

CORONARY ARTERY DISEASE

What is coronary artery disease?

Coronary artery disease (*CAD*) occurs when the arteries that supply blood to the heart muscle (*the coronary arteries*) become hardened and narrowed. The arteries harden and narrow due to buildup of a material called plaque (*plak*) on their inner walls. The buildup of plaque is known as atherosclerosis (*ATH-er-o-skler-O-sis*). As the plaque increases in size, the insides of the coronary arteries get narrower and less blood can flow through them. Eventually, blood flow to the heart muscle is reduced, and, because blood carries much-needed oxygen, the heart muscle is not able to receive the amount of oxygen it needs. Reduced or cutoff blood flow and oxygen supply to the heart muscle can result in:

- ❑ **Angina** (*AN-ji-na or an-JI-na*). Angina is chest pain or discomfort that occurs when the heart does not get enough blood.
- ❑ **Heart attack**. A heart attack happens when a blood clot develops at the site of plaque in a coronary artery and suddenly cuts off most or all blood supply to that part of the heart muscle. Cells in the heart muscle begin to die if they do not receive enough oxygen-rich blood. This can cause permanent damage to the heart muscle.

Over time, CAD can weaken the heart muscle and contribute to:

- ❑ **Heart failure**. In heart failure, the heart can't pump blood effectively to the rest of the body. Heart failure does not mean that the heart has stopped or is about to stop. Instead, it means that the heart is failing to pump blood the way that it should.
- ❑ **Arrhythmias** (*a-RITH-me-as*). Arrhythmias are changes in the normal beating rhythm of the heart. Some can be quite serious.

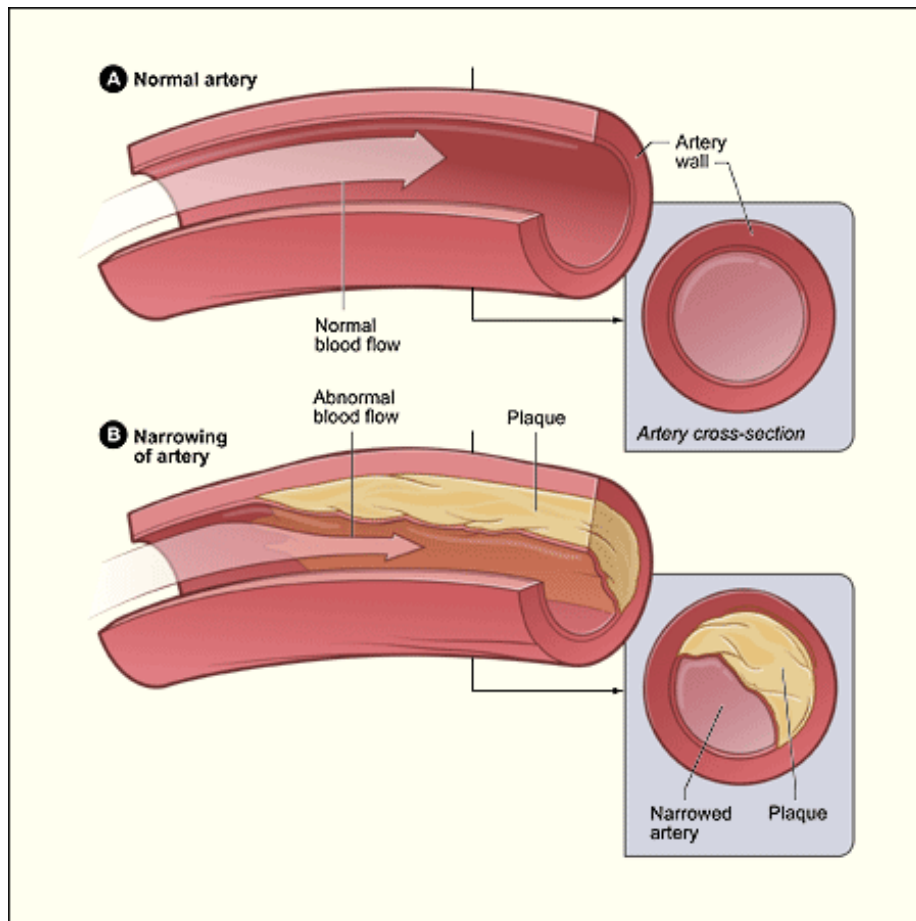
CAD is the most common type of heart disease. It is the leading cause of death in the United States in both men and women.

What causes coronary artery disease?

Coronary artery disease (*CAD*) is caused by atherosclerosis (the thickening and hardening of the inside walls of arteries). Some hardening of the arteries occurs normally as a person grows older.

In atherosclerosis, plaque deposits build up in the arteries. Plaque is made up of fat, cholesterol, calcium, and other substances from the blood. Plaque buildup in the arteries often begins in childhood. Over time, plaque buildup in the coronary arteries can:

- ❑ **Narrow the arteries.** This reduces the amount of blood and oxygen that reaches the heart muscle.
- ❑ **Completely block the arteries.** This stops the flow of blood to the heart muscle.
- ❑ **Cause blood clots to form.** This can block the arteries that supply blood to the heart muscle.



The illustration shows a normal artery with normal blood flow (Figure A) and an artery containing plaque buildup (Figure B).

Plaque in the arteries can be:

- Hard and stable. Hard plaque causes the artery walls to thicken and harden. This condition is associated more with angina than with a heart attack, but heart attacks frequently occur with hard plaque.
- Soft and unstable. Soft plaque is more likely to break open or to break off from the artery walls and cause blood clots. This can lead to a heart attack.

Who is at risk for coronary artery disease?

About 13 million people in the United States have coronary artery disease (CAD). It is the leading cause of death in both men and women. Each year, more than half a million Americans die from CAD.

Several factors increase the risk of developing CAD. The more risk factors you have, the greater chance you have of developing CAD. Some CAD risk factors, such as age, can't be modified, but others can.

- Risk Factors That Cannot Be Modified:
 - Age. As you get older, your risk for CAD increases.
 - In men, risk increases after age 45.
 - In women, risk increases after age 55.
 - Family history of early heart disease.
 - Heart disease diagnosed before age 55 in father or brother.
 - Heart disease diagnosed before age 65 in mother or sister.
- Risk Factors That Can Be Modified:
 - High blood cholesterol
 - High blood pressure
 - Cigarette smoking
 - Diabetes
 - Overweight or obesity
 - Lack of physical activity

Other Potential Risk Factors

Scientists continue to study other potential risk factors for developing CAD. According to some research studies, high blood levels of a substance called C-reactive protein (CRP) may be associated with an increased risk of

developing CAD and having a heart attack. CRP is a protein in the blood that shows the presence of inflammation. Inflammation is the body's response to injury or infection. CRP levels rise when there is inflammation. The inflammation process appears to contribute to the growth of plaque in arteries.

Research is underway to find out if reducing inflammation and lowering CRP levels can also reduce the risk of developing CAD and having a heart attack.

What are the signs and symptoms of coronary artery disease?

The most common symptoms of coronary artery disease (CAD) are:

- Chest pain or chest discomfort (angina) or pain in one or both arms or in the left shoulder, neck, jaw, or back
- Shortness of breath

The severity of symptoms varies widely. Symptoms may become more severe as coronary arteries become narrower due to the buildup of plaque (atherosclerosis).

In some people, the first sign of CAD is a heart attack. A heart attack happens when plaque in a coronary artery breaks apart, causing a blood clot to form and block the artery.

How is coronary artery disease diagnosed?

There is no single test to diagnose coronary artery disease (CAD). Your doctor will ask about your medical history and your family's medical history, assess your risk factors, and do a physical exam and several tests.

These procedures are used to:

- Decide if you have CAD
- Determine the extent and severity of the disease
- Rule out other possible causes of your symptoms

Based on the results of these procedures, your doctor may order one or more of the following tests:

- **EKG (electrocardiogram).** This test measures the rate and regularity of your heartbeat.
- **Echocardiogram.** This test uses sound waves to create a moving picture of your heart. Echocardiogram provides information about the size and shape of your heart and how well your heart chambers and valves are functioning. The test also can identify areas of poor blood flow to the heart, areas of heart muscle that are not contracting normally, and previous injury to the heart muscle caused by poor blood flow.

There are several different types of echocardiograms, including a stress echocardiogram. During this test, an echocardiogram is done both before and after your heart is stressed either by having you exercise or by injecting a medicine into your bloodstream that makes your heart beat faster and work harder. A stress echocardiogram is usually done to find out if you have decreased blood flow to your heart (coronary artery disease).

- **Stress Test.** Some heart problems are easier to diagnose when your heart is working harder and beating faster than when it's at rest. During stress testing, you exercise (or are given medicine if you are unable to exercise) to make your heart work harder and beat faster while heart tests are performed.

During exercise stress testing, your blood pressure and EKG readings are monitored while you walk or run on a treadmill or pedal a bicycle. Other heart tests, such as nuclear heart scanning or echocardiography, also can be done at the same time. These would be ordered if your doctor needs more information than the exercise stress test can provide about how well your heart is working.

If you are unable to exercise, a medicine can be injected through an intravenous line (IV) into your bloodstream to make your heart work harder and beat faster, as if you are exercising on a treadmill or bicycle. Nuclear heart scanning or echocardiography is then usually done.

During nuclear heart scanning, radioactive tracer is injected into your bloodstream, and a special camera shows the flow of blood

through your heart and arteries. Echocardiography uses sound waves to show blood flow through the chambers and valves of your heart and to show the strength of your heart muscle.

- Your doctor also may order two newer tests along with stress testing if more information is needed about how well your heart works. These new tests are magnetic resonance imaging (MRI) and positron emission tomography (PET) scanning of the heart. MRI shows detailed images of the structures and beating of your heart, which may help your doctor better assess if parts of your heart are weak or damaged. PET scanning shows the level of chemical activity in different areas of your heart. This can help your doctor determine if enough blood is flowing to the areas of your heart. A PET scan can show decreased blood flow caused by disease or damaged muscles that may not be detected by other scanning methods.
- **Chest x ray.** A chest x ray takes a picture of the organs and structures inside the chest. These include the heart, lungs, and blood vessels.
- **Cardiac catheterization.** A thin, flexible tube is passed through an artery in the groin or arm to reach the coronary arteries. The tube allows your doctor to examine the inside of your arteries to see if there is any blockage. Your doctor also can determine the pressure and blood flow in the heart's chambers, collect blood samples from the heart, and examine the arteries of the heart by x ray.
- **Coronary angiography.** This test is usually performed along with cardiac catheterization. A dye that can be seen by x ray is injected through the catheter into the coronary arteries. The doctor can see the flow of blood through the heart and the location of blockages.
- **Nuclear heart scan.** This test provides your doctor with moving pictures of the blood passing through your heart's chambers and arteries and shows the level of blood flow to the heart muscle. A small amount of a radioactive tracer is injected into your bloodstream through a vein, usually in your arm. A special camera is placed in front of your chest to show where the tracer lights up in healthy heart muscle and where it doesn't light up (in heart muscle that has been damaged or has a blocked artery).

There are different types of nuclear heart scans. Most scans have two phases—taking pictures of the heart at rest and while it is beating faster (called a stress test), although sometimes only a rest scan is done. Many heart problems show up more clearly when your heart is stressed than when it is at rest. By comparing the nuclear heart scan of your heart at rest to your heart at "stress," your doctor can determine if your heart is functioning normally or not.

- **Electron beam computed tomography.** This test identifies and measures calcium buildup in and around the coronary arteries.

Your doctor may also order the following blood tests:

- A fasting glucose test to check your blood sugar level
- A fasting lipoprotein profile to check your cholesterol levels

How is coronary artery disease treated?

Treatment for coronary artery disease (CAD) may include lifestyle changes, medicines, and special procedures. The goals of treatment are to:

- Relieve symptoms
- Slow or stop atherosclerosis by controlling or reducing the risk factors
- Lower the risk of having blood clots form, which can cause a heart attack
- Widen or bypass clogged arteries

Lifestyle Changes

Making lifestyle changes can help treat CAD. For some people, these changes may be the only treatment needed:

- Eat a healthy diet to prevent or reduce high blood pressure and high blood cholesterol and to maintain a healthy weight
- Quit smoking, if you smoke
- Exercise, as directed by your doctor
- Lose weight, if you are overweight or obese
- Reduce stress

Medicines

In addition to making lifestyle changes, medicines may be needed to treat CAD. Some medicines decrease the workload on the heart and relieve

symptoms of CAD. Others decrease the chance of having a heart attack or dying suddenly and prevent or delay the need for a special procedure (for example, angioplasty or bypass surgery). Several types of medicine are commonly used to treat CAD.

- **Cholesterol-lowering medicines** help to reduce your cholesterol to a doctor-recommended level.
- **Anticoagulants** (AN-te-ko-AG-u-lant) help to prevent clots from forming in your arteries and blocking blood flow.
- **Aspirin**, and other antiplatelet medicines, help to prevent clots from forming in your arteries and blocking blood flow. Blood contains small cells called platelets which clump together to form clots. Antiplatelet medicines reduce the ability of platelets to form clots. Aspirin may not be appropriate for some people because it increases the risk of bleeding. Discuss the benefits and risks with your doctor before starting aspirin therapy.
- **ACE** (angiotensin-converting enzyme) inhibitors help to lower blood pressure and reduce strain on your heart. They also may reduce the risk of a future heart attack and heart failure.
- **Beta blockers** slow your heart rate and lower your blood pressure to decrease the workload on your heart. Beta blockers are used to relieve angina and may also reduce the risk of a future heart attack.
- **Calcium channel blockers** relax blood vessels (arteries and veins) and lower your blood pressure. These medicines can reduce your heart's workload, help widen coronary arteries, and relieve and control angina.
- **Nitroglycerin** widens the coronary arteries, increasing blood flow to the heart muscle and relieving chest pain.
- **Long-acting nitrates** are similar to nitroglycerin but are longer acting and can limit the occurrence of chest pain when used regularly over a long period.
- **Glycoprotein IIb-IIIa inhibitors** are very strong antiplatelet medicines that are used in hospitals during and after angioplasty or to treat angina.
- **Thrombolytic agents** dissolve the clots that can occur during a heart attack. Thrombolytic therapy is administered in the hospital. Thrombolytic therapy and other treatments for heart attack are more effective the sooner they are given after a heart attack starts.

You need to get to a hospital as soon as possible if you think you are having a heart attack.

Special Procedures

- **Angioplasty.** This procedure opens blocked or narrowed coronary arteries. It can improve blood flow to your heart, relieve chest pain, and possibly prevent a heart attack. Sometimes a device called a stent is placed in the artery to keep the artery propped open after the procedure.
- **Coronary artery bypass surgery.** In this procedure arteries or veins from other areas in your body are used to bypass your narrowed coronary arteries. Bypass surgery can improve blood flow to your heart, relieve chest pain, and possibly prevent a heart attack.

Angioplasty or bypass surgery may be used to treat CAD if:

- Medicines and lifestyle changes have not improved your symptoms.
- Your symptoms are getting worse.

Some people may need to have angioplasty or bypass surgery on an emergency basis during a heart attack to limit damage to the heart.

Cardiac Rehabilitation

Your doctor may prescribe cardiac rehabilitation (rehab) for angina or after bypass surgery, angioplasty, or a heart attack. Cardiac rehab, when combined with medicine and surgical treatments, can help you recover faster, feel better, and develop a healthier lifestyle. Almost everyone with CAD can benefit from cardiac rehab. Cardiac rehab often begins in the hospital after a heart attack, heart surgery, or other heart treatment. Rehab continues in an outpatient setting after you leave the hospital. The cardiac rehab team may include:

- Doctors (Your family doctor, a heart specialist, a surgeon)
- Nurses
- Exercise specialists
- Physical therapists and occupational therapists
- Dietitians
- Psychologists or other behavior therapists

Rehab has two parts:

- **Exercise training.** This helps you learn how to exercise safely, strengthen your muscles, and improve your stamina. Your exercise plan will be based on your individual ability, needs, and interests.
- **Education, counseling, and training.** This helps you understand your heart condition and find ways to reduce your risk of future heart problems. The cardiac rehab team will help you learn how to cope with the stress of adjusting to a new lifestyle and to deal with your fears about the future.

How can coronary artery disease be prevented or delayed?

Preventing or delaying coronary artery disease (CAD) begins with knowing which risk factors you have and taking action. Remember, your chances of developing CAD increase with the number of risk factors you have.

Know your family history of health problems related to CAD. If you or someone in your family has CAD, be sure to tell your doctor. Make sure everyone in your family gets enough exercise and maintains a healthy body weight.

By controlling your risk factors with lifestyle changes and medicines, you may prevent or delay the development of CAD.

CAD can cause serious complications, but by following your doctor's advice and changing your habits, you can prevent or reduce the chance of:

- Dying suddenly from cardiac problems
- Having a heart attack and permanently damaging your heart muscle
- Damaging your heart because of reduced oxygen supply
- Having irregular heartbeats (arrhythmias)

If you have any other health conditions, it is important that you follow your doctor's directions to treat those conditions. By staying as healthy as possible, you can lower your risk of developing CAD and its complications.

Key Points

- About 13 million people in the United States have coronary artery disease (CAD). It is the leading cause of death in both men and

women. Each year, more than half a million Americans die from CAD.

- CAD occurs when the arteries that supply blood to the heart muscle (the coronary arteries) become hardened and narrowed. The arteries harden and narrow due to buildup of a material called plaque on their inner walls. The buildup of plaque is known as atherosclerosis. As the plaque increases in size, the insides of the coronary arteries get narrower and less blood can flow through them. Eventually, blood flow to the heart muscle is reduced, and, because blood carries much-needed oxygen, the heart muscle is not able receive the amount of oxygen it needs. Reduced flow of blood and oxygen can lead to problems such as angina (chest pain) and heart attack.
- Plaque in the coronary arteries can be hard and stable or soft and unstable. Hard plaque causes the artery walls to thicken and harden. This condition is associated more with angina than with a heart attack. Soft plaque is more likely to break open or break off from the artery walls and cause blood clots. This can lead to a heart attack.
- Some of the risk factors for CAD can't be modified but others can. For example, you can't modify your age and family history. But you can control high blood cholesterol, high blood pressure, cigarette smoking, high blood sugar, overweight or obesity, and lack of physical activity.
- Angina is the most common symptom of CAD.
- There is no single test to diagnose CAD. Your doctor will ask about your medical history and your family's medical history, assess your risk factors, and do a physical exam and several tests. These procedures are used to decide if you have CAD, to determine the extent and severity of the disease, and to rule out other possible causes of your symptoms.
- The goals of treatment are to:
 - Relieve symptoms
 - Slow or stop atherosclerosis by controlling or reducing the risk factors
 - Lower the risk of having blood clots form, which can cause a heart attack
 - Widen or bypass clogged arteries

- Prevention begins with knowing which risk factors you have and taking action. Your chance of developing CAD increases with the number of risk factors you have.

*Source: National Heart Lung and Blood Institute
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