Your heart is a muscle that pumps about 3,000 gallons of blood through your body each day. Like every muscle, it requires a steady supply of blood carrying oxygen and nutrients to it, and that blood reaches your heart muscle through several coronary arteries.

Coronary artery disease is the narrowing or blockage of those coronary arteries. It is usually caused by atherosclerosis – the hardening or clogging of the arteries through the buildup of plaques on the inner wall of the arteries that can restrict blood flow to the heart muscle.

Without an adequate blood supply, the heart muscle becomes starved of oxygen and the nutrients it needs to work properly. This can cause chest pain called angina. If blood supply to a portion of the heart muscle is cut off entirely, or if the energy demands of the heart become much greater than its blood supply, a heart attack – injury to the heart muscle itself – may occur.

Coronary artery disease affects 16.8 million Americans, and is the leading cause of death for both men and women. The American Heart Association estimates that every 34 seconds, an American will have a heart attack. In addition, the lifetime risk of having cardiovascular disease after age 40 is 2 in 3 men and more than 1 in 2 women.
What causes the coronary arteries to narrow?

Coronary arteries are shaped like hollow tubes through which blood can flow freely. The muscular walls of coronary arteries are normally smooth and elastic and lined with a layer of cells called the endothelium. The endothelium provides a barrier between the blood stream and the coronary artery walls, while regulating the function of the artery by releasing chemical signals in response to various stimuli.

Coronary artery disease starts when you are very young. Before your teen years, the blood vessel walls begin to show streaks of fat. As you get older, the fat builds up, causing slight injury to your blood vessel walls. Other substances traveling through your blood stream, such as inflammatory cells, cellular waste products, proteins and calcium begin to stick to the vessel walls. The fat and other substances combine to form a material called plaque.

Over time, the inside of the arteries develop plaques of different sizes. Many of the plaque deposits are soft on the inside with a hard fibrous cap covering the outside. If the hard surface cracks or tears, the soft, fatty material inside is exposed. Platelets – disc-shaped particles in the blood that aid clotting – come to the area, and blood clots form around the plaque. The endothelium can also become irritated and fail to function properly, causing the muscular artery to squeeze at inappropriate times. This causes the artery to narrow even more.

Sometimes, the blood clot breaks apart and blood supply is restored. In other cases, the blood clot – called a coronary thrombus – may suddenly block the blood supply to the heart muscle. This is called a coronary occlusion, and can cause causing one of three serious acute coronary syndromes.
Acute coronary syndromes

Unstable angina
This may be a new symptom or a change from stable angina. The angina may occur more frequently, occur more easily at rest, feel more severe, or last longer. Although this can often be relieved with oral medications, it is unstable and may progress to a heart attack. Usually more intense medical treatments or procedures are required to treat unstable angina.

Non-ST segment elevation myocardial infarction (NSTEMI)
This type of milder heart attack, or MI, does not cause major changes on an electrocardiogram (ECG). However, chemical markers in the blood indicate that damage has occurred to the heart muscle. In NSTEMI, the blockage may be partial or temporary, so the extent of the damage is relatively minimal.

ST segment elevation myocardial infarction (STEMI)
This type of heart attack, or MI, is caused by a prolonged period of blocked blood supply. It affects a large area of the heart muscle, and causes changes on the ECG as well as in blood levels of key chemical markers.

Some people have symptoms that indicate they may soon develop an acute coronary syndrome, others may have no symptoms until something happens, and still others have no symptoms of the acute coronary syndrome at all.

All acute coronary syndromes require emergency evaluation and treatment.
Collateral Circulation

As the size of the blockage in a coronary artery increases, the body may attempt to compensate through collateral circulation — the development of new blood vessels that reroute blood flow around the blockage. However, during times of increased exertion or stress, the new arteries may not be able to supply enough oxygen-rich blood to the heart muscle.

Ischemia

Ischemia is the cramping of the heart muscle. It occurs when the narrowed coronary artery reaches a point where it cannot supply enough oxygen-rich blood to meet the heart’s needs and the heart muscle becomes starved for oxygen.

Ischemia is like a cramp in your leg. When you exercises very hard, your leg muscles cramp because they’re starved for oxygen and nutrients. Your heart needs the same oxygen and nutrients to keep working. If the heart muscle’s blood supply is inadequate to meet its needs, ischemia occurs, and you may feel chest pain or other symptoms.

Ischemia is most likely to occur when the heart demands extra oxygen. This is most common during exertion, eating, excitement or stress, or exposure to cold.

When ischemia is relieved in less than 10 minutes with rest or medications, you may be told you have “stable coronary artery disease” or “stable angina.” Coronary artery disease can progress to a point where ischemia occurs even at rest.

Ischemia, and even a heart attack, can occur without any warning signs and is called silent ischemia. Silent ischemia can occur among all people with heart disease, though it is more common in people with diabetes.
The most common symptom of coronary artery disease is angina, or chest pain. It can feel like chest discomfort, heaviness, tightness, pressure, aching, burning, numbness, fullness, or squeezing. It can be mistaken for indigestion or heartburn. Angina is usually felt in the chest, but may also be felt in the left shoulder, arms, neck, back or jaw.

Other symptoms that may occur with coronary artery disease include:

- Shortness of breath
- Palpitations \(^{(irregular heartbeats, skipped beats or a “flip-flop” feeling in your chest)}\)
- A faster heartbeat
- Dizziness
- Nausea
- Extreme weakness
- Sweating

If you experience any of these symptoms, it is important to call your doctor, especially if these are new symptoms or if they have become more frequent or severe.

**Symptoms in Women:**

Women often have different symptoms of coronary artery disease than men. For example, symptoms of a heart attack in women include:

- Pain or discomfort in the chest, left arm or back
- Unusually rapid heartbeat
- Shortness of breath
- Nausea or fatigue

If any of these symptoms occur, it is important to get medical help right away - call 911 or have someone take you to the nearest emergency room.
If you have symptoms

If you or someone you are with has chest, left arm or back pain that lasts more than 5 minutes, with one or more of the symptoms listed above, call 911 to get emergency help. **DO NOT WAIT.** Quick treatment of a heart attack is very important to reduce the amount of damage to your heart.

After calling 911, emergency personnel may tell you to chew one aspirin tablet (325mg) slowly, if you do not have a history of aspirin allergy or bleeding. Aspirin is especially effective if taken within 30 minutes after the start of symptoms.

**Do NOT take an aspirin for symptoms of a stroke.** (Stroke symptoms include sudden numbness or weakness of face, arm or leg – especially on one side of the body; sudden confusion, trouble speaking or understanding; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, loss of balance or coordination; and sudden severe headache with no known cause.)

If your cardiac symptoms stop completely within minutes, still call your doctor to report your symptoms. Call your doctor if this is the first time you have experienced these symptoms so you can be evaluated. Learn to recognize your symptoms and the situations that cause them.

Call your doctor if you have new symptoms or if they become more frequent or severe.
Angina vs. a heart attack

Angina is a warning symptom of heart disease, but it is not a heart attack. Yet the symptoms of a heart attack are similar to angina.

<table>
<thead>
<tr>
<th>Angina</th>
<th>Heart Attack</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angina</strong> is brought on by a brief period of poor blood supply to the heart muscle.</td>
<td><strong>Heart attack</strong> occurs when the blood supply to the heart muscle is blocked for an extended period of time, often due to a clot forming in a partially blocked coronary artery.</td>
</tr>
<tr>
<td><strong>Angina</strong> does not cause permanent damage to the heart.</td>
<td><strong>Heart attack</strong> results in permanent damage to the heart muscle.</td>
</tr>
<tr>
<td><strong>Angina</strong> symptoms – chest pain or discomfort, shortness of breath, palpitations, increased heart rate, dizziness, nausea, weakness and sweating – last just a few minutes and are usually relieved by rest or medication.</td>
<td><strong>Heart attack</strong> symptoms usually last more than a few minutes and include chest pain or discomfort that lasts for more than a few minutes or goes away and comes back. Other symptoms include pain or discomfort in other areas of the upper body; difficulty breathing or shortness of breath; sweating or cold sweats; fullness, indigestion or choking feeling; nausea or vomiting; lightheadedness; extreme weakness; anxiety; rapid or irregular heartbeats.</td>
</tr>
<tr>
<td><strong>Angina</strong> symptoms are relieved by rest or medications.</td>
<td><strong>Heart attack</strong> symptoms are not relieved by rest or oral medications within a few minutes.</td>
</tr>
<tr>
<td><strong>Angina</strong> does not require emergency medical attention; however, call your doctor if this is the first time you’ve experienced angina, if you have new symptoms or if they become more frequent or severe.</td>
<td><strong>Heart attack</strong> requires emergency medical attention if symptoms last longer than 5 minutes.</td>
</tr>
</tbody>
</table>
If you have been prescribed nitroglycerin and experience angina, stop what you are doing and rest. Take one nitroglycerin tablet and let it dissolve under your tongue, or if using the spray form, spray it under your tongue. Wait 5 minutes. If you still have angina after 5 minutes, call 911 to get emergency help.

For patients diagnosed with chronic stable angina: If you experience angina, take one nitroglycerin tablet and let it dissolve under your tongue, repeating every 5 minutes for up to 3 tablets spanning 15 minutes. If you still have angina after taking 3 doses of nitroglycerin, call 911 to get emergency help.

DO NOT WAIT TO GET HELP!

At the first signs of a heart attack, call 911 for emergency treatment. Do not wait for your symptoms to go away. Early recognition and treatment of heart attack symptoms can reduce the risk of heart damage and allow treatment to be started immediately. Even if you're not sure your symptoms are those of a heart attack, you should still be evaluated.
How is coronary artery disease diagnosed?

Your doctor diagnoses coronary artery disease by talking to you about your symptoms, reviewing your medical history and risk factors, and performing a physical exam and diagnostic tests.

Those tests may include blood tests, electrocardiogram (ECG or EKG), exercise stress tests and cardiac catheterization. They help your doctor discover the extent of your coronary heart disease, its effect on your heart function and the best form of treatment for you.

New testing procedures, such as coronary computed tomography angiogram (CTA), may change the way coronary artery disease is diagnosed in the future.
There are several risk factors for heart disease that can be treated or controlled, including:

- **Cigarette smoking and exposure to tobacco smoke**

- **High blood cholesterol and high triglycerides** - especially high LDL (the bad cholesterol) over 100 mg/dL and low HDL (the good cholesterol) under 40 mg/dL. Some patients who have existing heart or blood vessel disease and other patients who have a very high risk should aim for a LDL level less than 70 mg/dL. Your doctor can provide specific guidelines.

- **High blood pressure** (140/90 mm/Hg or higher)

- **Uncontrolled diabetes**

- **Physical inactivity**

- **Being overweight** (body mass index or BMI from 25-29 kg/ml) or being obese (BMI higher than 30 kg/m2) Weight distribution is also important. The risk of cardiovascular disease increases with a waist measurement of over 35 inches in women and 40 inches in men.

- **Uncontrolled anger or stress**

- **Diet high in saturated fat and cholesterol**

- **Excessive alcohol consumption**

Risk factors that can’t be modified include:

- **Gender.** Men have a greater risk of heart attacks than women, and men have heart attacks earlier in life than women. However, at age 70 and beyond, men and women are equally at risk.

- **Age.** Coronary artery disease is more likely to occur as you get older, especially after age 65.

- **Family history of heart disease.** If your parents have heart disease (especially if they were diagnosed with heart disease before age 50), you have an increased risk of developing it. Ask your doctor when it’s appropriate for you to start screenings for heart disease so it can be detected and treated early.

- **Race.** African Americans have more severe high blood pressure than Caucasians and therefore have a higher risk of heart disease. Heart disease risk is also higher among Mexican Americans, American Indians, native Hawaiians and some Asian Americans. This is partly due to higher rates of obesity and diabetes in these populations.
Treatment for coronary artery disease involves reducing your risk factors, taking medications as prescribed, possibly undergoing invasive or surgical procedures and seeing your doctor for regular visits. Treating coronary artery disease is important to reduce your risk of a heart attack or stroke.

Reducing your risk factors involves making lifestyle changes. Your doctor will work with you to help you make these changes.

If you smoke, you should quit.

Make changes in your diet to reduce your cholesterol, control your blood pressure, and manage blood sugar if you have diabetes. Low-fat, low-sodium and low-cholesterol foods are recommended. Limiting alcohol to no more than one drink a day is also important. A registered dietitian can help you make the right dietary changes.

Increase your activity level to maintain a healthy weight and reduce stress. Always check with your doctor before beginning any exercise program.
Procedures to treat coronary artery disease

Common interventional procedures to treat coronary artery disease include balloon angioplasty (PTCA) and stent or drug-eluting stent placement.

These procedures are considered non-surgical because they are done by a cardiologist through a tube or catheter inserted into a blood vessel, rather than by a surgeon through an incision. Several types of balloons and/or catheters are available to treat the plaque within the vessel wall. The cardiologist chooses the type of procedure based on individual patient needs.
Coronary artery bypass graft (CABG) surgery

One or more blocked coronary arteries are bypassed by a blood vessel graft to restore normal blood flow to the heart. These grafts usually come from the patient’s own arteries and veins located in the chest, arm or leg. The graft goes around the clogged artery (or arteries) to create new pathways for oxygen-rich blood to flow to the heart.

When these traditional treatments are not options for you, doctors may suggest other less traditional therapies, such as TMR or EECP.

Transmyocardial laser revascularization (TMR) is a treatment aimed at improving blood flow to areas of the heart that were not treated by angioplasty or surgery. A special carbon dioxide laser is used to create small channels in the heart muscle, improving blood flow in the heart. TMR is most frequently performed as an adjunct to coronary artery bypass graft surgery and rarely performed as a stand-alone procedure.

Enhanced external counterpulsation (EECP) may stimulate collateral circulation in patients with persistent angina whose symptoms do not respond to standard treatments. EECP is a non-invasive treatment for people who have chronic, stable angina; who are not receiving adequate relief from angina by taking nitrate medications; and who do not qualify for a procedure such as bypass surgery, angioplasty or stenting.

Follow-Up Care

Your cardiologist will want to see you on a regular basis for a physical exam and possibly to perform diagnostic tests. Your doctor will use the information gained from these visits to monitor the progress of your treatment. Check with your doctor to find out when to schedule your next appointment.