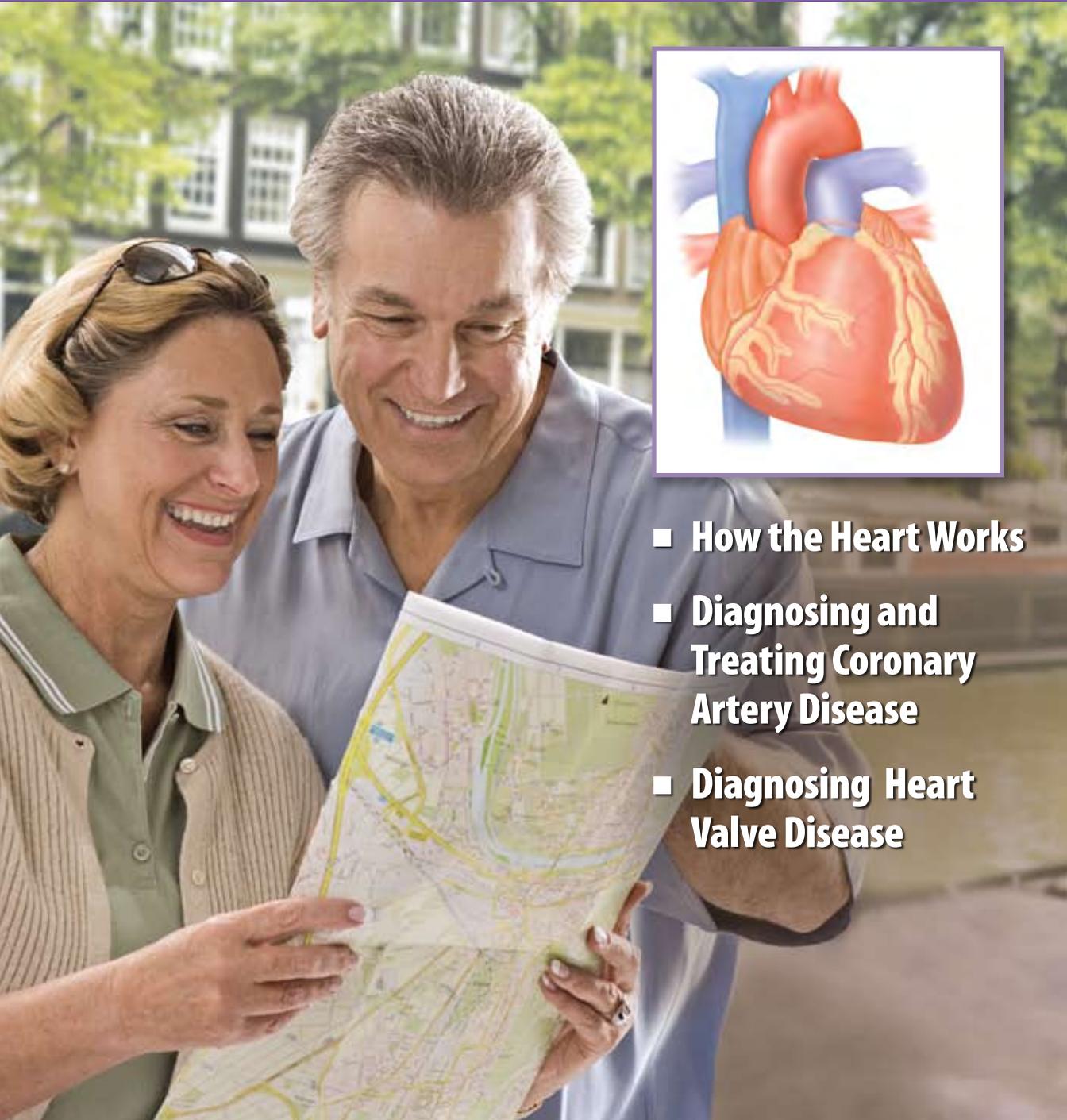


Understanding Cardiac Catheterization



- **How the Heart Works**
- **Diagnosing and Treating Coronary Artery Disease**
- **Diagnosing Heart Valve Disease**

Looking into Your Heart Problem

You may have signs or symptoms of heart trouble. Or, test results may suggest that you have a heart problem such as coronary artery disease (CAD) or valve disease. Left untreated, these conditions can lead to a heart attack or heart failure. The good news is that **cardiac cath** (catheterization) can help to confirm, and in many cases treat, heart problems. Keep reading to learn how cardiac cath can help your doctor form a treatment plan that's right for you.

Signs of Heart Trouble

Your doctor may suspect that you have a heart problem because:

- **You have angina.** Angina can be a painful or uncomfortable feeling in or near the chest. It is a symptom of coronary artery disease.
- **Stress testing indicates a problem with your coronary arteries.** A stress ECG, echocardiogram, or nuclear scan can show problems that occur when the heart works harder.
- **You have symptoms of heart valve or heart muscle problems.** These symptoms include weakness, dizziness, shortness of breath, and swollen legs, ankles, or feet.
- **An echocardiogram shows heart valve or heart function problems.** This ultrasound of the heart can show some details of the heart structure.



Angina often occurs during activities that make the heart work harder, such as climbing stairs.

Diagnosing Heart Problems with Cardiac Cath

Cardiac cath is a common nonsurgical procedure. It is done using a **catheter** (a long, thin, flexible tube). The catheter is inserted into a blood vessel and guided to the heart. This allows your doctor to gather information about the coronary arteries and the structure and function of the heart. It's also the first step in certain procedures to improve heart function. Cardiac cath can:

- Show whether the blood vessels supplying the heart muscle are narrowed or blocked.
- Show whether the heart is pumping normally and blood is flowing properly through the heart.
- Help your doctor to form a treatment plan based on test results.
- Make treatment of certain heart problems possible.
- Rule out certain heart problems.

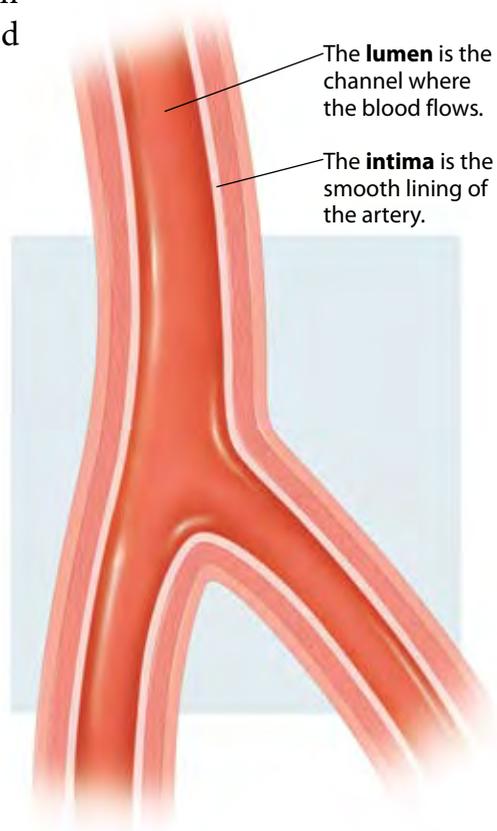


How the Heart Gets Oxygen

The heart is a muscle that pumps blood throughout the body. Like other muscles, the heart needs a steady supply of oxygen to function. Blood carries oxygen to the heart and the rest of the body through blood vessels called **arteries**. In the heart, the coronary arteries supply blood and oxygen to the heart muscle. If the heart doesn't get enough oxygen, angina or a heart attack can result.

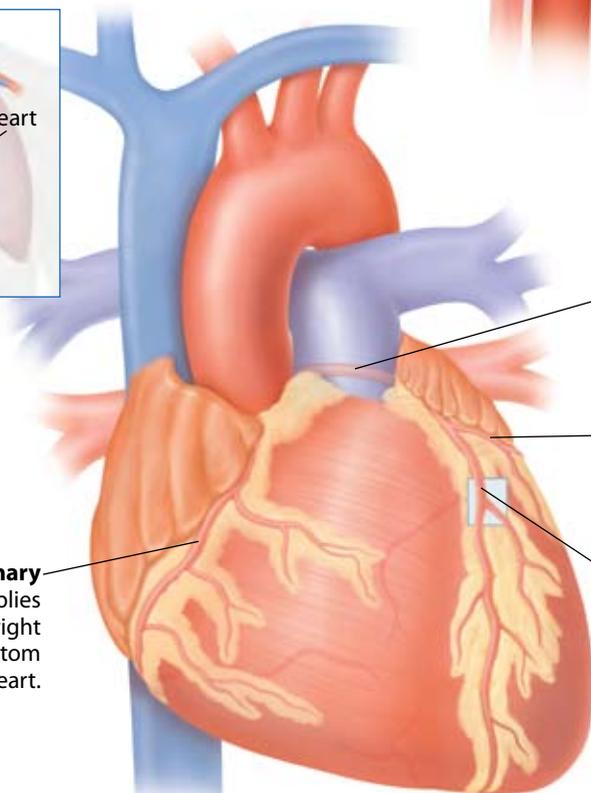
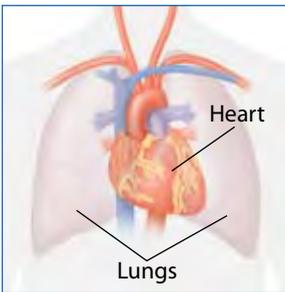
Healthy Coronary Arteries

Coronary arteries wrap around the surface of the heart. Their job is to supply the heart muscle with oxygen-rich blood. The amount of oxygen the heart needs depends on how hard it's working. For example, exercise makes the heart beat faster, increasing the muscle's need for oxygen. Healthy arteries can easily meet this need. They have smooth, flexible walls that can accommodate changes in blood flow.



The **lumen** is the channel where the blood flows.

The **intima** is the smooth lining of the artery.



The **right coronary artery** supplies blood to the right side and bottom of the heart.

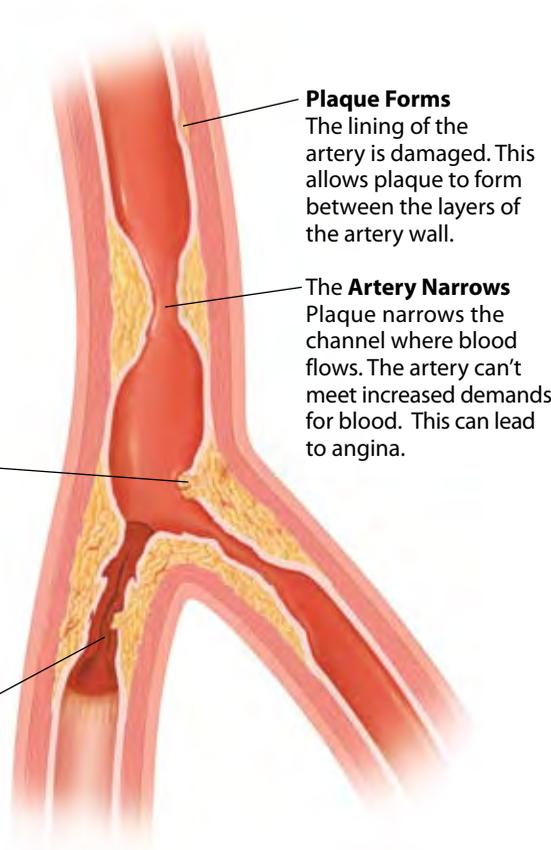
The **left main coronary artery** divides into two branches, described below.

The **circumflex coronary artery** supplies blood to the back and left side of the heart.

The **left anterior descending coronary artery** supplies blood to the front and left side of the heart.

Coronary Artery Disease

Coronary artery disease starts when the lining of a coronary artery is damaged. This is often due to risk factors, such as smoking or high blood cholesterol. **Plaque** (a fatty material composed of cholesterol and other particles) then builds up within the artery wall. This buildup (called atherosclerosis) narrows the space inside the artery. It also makes artery walls less able to expand. At times when the heart needs more oxygen, not enough blood can get through to meet the need. This can lead to angina.

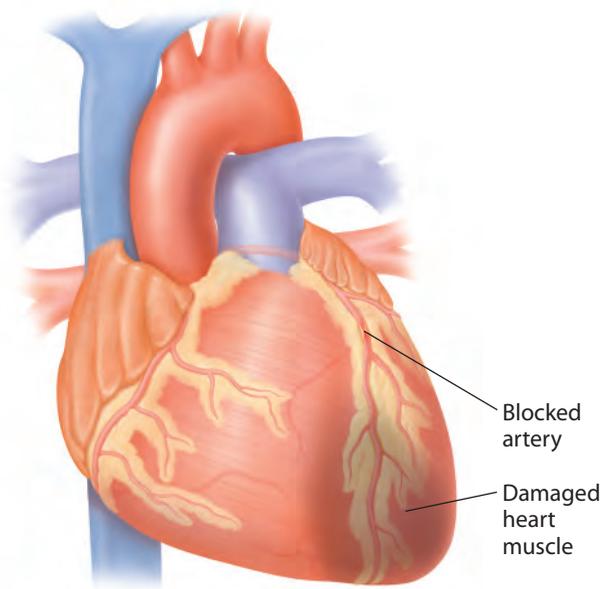


Plaque Forms
The lining of the artery is damaged. This allows plaque to form between the layers of the artery wall.

The Artery Narrows
Plaque narrows the channel where blood flows. The artery can't meet increased demands for blood. This can lead to angina.

Plaque Ruptures
Plaque deposits sometimes rupture. A rupture can narrow the artery even more. It can also cause a blood clot to form. This is part of the body's healing process, but it can also be dangerous.

A Blood Clot Blocks the Artery
If a blood clot cuts off blood flow in the narrowed artery, angina or a heart attack results.



Heart Attack

A heart attack (myocardial infarction) occurs when a coronary artery is blocked by plaque or a blood clot. When this happens, the heart muscle beyond the blockage doesn't receive enough oxygen. That part of the heart muscle begins to die. This damage cannot be reversed. Though many people survive heart attacks, a heart attack can be deadly.

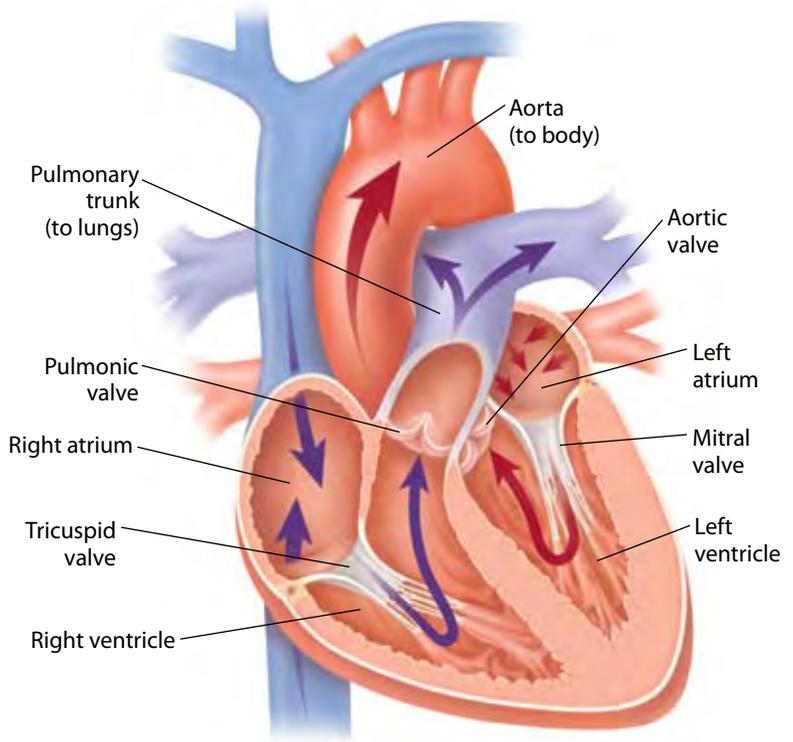
How the Heart Pumps Blood

The heart is a system of chambers and valves that keep blood moving in the correct direction. The heart muscle squeezes (beats) to move blood in and out of the heart's four chambers. (These chambers are called **ventricles** and **atria**.) Four valves open and close to keep blood moving in the proper direction through the heart.

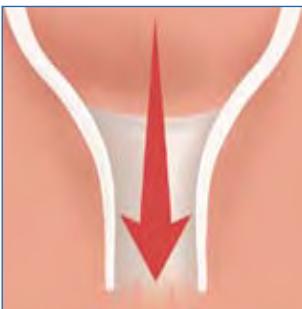
Valves Direct Blood Through the Heart

With each heartbeat, valves open and close. This moves blood in the correct direction.

- **Oxygen-poor blood** is pumped from the right atrium through the tricuspid valve into the right ventricle. It is then pumped through the pulmonic valve to the blood vessel that leads to the lungs. There, it picks up oxygen and returns to the heart through the pulmonary veins.
- **Oxygen-rich blood** is pumped from the left atrium through the mitral valve into the left ventricle. It is then pumped through the aortic valve to the aorta, so it can travel to the rest of the body.



Oxygen-poor blood (blue arrows) is pumped to the lungs. Oxygen-rich blood (red arrows) is pumped to the rest of the body.



A valve opens to let blood move forward.



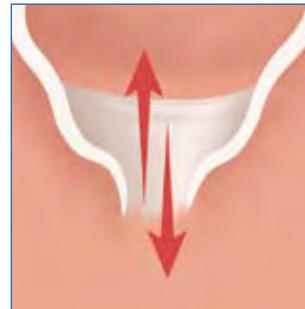
A valve closes to keep blood from leaking backward.

Valve Problems

Valve disease occurs when a valve doesn't open or close properly. When this happens, the heart has to work harder to move the same amount of blood. Over time, this can cause the heart muscle to tire and weaken, leading to heart failure.



Narrowed valve



Leaky valve

Problems Opening (Stenosis)

Stenosis (also called valvular narrowing) occurs when a valve doesn't open all the way. Scarring or deposits of calcium can make a valve stiff and hard to open. This means that blood has to flow through a smaller opening. So the heart muscle has to work harder to push blood through. Stenosis can get worse over time.

Problems Closing (Insufficiency)

Insufficiency (also called regurgitation) occurs when a valve doesn't close tightly enough. A valve may have extra tissue, or be loose or shortened. Or the structures that support the valve may be torn. When this happens, blood leaks backward through the valve. The heart has to move some of the same blood over again. Insufficiency can also worsen over time.

Other Heart Structure Conditions

In addition to CAD and valve problems, cardiac cath is used to diagnose other types of heart problems. These include heart muscle problems and congenital heart problems.

Heart Muscle Problems

The heart muscle can weaken for many reasons. A weakened heart loses the ability to pump enough blood to the rest of the body. This is called heart failure. If you have heart failure, cardiac cath may be used to find the cause so that the underlying problem can be treated.

Congenital Heart Problems

Most heart problems develop as people age. But some people are born with heart problems (congenital heart disease). These problems include structural ones such as a hole between two of the heart's chambers. Cardiac cath can be used to find out how a congenital problem is affecting heart function.

Cardiac Catheterization

During this procedure, catheters are inserted into the coronary arteries and chambers of the heart. This allows your doctor to take pictures of the coronary arteries and do tests inside the heart. Based on the results, your doctor may advise procedures to correct your heart problem. Prepare for cardiac cath as directed by your healthcare provider.



Preparing for the Procedure

- Take medication as prescribed by your doctor. He or she may prescribe new medications or ask you to stop taking certain medications before cardiac cath.
- Do not eat or drink after the midnight before the procedure.
- Arrange for a ride home after the procedure. Pack a bag in case you need to stay in the hospital overnight.
- Read and sign the consent form.

Possible Risks

Any procedure involves some risk. Although complications of cardiac cath are rare, risks may include:

- Bleeding from or infection of the catheter insertion site
- Allergic reaction to the x-ray dye
- Abnormal heartbeat (arrhythmia)
- Tearing of the artery lining
- Kidney damage or failure
- Heart attack, stroke, or death (very rare)
- The need for emergency cardiac surgery (very rare)

Be Sure to Tell Your Doctor:

- **About any medications you take.** Include herbs, supplements, or over-the-counter medications.
- **If you are allergic to iodine or any medications.** The x-ray dye used during the procedure contains iodine. If needed, you will be given medication to help prevent an allergic reaction.
- **If you are pregnant or think you could be pregnant.** Cardiac cath may need to be postponed until after the baby is born.

Before the Procedure

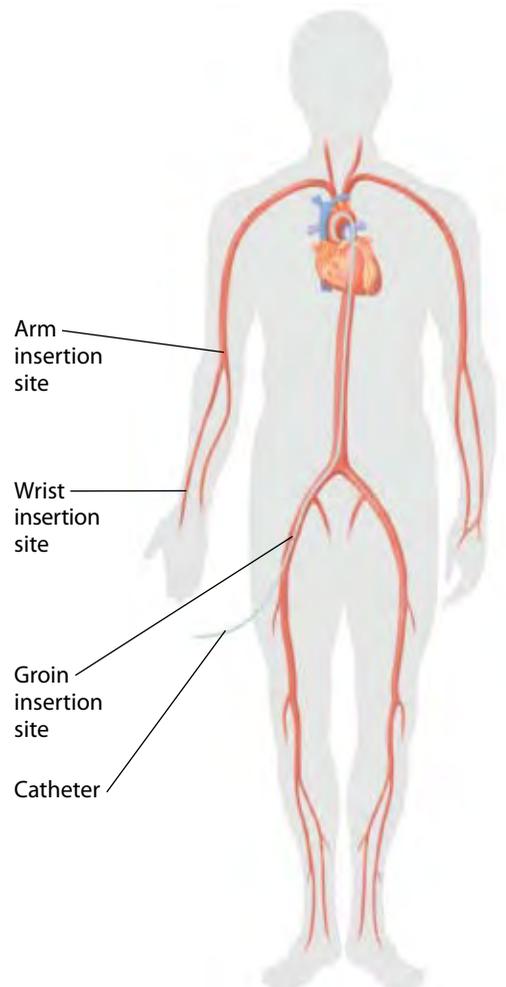
You'll be taken to a prep room, where you can change into a hospital gown. You may be in the lab for a few hours, so you'll be asked to empty your bladder and bowels. An IV line will then be started. Medication or fluid may be given through this line. Hair may be removed from the area where the catheter is inserted. Then you'll be taken to the cath lab.



In the Cath Lab

Once in the cath lab, you'll lie on an x-ray table. You will be given a sedative to help you relax. You may remain awake throughout the procedure:

- The skin in the area of the insertion site is numbed. An introducing sheath is inserted into an artery in the groin, arm, or wrist. The sheath remains in place during the entire procedure.
- If you are having a right-heart cath, a sheath will also be placed in a vein in the same area. (Veins are blood vessels that carry blood back to the heart.)
- A catheter is slid over a guide wire. The guide wire is then inserted into the sheath and threaded through the blood vessels to the heart. Since blood vessels have no pain nerves, you won't feel this.
- The guide wire is removed, leaving the catheter in place.
- During the procedures that follow, the guide wire and catheter may be removed and replaced several times. This is done to reach each of the coronary arteries or heart chambers.



Viewing and Treating Coronary Arteries

Angiography involves taking x-ray pictures of blood vessels. These x-rays can show the location and severity of blockages in the vessels. This can help in forming a plan to open or bypass these blockages.

Coronary Angiography

Coronary angiography is a way of taking x-ray pictures of the arteries in the heart. X-ray dye is injected into the arteries through the catheter. This allows them to show up on x-rays. You may feel a warm flush as the dye reaches your bloodstream. Several images are then taken, showing the locations of any blockages. Your doctor may ask you to hold your breath or to cough. As pictures are taken, the lights may be dimmed and you may hear the noise of the camera.



Angiography Results

After the procedure, your doctor will discuss the results with you. This may occur while you're still on the table or after you've been moved to another area. In many cases, angioplasty and stenting can be used to improve blood flow. These procedures may be done right away or scheduled for a later date. But depending on factors, including the number and locations of blockages, your doctor may advise coronary artery bypass surgery instead. This surgery will be planned for a future date.

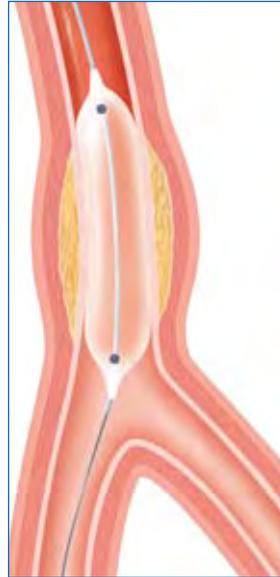


Narrowing in the artery is shown in the circle above.

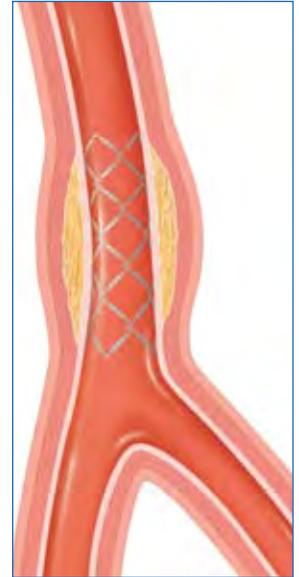
Procedures to Open Arteries

These procedures are done using catheters and are often performed right after angiography. The most common are:

- **Balloon angioplasty.** The catheter is used to insert a special balloon into the artery. The balloon is inflated and deflated one or more times to open the artery. This is often followed by placement of a stent.
- **Stenting.** A wire mesh tube (stent) is inserted into the artery to hold it open. This device is left in the artery permanently. Your doctor may advise using a **drug-eluting** stent. This is a stent that releases medication over time to help keep scar tissue from forming as the artery heals. This may prevent a new blockage from forming in the same place (restenosis).



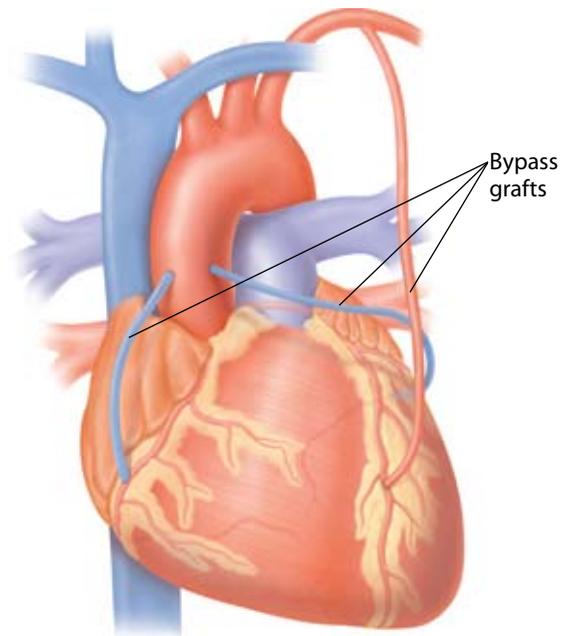
A balloon flattens plaque against the artery walls during balloon angioplasty.



A stent is permanently placed in the artery to hold it open.

Surgery to Bypass Blockages

Bypass surgery may be advised when blockages can't be opened with angioplasty or when angioplasty is not the best treatment. This surgery will most likely be scheduled at a later date. Bypass surgery creates a new route around the blockages in the arteries. This allows increased blood flow to areas of the heart that haven't been getting enough blood. For this surgery, a blood vessel from the leg, arm, or chest is used to make each bypass.



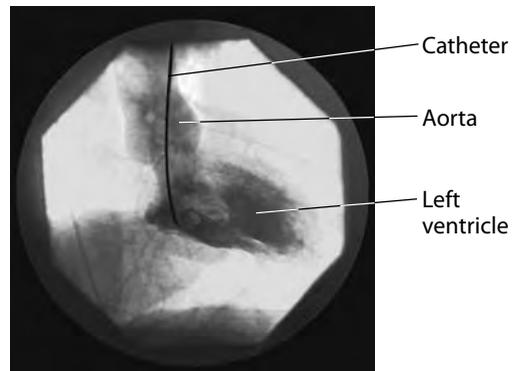
Diagnosing Heart Structure Problems

With cardiac cath, tests can be done to measure pressures within the heart. If needed, **ventriculography** (x-ray pictures of the left ventricle) is performed. This information helps your doctor evaluate and treat valve and heart muscle problems.

Heart Structure Tests

Cardiac cath is used to perform tests of heart structure and function:

- **Direct pressure measurement.** Instruments are used to measure pressures within the heart. These pressure measurements show whether blood is flowing properly through the valves. They also show whether the heart muscle is pumping correctly. Both sides of the heart will most likely be tested. For a **right-heart cath**, a catheter is guided through a vein to the right side of the heart. For a **left-heart cath**, a catheter is guided through an artery to the left side of the heart.
- **Ventriculography.** X-ray pictures are taken of the left ventricle, the heart's main pumping chamber. X-ray dye is injected through the catheter into the left ventricle. This chamber then shows up on an x-ray. You will feel a warm flush as the dye is injected.



This ventriculogram shows a left ventricle at the start of a contraction.

Test Results

Your doctor will recommend a treatment plan based on test results. Most valve problems do not need immediate treatment. Depending on the type of heart problem and how severe it is, your doctor may suggest:

- Medication to help control the problem and relieve symptoms.
- A catheter procedure to open a valve (valvuloplasty).
- Surgery to repair or replace a valve.



A prosthetic (substitute) valve can be placed in the valve opening and anchored in position.

After Catheterization

If you only had testing done, you may be able to leave the hospital within 2 to 8 hours. If angioplasty, stenting, or other treatments were performed, you may stay overnight. In either case, you will be sent home once your condition is stable.

Closing the Insertion Site

The sheath in your groin, wrist, or arm will be removed, and the insertion site closed. This may be done while you are still in the cath lab. Or, it may be done after you have been moved to a hospital room. You may need to keep still, with your leg or arm straight, for 2 to 6 hours. How long depends partly on the insertion site and the type of closure performed. During this time you may not be able to get up to go to the bathroom. Staff will help you keep comfortable while you rest.



Monitoring Your Condition

You will be closely monitored until you're ready to go home. Your pulse and blood pressure will be checked often. Be sure to tell the nurse or doctor if you have angina or any other symptoms. The IV line will remain in place until shortly before you leave. Your blood may be tested to assess your condition. You may also have an electrocardiogram (ECG).

Going Home

You can go home when:

- The insertion site is not bleeding.
- You can urinate.
- Your doctor has reviewed your condition and given his or her okay.



Recovering at Home

Depending on the procedures done, you may go home the same day or stay overnight. Follow your doctor's instructions on homecare. Depending on the results of the tests, you may need follow-up treatment. Make an appointment with your doctor to discuss the next steps.



At Home

You can resume most normal activities soon after the procedure. Be sure to:

- Take medications as directed by your doctor. This is crucial to the success of the procedure.
- Shower or take sponge baths for a few days if your insertion site was in the groin. Don't swim or soak in a tub.
- Avoid lifting anything over 10 pounds for at least 3 days. Your doctor can give you more specific guidelines.
- Avoid strenuous activities for about a week. Ask your doctor when you can resume driving, exercise, and sex.
- Talk with your doctor about when you can return to work.

When to Call Your Doctor

In the 2 weeks after cardiac cath, call your doctor if you notice any of the following:

- The insertion site is increasingly painful, swollen, red, warm to the touch, or is draining.
- The insertion site is bleeding.
- You have fever.
- You have angina.
- You can't urinate, or you have blood in your urine.
- You have severe pain, coldness, or a bluish color in the leg or arm where the catheter was inserted.

Your Follow-Up

Diagnosing your heart problem is the first step in forming a treatment plan. The goal of this plan is to help you stay healthy and active. After seeing your test results, your doctor may recommend further procedures or surgery. Or you may be able to control your heart problem with medications and lifestyle changes.

Procedures and Testing

Your doctor may recommend surgery to correct a valve or artery problem. Or you may need no treatment at this time. In either case, you may need to have blood tests and heart function tests from time to time. Talk with your doctor about what kinds of tests you'll need, and how often.

Taking Care of Your Heart

Your doctor will most likely prescribe medications for your heart. Depending on the type of heart problem you have, he or she may also suggest lifestyle changes. To take good care of your heart:

- **Take medications as directed.** Medications can help the heart work better and relieve symptoms. Taking them correctly reduces the risk of heart attack or heart failure.
- **If you smoke, quit.** Smoking and other forms of tobacco use harm the blood vessels and heart. Ask your healthcare provider for help in quitting.
- **Exercise.** Frequent moderate exercise can improve fitness. Talk with your doctor about how to exercise safely.
- **Learn to manage related conditions.** Diabetes, high blood pressure, high cholesterol, and obesity can harm your heart health. Your doctor, a dietitian, and other specialists can help you learn how to better control these risk factors.



Procedure Checklist

Follow any instructions given to you by your doctor. Before the procedure, be sure to:

- Discuss your medications with your doctor.
- Ask your doctor what kinds of treatment may be possible depending on the results of cardiac cath.
- Do not eat or drink after the midnight before the procedure.
- Pack a bag in case you need to stay in the hospital overnight.
- Arrange for a ride home after the procedure.
- Read and sign the consent form.

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