

Your Cardiac Catheterization

Introduction

A cardiac catheterization is a procedure that examines the heart. During this procedure, a physician can measure pressures inside the heart, take pictures of the arteries bringing blood to the heart, and assess how well the heart is pumping.

This booklet explains what happens before, during and after a cardiac catheterization. It also has information to help you understand the results of your cardiac catheterization. Coronary artery disease, angina and heart attacks are also discussed.

Understanding the Heart and its functions

Your heart is about the size of your fist. It consists of four connected hollow chambers. The heart's walls are mainly made up of a specialized type of muscle called myocardium. When this specialized muscle contracts, it pumps blood to the lungs and body. Special valves between the heart's chambers open and close with each heartbeat. They ensure that blood goes forward and doesn't leak backwards.

The human heart is divided into right- and left-sided chambers, and upper and lower chambers. The upper chambers, called the right and left atrium, receive blood returning from the lungs and the body, respectively. The lower chambers, the right and left ventricle, have thick muscular walls. They pump blood to the rest of the body.

The flow of blood in the heart and throughout the body is shown in Figure 1. Blood returning from your body's organs and limbs enters the right atrium. This blood is "oxygen-poor." This blood passes from the right atrium to the right ventricle. The right ventricle then pumps it to the lungs, where the blood absorbs oxygen from air inhaled into the lungs. This now-oxygen-rich blood returns to the heart, enters the left atrium and passes from the left atrium into the left ventricle. From there, it's pumped to the brain, to the many organs in the abdomen and pelvis, and to the arms and legs. The body's organs and arms and legs remove some of the oxygen in the blood. Then the oxygen-poor blood returns to the heart and the cycle repeats.

Coronary Arteries and Why They're important

The heart's pumping requires energy. The heart's muscle (myocardium) requires oxygen to generate this energy. The heart's chambers are filled with blood, but the heart doesn't absorb oxygen directly into the myocardium. Instead, specialized blood vessels carry blood to the heart's muscular walls.

These specialized blood vessels are called coronary arteries. They travel on the outside of the heart, forming many smaller branches along the way. Tiny branches of these arteries penetrate into the heart muscle itself, bringing oxygen-rich blood to the heart muscle.

Your doctors may discuss findings in different coronary arteries or their branches. That's why you should know the names of the coronary arteries and their branches.

The left main coronary artery is about the width of a pencil and about an inch long. It makes up the initial part of the left coronary artery. The left main coronary artery divides into the left anterior descending artery (commonly called the "LAD") and the left circumflex artery. The left anterior descending artery (LAD) travels down the "front" of the heart. The left circumflex artery goes around the heart's "left" side to the "back." The right coronary artery travels toward the "bottom" of the heart.

When blockages develop in the coronary arteries, the heart can't get enough oxygen-rich blood, particularly during moderate or strenuous activity. Then chest pain or even a heart attack can occur. The next section discusses this.

Coronary Artery Disease, Angina and Heart Attacks

Over time fatty collections, called plaques, can develop and enlarge in the coronary arteries. These plaques are believed to first develop when fatty substances (such as cholesterol) and other materials are deposited in the coronary artery's inner lining. Smoking, high blood pressure, diabetes, high cholesterol levels, lack of exercise and obesity are factors linked with a higher risk of plaque build-ups and blockages.

Two problems can occur when plaques form. As plaques get bigger, they can start to block the coronary arteries and reduce the amount of blood that reaches the heart. In general, plaques that grow to block more than 70 percent of the diameter of the coronary arteries are the ones that usually restrict blood flow to the heart muscle. When the heart muscle doesn't get enough blood, it becomes ischemic ("starved" for oxygen). This condition causes chest pain or discomfort called angina. Some people develop angina when they exert themselves. This occurs because the heart needs more oxygen during physical activity. But the blockages in the coronary arteries can prevent enough oxygen-rich blood from reaching the heart.

A second problem is that one of these plaques may "rupture." When a plaque ruptures, a blood clot can form on top of the ruptured plaque. If this clot limits or blocks blood flow through the artery for even a short time, chest pains (angina) occur at rest (that is, without exertion). Doctors call this condition unstable angina. If this blood clot completely blocks blood flow in the coronary artery for more than about 30 minutes, the heart muscle can be permanently damaged. This damage is called a heart attack or myocardial infarction.

The left ventricle has the most muscle, because it must contract strongly enough to pump blood throughout the body. Because of this, the left ventricle is most susceptible to damage from blockages in the coronary arteries. If you hear a doctor describe how much heart damage occurred due to a heart attack, he or she is usually referring to how much the left ventricle was damaged.

Heart Failure and Leaky and Narrowed valves

Some people have a cardiac catheterization because they have trouble breathing due to a weakened heart muscle. This condition is called congestive heart failure.

In congestive heart failure, fluid "backs up" into the lungs because of a weakened heart, causing breathing difficulties. Normally, each time the left ventricle contracts, it ejects about 60 percent of the blood it holds into the aorta, the body's main artery. In many people with congestive heart failure, the left ventricle may eject only 40 percent or even only 10 percent of the blood it holds.

Some people develop heart failure or chest pain if any of the one-way valves in the heart malfunction. They may undergo a catheterization to evaluate this malfunctioning valve. Sometimes a valve can "leak" (let blood flow backward as well as forward). A valve can also be "narrowed" (it doesn't open normally to let blood flow forward). People with leaky or narrowed valves can have certain pressures in the heart that can become abnormally high. Both "leaky" and "narrowed" valves can cause fluid to "back up" into the lungs and other related problems.

Your doctor will likely discuss the problem that he or she suspects you may have before the cardiac catheterization.

What Happens Before a Cardiac Catheterization

In many cases, patients come to the hospital in the morning, undergo the cardiac catheterization procedure, and leave later in the afternoon. Such procedures are called outpatient procedures. Whether you undergo the procedure as an outpatient or inpatient, you'll first meet with the doctor who'll do the procedure and/or a member of the catheterization team. The doctor or catheterization team member will explain why and how the procedure will be done and its risks. Cardiac catheterization is relatively safe. Still, there's a small risk (less than one person in 250 procedures) of bleeding, infection, allergic reaction to the dye, damage to blood vessels, and kidney failure associated with the procedure. In an average patient, the risk of severe complications such as stroke, heart attack and even death is low, about one person in 1,000 procedures.

If you're having the procedure as an outpatient, you may want to bring a change of clothes, pajamas and toiletries in case you need to stay in the hospital.

Whether you'll be an outpatient or an inpatient, you'll be told not to eat or drink anything the morning of the procedure. Your doctor will want you to take certain medications (such as aspirin and other heart medicines) before your procedure. But he or she may not want you to take other medicines (such as certain diabetes medications, "water pills" or blood-thinning medicines). Make sure you know which medicines to take and avoid before your catheterization.

Patients who've had previous allergic reactions to X-ray contrast dye or to shellfish are usually given medication to take the night before and/or morning of the procedure. It will reduce the risk of a severe allergic reaction. Be sure to tell your doctor if you've ever had an allergic reaction to dye or to shellfish.

What Happens During a Cardiac Catheterization

Patients are usually given a mild sedative before the procedure to help them relax. Most patients are awake but slightly sleepy during the procedure. Some even doze off.

Once inside the cardiac catheterization laboratory, you'll be transferred to the cardiac catheterization table. Most cardiac catheterizations are done through the artery in the groin area. Some patients will have it done via the artery in the elbow area or wrist. Your groin area (or arm) will be cleansed and shaved. You'll then be covered with sterile drapes. Next the doctor will numb the area with one or two injections of an anesthetic agent (like the Novocaine® you may have received at the dentist).

After that, a small straw sized tube (called a sheath) will be inserted into the artery in your groin (or arm).

Sometimes a second straw-sized tube is inserted into a vein in the leg in order to measure pressure and blood oxygen samples in the heart.

At the start of the procedure, special catheters (long, thin plastic tubes) may be threaded up to the heart to measure certain pressures in the heart chambers. After that, specially shaped catheters will be threaded up to the heart and to the left main coronary artery. A special iodine-based Xray dye is injected into the left main coronary artery and its branches. As the dye is injected, Xrays take pictures of the arteries. The X-ray camera is rotated or moved around the patient to give different views of the coronary arteries. Another specially shaped catheter is then threaded up to the origin of the right coronary artery. Pictures of the right coronary artery are obtained in the same way. Most patients don't feel anything as dye is injected into the coronary arteries. Some people may notice a mild discomfort, but this usually passes several seconds after each dye injection.

After pictures of the coronary arteries are obtained (or sometimes before then), another special catheter is threaded into the heart's left ventricle. Then dye is injected into the left ventricle, allowing the doctors to assess how well it's pumping blood. This picture (a ventriculogram) also can show if one of the heart valves has become "leaky." During the ventriculogram, most patients will feel a "hot flash" all through their body for about 15 seconds.

During the catheterization, doctors view the heart and X-ray images on special screens. The entire catheterization can take as little as 20 minutes or sometimes more than an hour. The time it takes depends on what measurements are needed during the catheterization and other factors related to your heart's particular anatomy.

What Happens After the Cardiac Catheterization

After your procedure, the sheaths that have been placed in your groin (or arm) will be removed. A nurse or other cath lab team member will compress the puncture area for a time to help the small hole in the artery to close. Then you'll have to lie on your back for hours to ensure the small hole stays sealed. A special dressing or sandbag may be placed on the groin area during this time.

Some physicians use various types of vascular closure devices to seal the puncture in the artery. You should follow your doctor's specific directions about this. Patients treated with one of these devices usually can sit up within an hour and walk around within several hours.

Most outpatients will go home several hours (usually 2-6) after the procedure. Because you've had an important procedure and may have been given medicine to relax you, plan on having someone else drive you home.

After your procedure, the puncture area in your groin may be a little tender. There may be a small, swollen area for a day or two. This may be normal, but if you notice very much tenderness, pain or swelling, talk to your doctor. It's important to make sure that nothing needs further evaluation. In rare cases the artery doesn't completely seal or an infection may develop.

How Coronary Artery Disease, Heart Failure and Leaky and Narrowed valves can be treated

Three general forms of treatment exist for patients who have significant blockages in their coronary arteries. One is to use medications to control chest pains that a patient may have. Such medications may include

- beta blockers to slow the heart and decrease its demand for oxygen.
- nitrates (including long-acting forms of nitroglycerin tablets) to help dilate (open up) the coronary arteries.
- calcium channel blockers, which can dilate the coronary arteries (and other arteries of the body) and, in some cases, also slow the heart rate.

A second treatment option may be to have a coronary angioplasty (the "balloon" procedure). During an angioplasty, another special catheter is threaded up to the blocked artery. A very thin wire is passed across the blockage, and a thin balloon is threaded to the blockage. Then the balloon is inflated, compressing the blockage and stretching the artery open. A small metal stent may also be placed into the artery to increase the chances that the artery stays open.

The third treatment option is bypass surgery ("open-heart" surgery). During the bypass operation, veins from a leg and often an artery from the chest wall are used to "bypass" the blockages in your coronary arteries. Many factors will determine which treatment is best for you. Proper treatment depends on the size and location of the blockages in your coronary arteries, the symptoms you're having, your overall medical condition and your individual preference.

Patients who have congestive heart failure and whose left ventricle isn't pumping blood normally are often treated with a combination of medicines that can decrease symptoms and increase life expectancy. These medications often include

- digoxin (which stimulates the heart to beat more vigorously).
- diuretics ("water pills" that increase urination and reduce the volume of fluid in the bloodstream).
- ACE inhibitors (which dilate the blood vessels and have other beneficial effects).
- Beta blockers (which, if used carefully, can increase life expectancy).

A few patients with mildly leaky or narrowed valves and little or no symptoms will be followed carefully, treated with medications or both. Most patients with significant symptoms believed to be due to either a leaky or narrowed heart valve will be referred to undergo valve replacement surgery.

Besides the above treatments, all patients with heart disease should work to reduce their risk factors. Have your cholesterol levels checked. If they're high, modify your lifestyle and take medications (if prescribed) to lower these levels. Control high blood pressure and diabetes with diet, weight loss and medications. Talk to your doctor about starting a regular exercise program. And if you smoke cigarettes, quit. Taking these steps will help you slow or even stop the progression of your heart disease.