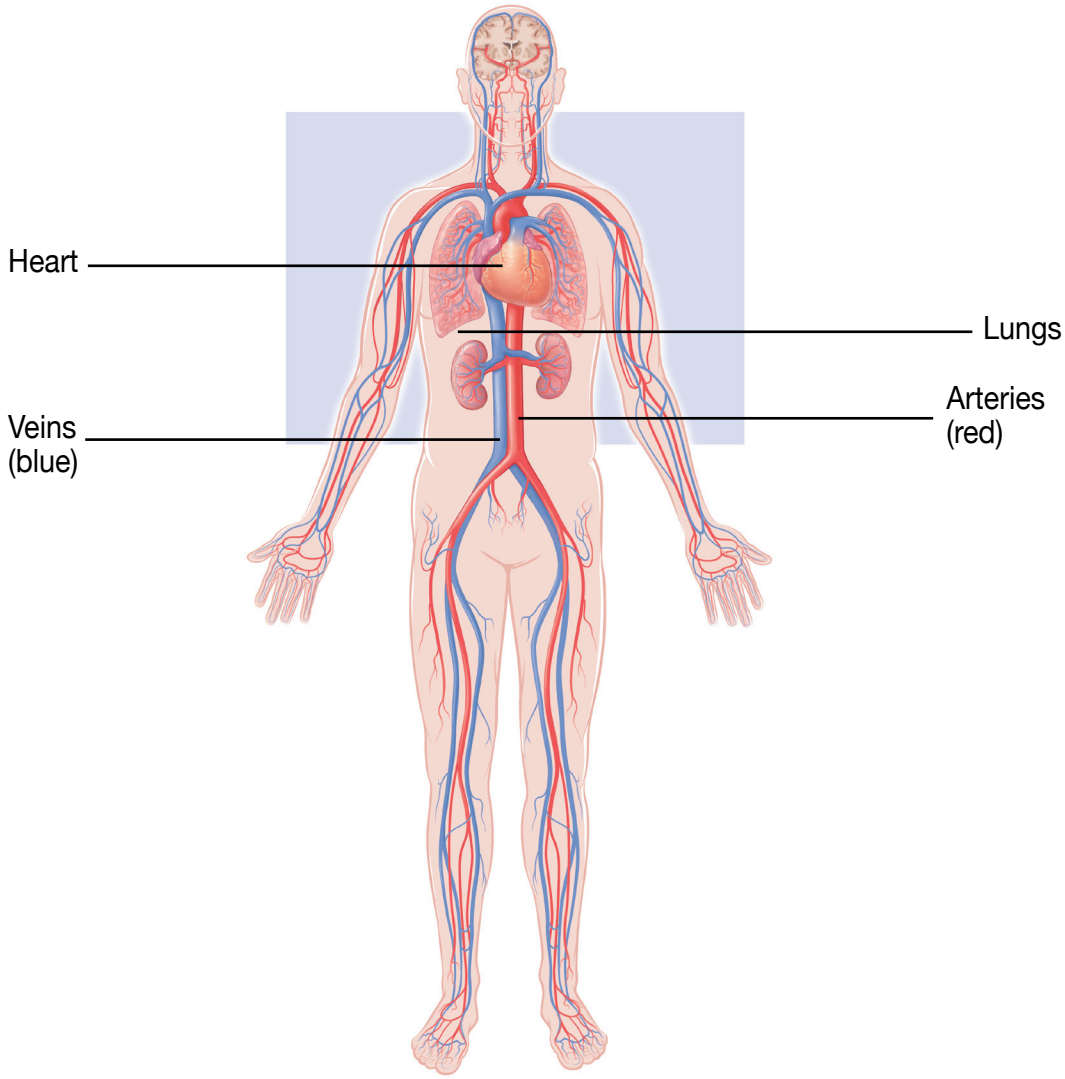
How Your Heart Works

Your heart is a muscular pump about the size of your fist, located slightly to the left and behind your breastbone. Its function is to pump blood throughout your body. As your heart beats, the walls of the heart squeeze, sending nearly 12 pints of blood throughout your body every minute. In a normal heart, it takes less than one minute for blood to travel from your heart to your big toe and back. In that minute, your heart will beat 60 to 80 times.

The illustration below shows the body's circulation. The heart pumps oxygen-rich blood throughout the body via arteries (shown in red); veins (shown in blue) bring oxygen-poor blood back to the heart.

Circulation Throughout Your Body

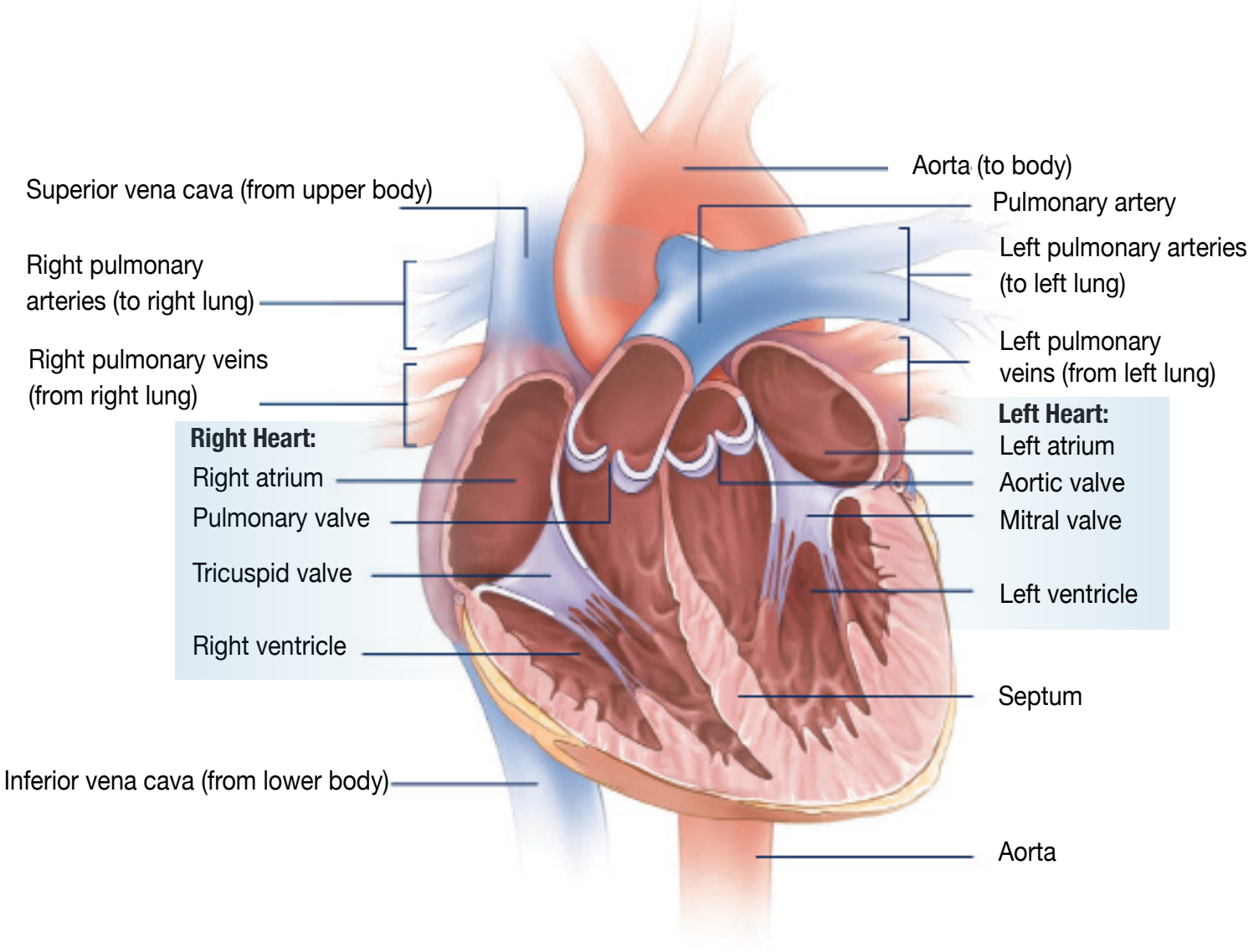


Heart Anatomy

The heart has two sides, separated by an inner wall called the **septum**. The right side of the heart pumps blood to the lungs to pick up oxygen. The left side of the heart receives the oxygen-rich blood from the lungs and pumps it to the body.

The heart has four chambers and four valves and is connected to various blood vessels. **Veins** are blood vessels that carry blood from the body to the heart. **Arteries** are blood vessels that carry blood away from the heart to the body.

The illustration shows a cross-section of a healthy heart with its inside structures. The explanations of these structures are listed on the next page.



Heart Chambers

Your heart has four chambers.

The two upper chambers are called atria (**left atrium** and **right atrium**) and the two lower chambers are called ventricles (**left ventricle** and **right ventricle**).

Heart Valves

Four valves control the flow of blood from the atria to the ventricles and from the ventricles into the two large arteries connected to the heart. These one-way valves have either two or three tissue flaps called leaflets that act as doors that open and close to ensure that blood flows only in the proper direction.

Right Side

The **tricuspid valve** allows blood to move from the right atrium into the right ventricle.

The **pulmonary valve** allows blood to move from the right ventricle to the lungs to get oxygen.

Left Side

The **mitral valve** allows blood to move from the left atrium into the left ventricle.

The **aortic valve** allows blood to move out of the left ventricle into the aorta and then to the rest of the body.

Veins

The veins are major blood vessels connected to your heart.

The **superior and inferior vena cavae** are large veins that carry oxygen-poor blood from the body back to the heart.

The **pulmonary veins** carry oxygen-rich blood from the lungs to the left side of the heart so it can be pumped to the body.

Arteries

The arteries are major blood vessels connected to your heart.

The **pulmonary artery** carries blood from the right side of the heart to the lungs to pick up a fresh supply of oxygen.

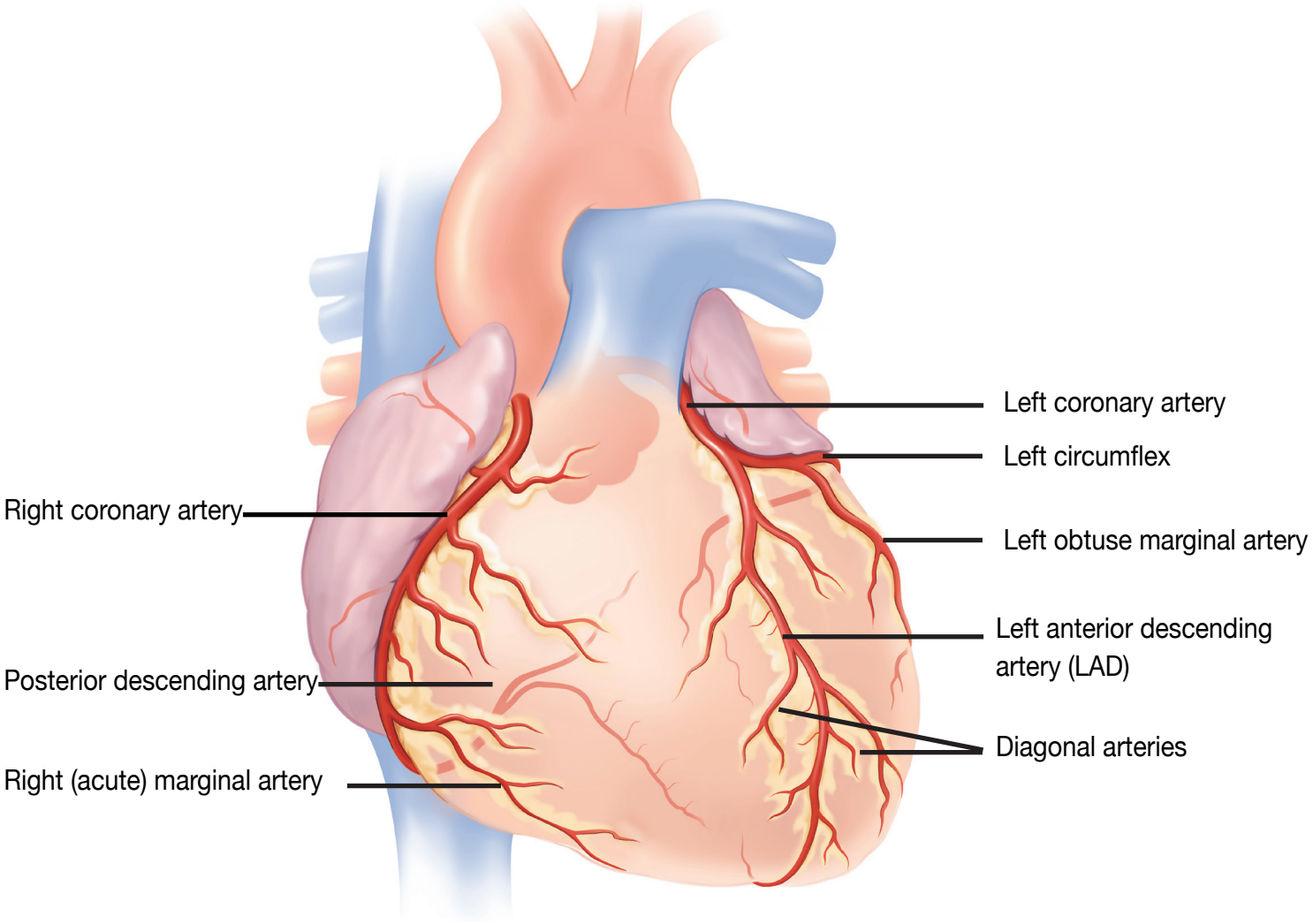
The **aorta** is the main artery that carries oxygen-rich blood from your heart to the rest of your body.

The **coronary arteries** (see illustration on next page) are the other important arteries attached to the heart. They carry oxygen-rich blood from the aorta to the heart muscle, which must have its own blood supply to function.

Adapted from http://www.nhlbi.nih.gov/health

Coronary Arteries of The Heart

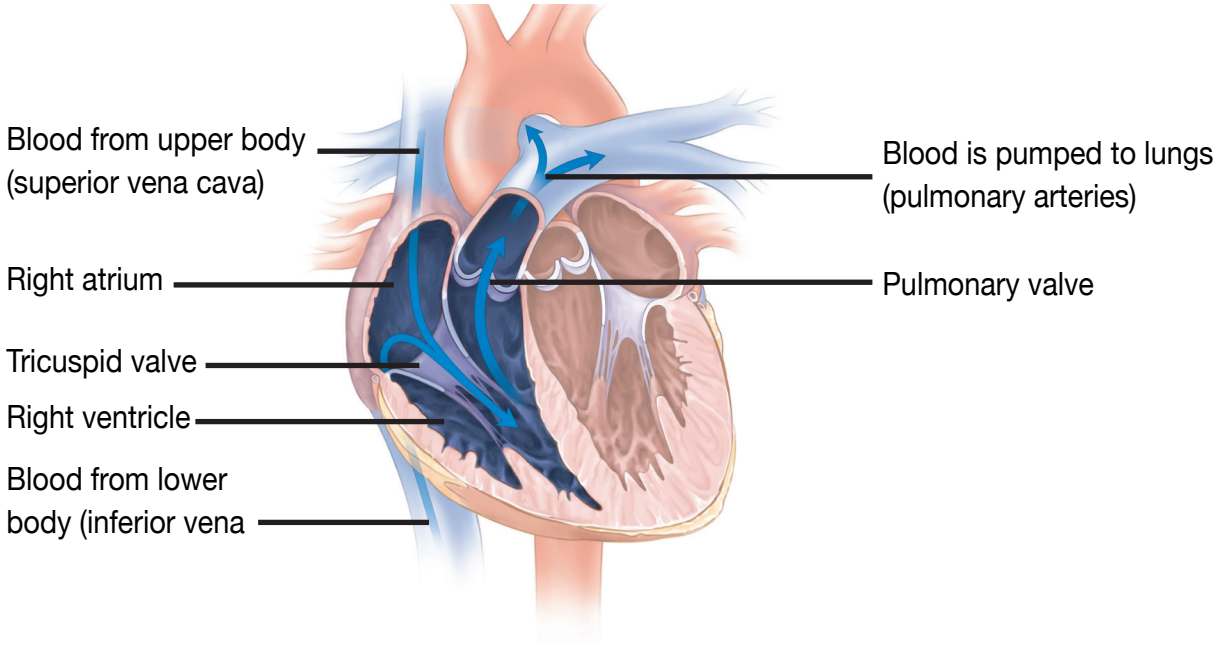
The illustration shows the largest of the coronary arteries.



Heart Function

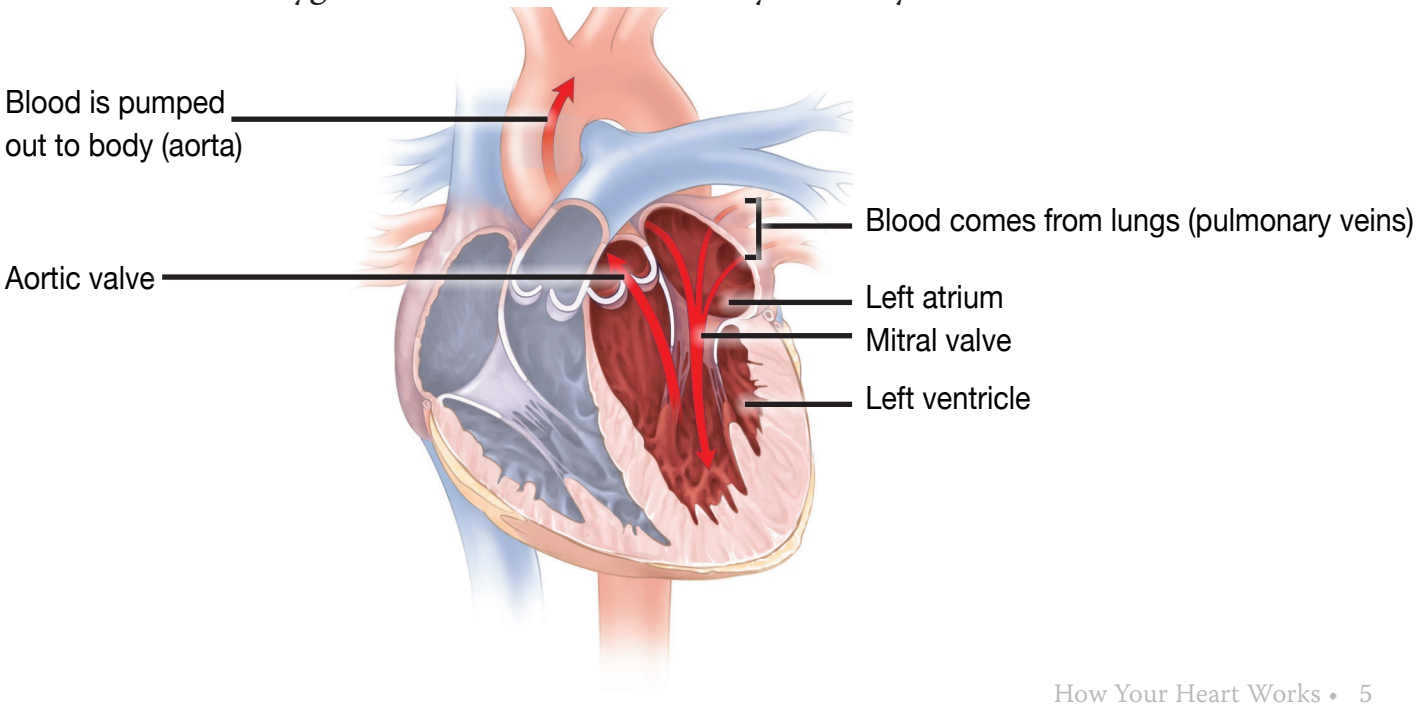
A. The Right Side of Your Heart

The right side of your heart takes in **oxygen-poor blood (blue)** from the body and pumps it into the lungs to receive oxygen. Blue arrows in the illustration below show the path of the oxygen-poor blood through the right atrium, tricuspid valve, right ventricle, and pulmonary valve to the lungs where the blood will receive oxygen.



B. The Left Side of Your Heart

The left side of your heart takes in **oxygen-rich blood (red)** from the lungs and pumps it out to the body. Red arrows in the illustration below show the path of the oxygen-rich blood through the left atrium, mitral valve, left ventricle, and aortic valve to the aorta. The aorta delivers this oxygen-rich blood to the rest of your body.



Types of Heart Problems and Surgical Procedures

Acute Coronary Syndrome: Heart Attack and Unstable Angina

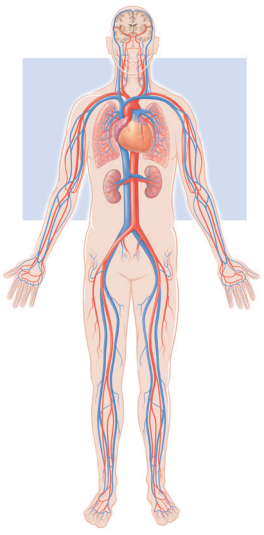
The following section provides you with information about heart attacks and unstable angina, two well-known heart problems that fall under the term acute coronary syndrome (ACS).

What is acute coronary syndrome?

Acute coronary syndrome is a medical term used to describe a condition where the blood flow to the heart muscle is severely reduced or suddenly stopped. When blood cannot flow to the heart, the heart muscle can become damaged. Heart attack and unstable angina are both conditions of acute coronary syndrome (ACS).

What causes acute coronary syndrome?

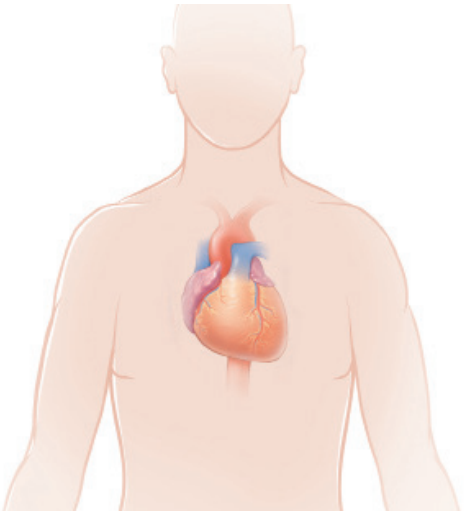
Acute coronary syndrome usually results from the buildup of fat, cholesterol, or other substances (called plaque) inside the coronary arteries. Coronary arteries are small vessels on the outside of your heart. These arteries supply blood to your heart muscle. If plaque builds up inside these arteries, they may narrow and lose their ability to deliver blood and oxygen to your heart. This condition is called **atherosclerosis**, hardening of the arteries, or coronary artery disease.



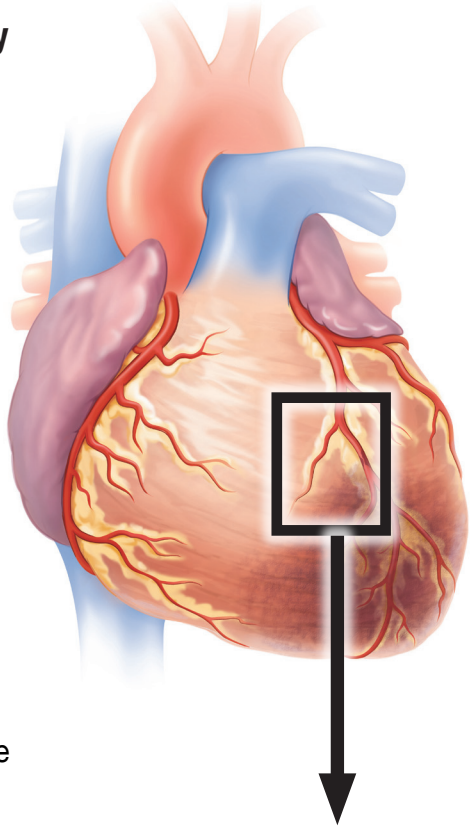
Your heart muscle needs blood to function.

Heart Damage from a Blocked Coronary Artery

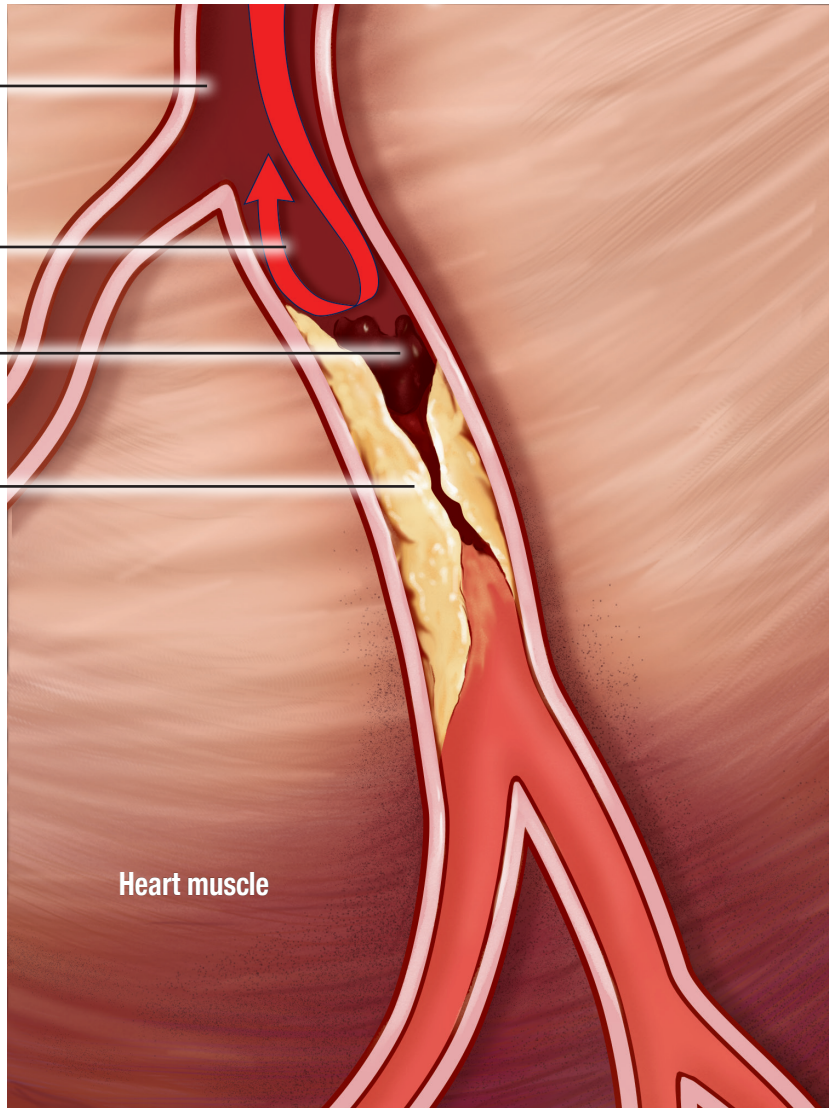
A. Location of the heart in the body.



Heart muscle



B. Shows a section of the coronary artery with plaque buildup and a blood clot.



Plaque is a build-up of fat, cholesterol, and other substances.

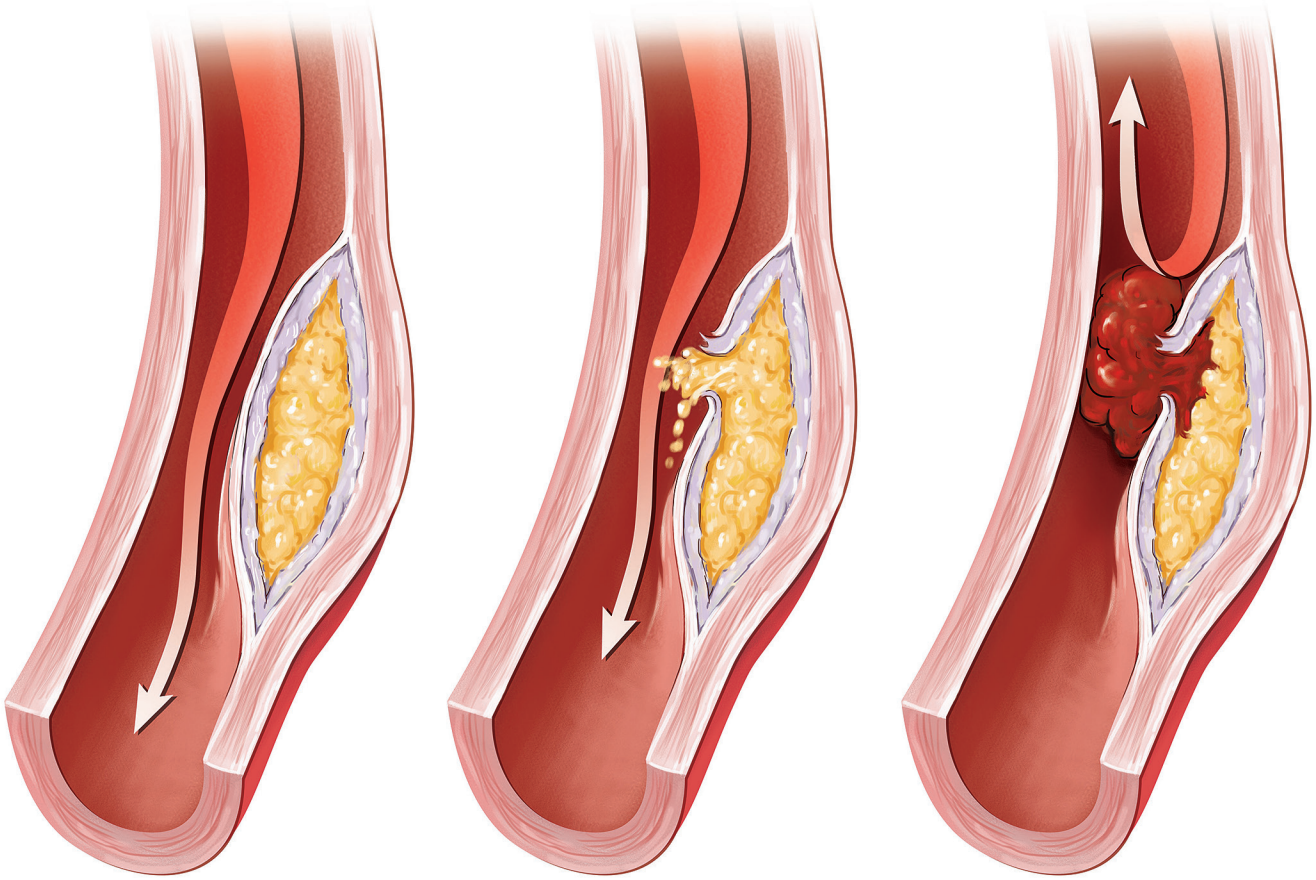
Adapted from http://www.nhlbi.nih.gov/health

Heart Attack or Acute Myocardial Infarction (AMI)

A heart attack occurs when the blood flow to the arteries in your heart is blocked. This happens when plaque builds up in your heart arteries and blocks blood flow. Your heart muscle needs blood to function. If your heart arteries are blocked, the heart muscle beyond the blockage doesn't get enough oxygen.

Without oxygen, your heart muscle gets damaged or could even die. This is called a **heart attack** or acute myocardial infarction.

Plaque inside your heart artery can also break or rupture. When this happens, a blood clot forms around the plaque and can also block the blood flow to your heart.



Unstable angina

You may have had stable angina (chest pain) before. You may have known when to expect your symptoms, like while you are exercising. Stable angina usually goes away when you rest or take your angina medicine (nitroglycerine).

Unstable angina happens when blood flow to the arteries in your heart is suddenly slowed by:

- Plaque that narrows the arteries in your heart.
- Small blood clots that form in these arteries

Unstable angina symptoms are similar to those of a heart attack. The following is important information to know about the symptoms of unstable angina:

- You may experience unexpected chest pain or discomfort that usually occurs while you are resting.
- The symptoms **may not** go away when you rest or take your angina medicine (nitroglycerin).
- The symptoms may get worse or happen at times that it didn't before.
- The symptoms may mean you are having a heart attack.

How is acute coronary syndrome diagnosed?

A doctor will ask you about your symptoms, health history and complete a physical exam. You will have several tests to find out what is causing your symptoms. The following common tests are used to tell whether you have unstable angina or have had a heart attack:

- **Electrocardiogram (EKG or ECG)**- measures the electrical signals that control the way your heart beats.

    - **What will happen?** Small sticky pads or patches will be placed on your chest, arms, and legs. Wires connected to a machine will be attached to these patches. These wires connect to the EKG machine, which graphs the electrical activity of your heart. Your doctor will look for certain changes on the graph to see if your heart is not getting enough blood or if you are having a heart attack.

Blood tests often are repeated to check for changes over time.

- **Blood tests-** Commonly used blood tests include troponin tests, CK or CK–MB tests, and serum myoglobin tests.

  What will happen? A technician will take samples of your blood. Your doctor will look for an increase in cardiac proteins in your blood. The heart releases these protein substances into your blood when it is damaged. Blood tests often are repeated to check for changes over time.

- **Cardiac catheterization (Heart Cath)-** is a procedure used to check the heart and its blood supply. This test can help your doctor:
  - See narrowed or plaque build-up in the arteries of your heart
  - Measure blood pressure within your heart
  - Evaluate how well your heart muscle is working
  - Decide whether further treatment, such as stenting, is needed

  What will happen? To perform a cardiac catheterization, a thin flexible tube called a catheter is put into an artery in your groin (femoral artery) or wrist (radial artery). The catheter is then slowly guided through your arteries by a heart doctor who can see the progress on a computer screen. Once the catheter has reached your heart, a small amount of dye is injected. Your heart doctor is able to see the dye move through your heart. This helps show any blockages in your heart, and whether further treatment is needed.

How is acute coronary syndrome treated?

The priority for treating a heart attack or unstable angina is to restore blood flow to your arteries to minimize the amount of damage to your heart muscle. The following are commonly used treatment options:

- **Coronary Angioplasty**- is a procedure used to widen heart arteries that have become partially or completely blocked. It is done by inserting a catheter-guided balloon through a small opening in your leg or arm. The balloon is guided to the blockage, where it is inflated. As the balloon inflates, it pushes the plaque against the artery wall. The balloon is then deflated and removed. This will improve blood flow to your heart. Often a stent (described in the section below) is then placed to keep the heart artery open.

- **Stent Procedure**- a stent is a small wire-mesh tube placed in an artery to keep it open after angioplasty. Some stents are coated with medication that is slowly released into the artery to help prevent scar tissue from causing a blockage in the future. These are called drug-eluting stents (DES).

The priority for treating a heart attack or unstable angina is to restore blood flow to your arteries to minimize the amount of damage to your heart muscle.

Notes