is located on the first floor of the South Pavilion and is open 24 hours a day for prayer and meditation.

- Roman Catholic Mass: Sundays at 9:30 am
- Ecumenical Christian Service: Sundays at 10:30 am

**Social workers:** Social workers are available to provide you and your family emotional and educational support while you are in the hospital.

**Care coordinators:** Care coordinators work with you, your family and your healthcare team to find the services you and your family may need once you are ready to leave the hospital. This may mean rehabilitation, skilled nursing care and/or home care. Care coordinators are not always able to guarantee placement in a particular facility due to bed availability and insurance coverage.

**Physical therapists:** Physical therapists in the CTICU are trained to work with patients following open-heart surgery to help them regain their physical strength. Your physical therapist will work with you to get you out of bed and walking.
Care after the CTICU: the Step-Down Unit
The Step-Down Unit

Your doctors and nurses will decide when you are ready to leave the CTICU. The CTICU and Step-Down Units work together to make sure that you are exactly where you need to be on your journey to recovery. Transfer to Step-Down Unit is a positive move and shows that you are making progress in your recovery toward discharge home.

Your healthcare team

Your cardiac surgery team will coordinate and manage your care throughout your hospital stay. Every member of your healthcare team is highly trained to provide the best care and ensure your safe return home. We encourage you to be involved in your health care. Speak up if you have questions or concerns. YOU are the most important member of this team.
**Team members**

**Registered nurse** (RN): An RN will care for you at all times while you are in the hospital. The RN will work closely with your doctors in your plan of care, which includes managing your medications. A patient care associate (PCA) will assist the RN in caring for you.

**Nurse practitioner** (NP) and **physician assistant** (PA): The NP and PA work closely with your surgeon and the cardiac surgical residents and oversee your day-to-day care on the unit. They also write orders for medications and tests, and review your progress as you recover from your operation.

**Cardiac surgical resident** (MD): The surgical residents are always available to support your NP, PA or RN with your care. They make “rounds” with your surgeon every day and are very involved in seeing that you receive the care you need.

**Care coordinator** (RN): The care coordinator is a nurse specialist who is responsible for making sure that a care plan is in place when you are ready to be discharged home. We start this process early during your stay so that we can help you and your family make the best decisions possible with regard to discharge. Questions your care coordinator will ask you before discharge include:

- Who will be at home with you?
- Do you have stairs you need to climb at home?
- Do you need visiting nurses?
- Do you need to go to a short-term rehabilitation center before you can go home?

**Nurse associate:** The nurse associate is a nurse specialist who works directly with your surgeon and the rest of the staff to see that your recovery is moving forward and that we are meeting all of your needs. A nurse associate will follow you from the very beginning of your hospital stay through your discharge.

**Other members of your healthcare team may include:**

- Chaplains
- Physical and occupational therapists
- Respiratory therapists
- Social workers

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**Routine care**

**Cardiac monitoring** (telemetry): You will be attached to a cardiac monitor during your hospital stay so that our staff can always watch your heart rate and rhythm. Our staff will also check your vital signs on a regular basis. We will do our best to limit the time we check on you so that you can get a good night’s rest.

**Intravenous (IV) line:** You will have an intravenous line inserted while you are in the hospital. The IV line allows us to give you medicine and other important liquids your body needs to recover. When the line is not in use, your nurse will put a cap on it so that you can move more freely. Please let the staff know if the IV is bothering you.

**Chest tubes:** Your chest tubes drain any leftover blood or fluid that is in your chest area after your operation. These tubes are generally removed about 24 to 48 hours after your operation.

**Temporary pacing wires:** In the event your heart rate becomes too fast or too slow, these wires can be connected to a temporary pacemaker.

**Bladder catheter** (Foley): This catheter drains urine from your bladder and is generally removed on the first day or two after your operation. Once it has been removed, you can use a commode, urinal, or the bathroom. Your nurse may ask you to save your urine so that he or she can measure the amount. The staff will also weigh you every day to make sure that you are not retaining fluid.
**Pain control:** We know that you may be uncomfortable the first few days after your operation. We will ask you often to rate your pain on a scale of 1-10.

**Wound care:** The dressing on your breastbone (sternum) is usually removed on the first day or two after your operation. If your incision looks clean and dry, no further dressing will be needed. If you have staples along your incision, they may be removed before you go home.

**Daily tests:** You may have your blood drawn every day you are in the hospital so we can make sure your blood counts and electrolytes are normal. You may also need to have an electrocardiogram and a chest x-ray so we can make sure your heart rhythm and your lungs are working properly.

**Activity:** After your operation, it is important to get moving as soon as possible. Getting out of bed, sitting up in a chair, walking and taking deep breaths are important to your recovery. It is also important to keep your lungs clear by breathing deeply and coughing. It is helpful to use a pillow to protect your wound while coughing.

You will be encouraged to walk around the unit as frequently as you are able, with a goal of about four or more walks a day. The staff will assist you until you are ready to walk by yourself or with a family member. Each step is a step closer to home.

**Nutrition:** Diet progresses from ice chips to a heart healthy diet (solid foods) as tolerated. You may be more thirsty than hungry for a few days. This is normal. It is important to resume normal bowel function before you are discharged.
Going home after surgery
What to expect at home

Remember that you have undergone a major operation — give your body time to recover! Patients often feel as if they are not progressing quickly enough. It usually takes four to six weeks to feel like your normal self.

Wound care/showering

Look at your incisions daily, paying close attention to any signs of infection such as redness, thick drainage or foul odor. It is normal to have a small amount of clear, blood-tinged drainage from the incision. You may notice a small “bump” at the top of your chest incision. This is normal and will become smaller over time. Using your fingertips, wash your incisions daily in the shower with mild soap and water. Pat the incisions dry. Do not take tub baths or hot tubs until approved by your physician. It is important to protect your incision from sun exposure.

Weigh yourself

It is common to retain fluid following your surgery. Weigh yourself daily in the morning and keep a journal of your weight. Call your doctor if you gain three to five pounds during your first week home.
Activity

Walking is the best form of exercise in the recovery period. Frequent, short walks will allow you to gradually build up your endurance. As you regain your strength, increase the distance and duration of your walks in your house, in a mall, or outside.

Avoid lifting anything weighing more than ten pounds during the first month after surgery, since your breastbone is still healing. If you have had minimally invasive surgery, your lifting restrictions may be different. Your physician will guide you regarding your limitations.

Climbing stairs can be physically exhausting in the early recovery period. Take your time and stop frequently if you feel too tired.

Elevate your legs when you are sitting for any length of time. Sitting for prolonged periods, especially with your legs down, can lead to swelling of your feet and lower legs. Remember to walk frequently.

Sleep

You will probably experience abnormal sleep patterns for several weeks after surgery. Try to re-establish your normal routines. Being active during the day and taking only short naps should help in reestablishing your usual sleep patterns. You can sleep in the position of comfort.

Emotions

It is common to feel mildly depressed after surgery. This is usually the result of feeling dependent on others and not being able to do simple tasks without becoming overtired. Temporary feelings of sadness are normal and should gradually go away within a few weeks, as you get back to your normal routine and activities.

Sexual activity

You may resume sexual activity when you feel ready and your surgeon approves. The effort required is similar to climbing two flights of stairs. Choose a position that does not put pressure on your chest.

Driving

Your physician will determine when you can drive. You should not drive if you are taking narcotic pain medications. When wearing your seatbelt, we recommend using a small pillow or towel to decrease discomfort from the belt rubbing against your chest incision.

Travel

If you plan to travel by air in the first few weeks following surgery, you must have clearance from your physician. During the flight, be sure to walk frequently. If you are traveling a long distance by car, plan to take breaks every one to two hours to stretch your legs.

Returning to work

Most patients return to work approximately four to six weeks after surgery. This period may need to be longer if your work requires you to perform strenuous activities.
Diet/appetite

After surgery many patients have a poor appetite and find the smell and taste of certain foods disagreeable. Small frequent meals are usually better tolerated.

Diet: Unless specifically prescribed by your physician, we advocate a heart healthy diet. There are many resources available on the internet, in bookstores, and at the local library to learn about healthy food choices. If your cardiologist enrolls you into cardiac rehab (approximately 6 weeks after surgery), you will also be provided with information.

Caffeine: Avoid all caffeine for the first month following surgery.

Medications

You will be given a list of medications and prescriptions you will need when you are discharged from the hospital. This list may be different from the medications you were taking before surgery. It is important that you do not stop taking any medications without first discussing this with your physician.

Follow-up appointments

Cardiac surgeon: You will be given an appointment to see your surgeon in approximately two to six weeks.

Cardiologist: Call your cardiologist to schedule an appointment.

Primary Care physician (PCP): It is recommended you also follow up with your PCP.

Signs and symptoms that require immediate attention

- Chest pain or pressure not related to incisional discomfort
- Racing heart rate or irregular pulse
- Fever of 101° or greater, or shaking chills lasting more than 24 hours
- Sudden onset of shortness of breath
- Drainage from your incisions that is thick, pus-like, or has a foul odor

If you are readmitted to the hospital, please have your family notify your surgeon’s office.
Frequently asked questions

Q: How long does the operation take?
A: Routine cardiac operations usually last four to six hours, though other factors can result in shorter or longer durations. Additional time is required to transport the patient to and from the operating room, to induce anesthesia, and to prepare the patient for surgery.

Q: How soon can I have visitors?
A: As soon as the patient is admitted to the CTICU and stabilized, you will be allowed to visit. Please call in by using the phone in the waiting room, or use the intercom at the door to the CTICU to make sure the patient is ready for a visitor.

Q: Why do patients shiver after surgery?
A: Shivering can occur in the early postoperative period as the patient’s body re-warms. Nurses monitor the re-warming carefully and occasionally give medication to decrease shivering if it does not stop on its own.

Q: When can family members visit patients in the CTICU, and can family stay overnight?
A: Family and other visitors may visit during the first few hours in the early postoperative period for brief five- to ten-minute visits. Family members are generally not permitted to stay overnight in the CTICU patient rooms. There is a family waiting room just outside the CTICU where families are welcome to wait between visits.

Q: Why do patients appear puffy?
A: Patients often appear puffy in the first several days after their operation due to the intravenous fluids given in the operating room. This puffiness will decrease as the patient is able to sit up, get out of bed, and urinate.

Q: What are my chances for doing well after my operation?
A: Risks for cardiac operations vary according to the operation and your personal risk factors. For most cardiac operations, potential complications include bleeding, stroke, heart failure, infection and death. For most routine operations in otherwise healthy patients, the risk of major complications is between 2 and 3 percent. Talk with your surgeon about your personal risks.

Q: Why am I so thirsty, and when can I drink water?
A: You will be very thirsty due to medications given during the operation. At first, you will be allowed to have only ice chips and sips of water to avoid nausea. You will receive more fluids as your bowel function returns.
Q: When can I eat?
A: You will be able to eat once the breathing tube is out and your nurse has determined that it is safe for you to begin eating food. Most patients are able to eat on the morning after their operation.

Q: When do I transfer to the Step-Down Unit? Will the room be a private or double occupancy?
A: Once your care team decides that you are stable for transfer out of the CTICU, you will be moved to the Step-Down Unit. Most of the rooms in the Step-Down Unit are double occupancy, but there are some single rooms. You can request one, but know that it is not possible for us to provide everyone a private room.

Q: My blood sugar was high postoperatively and I needed insulin. Why?
A: Your blood glucose may increase as part of your body’s normal stress response to your operation. Because recent studies have proved that recovery and healing improve with well-controlled blood glucose, you may receive insulin in the early postoperative period. This does not mean you are diabetic or will need insulin in the future.

Q: How and when are the pacing wires removed?
A: Temporary cardiac pacing wires are placed in most patients. They are sometimes used to pace the heart in the early postoperative period. They will be removed before you are discharged home by your nurse practitioner or physician assistant.

Q: Why do I need a chest x-ray in the morning? Most importantly, why are they done so early?
A: Chest x-rays are usually performed early in the morning so the film can be seen by your surgeon to formulate your care plan for the day.

Q: What can and can’t I do when I go home?
A: A list of recommendations will be provided to you before you go home. In general, we ask that you balance rest and activity, avoid lifting anything heavier than ten pounds, and avoid driving. Your surgeon will determine the duration of these restrictions according to your individual factors.

Q: When can I shower?
A: Your surgeon will specify when you can shower, but most patients resume showers once they return home. In fact, many patients shower in the hospital before being discharged. However, you should avoid tub baths until your wound is completely healed.

Q: Is it safe for me to have an MRI after my operation?
A: In most cases this imaging is safe, but you should ask your surgeon.
Glossary of commonly used terms

**Abdominal aorta**: the section of aorta traveling in the abdomen

**Ablation**: a procedure using energy to interrupt abnormal electrical pathways in the heart that cause abnormal heart rhythms

**Aneurysm**: an abnormal widening or ballooning of a portion of an artery due to weakness in the wall of the blood vessel

**Aorta**: the main vessel that carries blood away from the heart to the rest of the body

**Aortic arch**: a curved portion of the aorta between the ascending and descending parts of the aorta

**Aortic dissection**: a tear in the inner wall of the aorta causes blood to flow between the layers of the wall of the aorta and force the layers apart

**Aortic root**: the aorta tissue surrounding the aortic valve

**Aortic valve**: a valve that permits oxygen-rich blood to be ejected from the left ventricle through the aorta to the rest of the body

**Arrhythmia**: a rhythm disturbance in the heart

**Ascending aorta**: the upper portion of the thoracic aorta

**Atria**: the two upper chambers of the heart that receive blood into the heart and drive it into a ventricle, or chamber, that pumps blood away from the heart

**Atrial fibrillation**: a relatively common but abnormal heart rhythm consisting of an irregular and unusual rapid beating of the heart

**Biologic valve**: an artificial cardiac valve composed of biological tissue

**Cardiac catheterization**: a medical procedure to diagnose and treat some heart conditions by inserting a catheter into a chamber or vessel of the heart

**Chest x-ray**: a painless, noninvasive test that creates pictures of the structures inside the chest, such as the heart, lungs and blood

**Computed tomography (CT) scan**: a heart-imaging test that provides detailed images of the heart and its blood vessels

**Congestive heart failure (CHF)**: a medical condition in which the heart can no longer pump blood properly throughout the body

**Coronary arteries**: specialized arteries that supply oxygen-rich blood to the heart muscle

**Coronary artery bypass grafting (CABG)**: a surgical procedure in which one or more blocked coronary arteries are bypassed by a blood vessel graft to restore normal blood flow to the heart muscle

**Coronary artery disease (CAD)**: a narrowing of the small blood vessels that supply blood and oxygen to the heart

**Descending thoracic aorta**: the lower portion of the thoracic aorta

**Echocardiogram**: a test that uses high-pitched sound waves to create moving pictures of the heart

**Ejection fraction**: a measurement of the percentage of blood pumped out from the main pumping chamber of the heart with each heartbeat; it is reduced in heart failure

**Electrocardiogram (ECG)**: a test that measures the heart’s electrical activity
**Foley catheter**: a thin, sterile tube inserted into the bladder to drain urine

**Fusiform aneurysm**: an out-pouching or widening of an artery or a vein that is shaped like a spindle

**Healthcare proxy**: a document that allows a patient to designate a person to make healthcare decisions if the patient is unable to make them for him- or herself

**Internal mammary artery**: blood vessels located on the inside of the chest wall that are frequently used as bypass grafts in coronary artery bypass surgery

**Intra-aortic balloon pump**: a device used to temporarily support a failing heart or to increase coronary artery blood flow

**Left coronary artery**: an artery that supplies blood to the left ventricular heart muscle

**Living will**: a document that describes a patient’s treatment preferences in end-of-life situations

**Magnetic resonance imaging (MRI)**: a scan that uses a magnetic field and pulses of radio-wave energy to provide pictures of blood vessels and other structures inside the body

**Mitral valve**: a one-way valve that permits oxygen-rich blood from the lungs to flow from the left atrium into the left ventricle

**Multiple-gated acquisition scanning (MUGA)**: See radionuclide ventriculography

**Myocardial biopsy**: a test in which a small, flexible biopsy cord is inserted into a vein in the neck or groin and takes small pieces of the heart muscle for examination

**Myocardial infarction** (MI): commonly known as a heart attack, an MI is caused when blood supply to the heart is cut off

**Off-pump CABG** (coronary artery bypass grafting): heart surgery performed without the use of a cardiopulmonary bypass (CPB) pump – that is, the surgeon does not stop the heart during surgery

**Pacemaker**: a small device implanted under the skin (most often in the shoulder area just under the collarbone), which sends electrical signals to speed up and regulate a slow heartbeat

**Pacing wires**: temporary small wires used to speed up the heart rate when necessary

**Pulmonary artery**: a large blood vessel that carries oxygen-poor blood from the heart to the lungs

**Pulmonary valve**: a valve that prevents the backflow of blood as it is pumped from the right ventricle to the pulmonary artery

**Radial artery**: an artery in the wrist that can be used to check your pulse

**Radionuclide ventriculography**: the injection of a small amount of radioactive dye into a vein to measure how much blood is ejected with each heartbeat; also called multiple-gated acquisition scanning (MUGA)

**Regurgitation**: the backward leakage of blood through defective heart valves

**Right coronary artery**: an artery that delivers oxygen-rich blood to the muscle of the right ventricle

**Saccular aneurysm**: a saclike out-pouching of an artery that is shaped like a berry

**Saphenous vein**: a large superficial vein of the leg and thigh

**Spirometer**: an instrument for measuring the volume of air entering and leaving the lungs

**Stent-graft**: Synthetic expandable tubes used to treat aortic disease

**Sternotomy**: a type of incision in the center of the chest that divides the breastbone (sternum) to allow access to the heart

**Sternum**: the long, flat bone in the front-center of the chest

**Stenosis**: an abnormal narrowing of a valve or artery

**Telemetry**: transmission of cardiac electrical signals to a receiving location where they are displayed for monitoring
Thoracic aorta: the section of the aorta that travels in the chest

Thoracic aortic aneurysm (TAA): a bulging, weakened area in the wall of the aorta resulting in an abnormal widening or ballooning greater than 50 percent of the normal width

Thoracotomy: an incision that a surgeon makes to open the chest between the ribs

Tricuspid valve: the three-flapped, one-way valve on the right side of the heart, between the right atrium and the right ventricle, which prevents backflow of blood from the ventricle to atrium

Venodyne boots: inflatable stockings that are applied to the legs to prevent blood clots from forming

Ventricles: the pumping chambers of the heart

Ventricular assist device (VAD): a mechanical device that can partially or fully take over the work of a failing heart

References

These references are available on request from the patient care units at Yale-New Haven Hospital:

* Straight from the Heart: A Book About Heart Surgery and Your Recovery (Herc Publishing, 2009)

* Stepping Toward Control: Type 1 and Type 2 Diabetes (Herc Publishing, 2009)

* Your Guide to Living with Heart Disease (HERC Publishing, 2011)


Directions, parking and accommodations

DIRECTIONS to main entrance, 20 York Street

I-95 traveling north Exit 47 to Route 34 west to Exit 3. The Air Rights Garage entrance is immediately on your left. You can enter it from North or South Frontage Roads, or York Street.

I-91 or I-95 traveling south Exit 1 to Route 34 west to Exit 3. The Air Rights Garage entrance is immediately on your left. You can enter it from North or South Frontage Roads, or York Street.

For valet parking at the main entrance Follow I-95 or I-91 directions above to Route 34 west to Exit 3. Left at the second light onto Park Street. Left at second light onto Howard Avenue. Left at next light onto York Street. Left into the circular driveway at the hospital’s main entrance (20 York Street). See valet parking attendant.

Wilbur Cross Parkway (Rte. 15) traveling south Exit 59 immediately after tunnel. Right at end of ramp. Merge left onto Whalley Avenue at light. Stay on Whalley until you see signs for Yale-New Haven at Park Street. Follow signs. Park in the Air Rights Garage. Enter from North or South Frontage Roads, or York Street.

Merritt Parkway (Rte. 15) traveling north Exit 57 to Route 34 east into New Haven. Right onto Ella T. Grasso Boulevard (Route 10) and left onto South Frontage Road (Legion Avenue). Follow hospital and Route 34 signs. Park in the Air Rights Garage.

Route 1 (Boston Post Road) traveling east After crossing Ella T. Grasso Boulevard (Route 10), turn left onto Davenport Avenue. When Davenport crosses Howard Avenue, it becomes York Street. The hospital’s main entrance is on the left. Parking is straight ahead in the Air Rights Garage spanning York Street.

Directions telephone line For pre-recorded directions to various buildings and parking areas at Yale-New Haven Hospital, call 203-688-1234.

PARKING

YNHH encourages patients and visitors to use valet parking or park in medical center garages staffed by the hospital’s protective services staff.

Parking rates
Call the hospital parking office to inquire about current rates — the valet rate or the garage rates — at 203-688-2623. The hospital parking office is open Monday–Friday, 7:30 a.m.–4 p.m.

Parking garages
Air Rights Garage (over York Street) Patients and visitors may park 24 hours a day in the
Air Rights Garage, which is owned and managed by the New Haven Parking Authority. A covered pedestrian bridge connects the second floor of the garage to the 20 York Street entrance of the hospital.

**Howard Avenue Garage** (790 Howard Avenue) Patients and visitors may also park in the Howard Avenue Garage, which is owned by Yale University and located next to the Yale Physicians Building. Hours are 6 a.m.–9 p.m., Monday–Friday.

**Children’s Hospital Garage** (corner of Howard Avenue and York Street), under the Children’s Hospital, is primarily reserved for physicians; however, families and visitors may park in the garage evenings (5–10 p.m.) and on weekends and holidays (9 a.m.–10 p.m.).

**Valet parking** Valet parking is available at the following locations and hours:
- Main hospital (20 York Street) Monday–Friday, 5:30 a.m.–8 p.m. and weekends 9 a.m.–5 p.m.
- Children’s Hospital (Howard Avenue) Monday–Friday, 6 a.m.–8 p.m. and weekends 9 a.m.–8 p.m.

**Parking escorts** You or your family member may request an escort to any hospital parking facility at any time by calling protective services, 203-688-2500.

**Parking passes** Long-term parking – if a patient is hospitalized for an extended period of time, the family may speak with the social worker on the unit about parking pass options.

**Financial hardship** If you are experiencing financial difficulties, speak with the social worker on the unit about parking options.

**ACCOMMODATIONS**
New Haven offers hotels and other accommodations geared toward longer-term stays. Some options are within walking distance, and many within a few minutes by car. Please call patient relations at 203-688-3430 for hotels, phone numbers and rates.

The Suites at Yale-New Haven is a new hotel offered by Yale-New Haven Hospital at the corner of Dwight Street and North Frontage Road. It includes 24 suites with full kitchens. Daily, weekly and monthly rates. For more information, visit [www.suitesatyale-newhaven.com](http://www.suitesatyale-newhaven.com). For reservations, please call 203-654-7500.
Weight & temperature chart

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