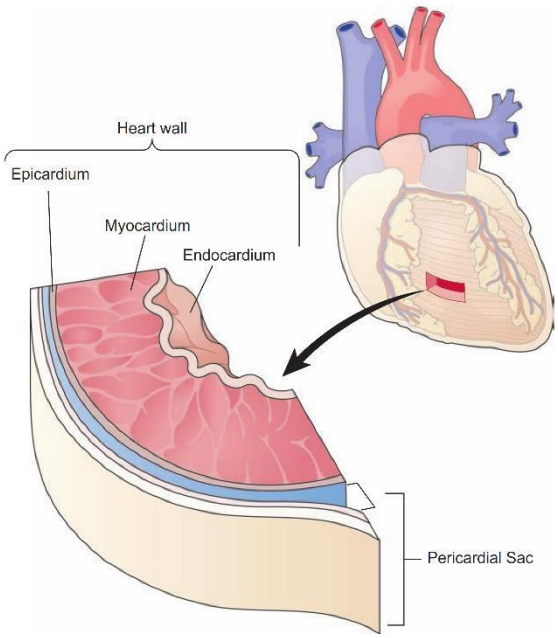
The Cardiovascular System

The cardiovascular system comprises the heart, the blood, and all the blood vessels, which carry blood to all parts of the body. The blood vessels include all the arteries, veins, and capillaries, which taken together form a transportation system that delivers oxygen and nutrients to the body's cells. The cardiovascular system also helps regulate body temperature and collects waste products from the cells.

The Heart

The heart is a four-chambered hollow organ with three layers. The innermost layer is called the **endocardium** [endo- (within); cardi/o (heart)]. The middle layer, which is the actual heart muscle and the thickest of the three layers, is called the **myocardium** [my/o (muscle); cardi/o (heart)]. The outer layer of the heart is called the **epicardium**, which is surrounded by the **pericardium** [peri- (surrounding); cardi/o (heart)], a sac that surrounds the heart.



The heart acts as a double pump separated by a wall called a **septum** [from the Latin word saeptum (a fence)]. The right-side pumps deoxygenated blood to the lungs where it picks up oxygen, and the left side of the heart pumps the oxygenated blood to all other parts of the body through the entire body. This

delivery system operates through the four chambers of the heart. The four chambers are as follows:

- **Right atrium** [a Latin word meaning "entry hall"]: upper right chamber that receives blood from all body parts except the lungs; the interatrial septum separates the right and left atria (plural of atrium).
- **Right ventricle** [from the Latin word venter (belly)]: lower right chamber that receives blood from the right atrium and pumps it to the lungs; the interventricular septum separates the right and left ventricles.
- **Left atrium**: upper left chamber that receives oxygen-rich blood as it returns from the lungs.
- **Left ventricle**: lower left chamber that pumps blood to all parts of the body. Each heart contraction, called **systole** [a Greek word meaning "contraction"], is followed by a relaxation called **diastole** [from the Greek word diastole (dilation)]. These two phases make up the cardiac cycle.

Heart rate is determined by how many times the heart beats per minute. The electrical activity of the heart can be recorded on an **electrocardiogram** [electro (electricity); cardi/o (heart); -gram (record or picture)]. The machine that does the recording is called an **electrocardiograph** [electro (electricity); cardi/o (heart); -graph (instrument used to record)].

The Blood Vessels

The blood vessels include the **arteries**, **capillaries**, and **veins**. Blood brings oxygen and nutrients to body cells and removes waste products. Blood itself is divisible into two main components: **plasma** [a Greek word meaning "something molded" or "created"], which is the liquid part, and the **formed elements** within

the plasma. Blood plasma, which is clear and straw-colored, is composed mostly of water (91%), along with proteins and other nutrients in solution.

The names of blood vessels in the cardiovascular system are listed here:

- **Arteries** [from the Greek word arteria (windpipe)]: thick-walled, elastic blood vessels that carry oxygenated blood away from the heart (note one exception: the pulmonary arteries carry unoxygenated blood).
- **Arterioles** [diminutive form of arteria]: branches of the arteries that carry oxygenated blood to the capillaries.
- **Capillaries** [from the Latin word capillus (hair)]: blood vessels that connect the arterial and venous systems; they are only one cell in thickness and exchange nutrients and waste material.
- **Venules** [diminutive form of vena [blood vessel])]: branches of the veins that receive blood from the capillaries and transport it to the veins.
- **Veins** [from the Latin word vena (blood vessel)]: blood vessels that return deoxygenated blood to the heart.

The lumen of a blood vessel is the opening through which blood flows. The nervous system can stimulate the lumen to be opened, a condition called **vasodilation** [vas/o (duct, blood vessel); from the Latin word dilatare (to make wider, enlarge)], or closed, a condition called **vasoconstriction** [vas/o (duct, blood vessel); from the Latin word constringere (to draw tight)]. Vasodilation and vasoconstriction each can have an effect on blood pressure. Blood pressure is a measurement of the amount of pressure exerted against the walls of blood vessels. Blood pressure is recorded as a fractional number: **systolic** over **diastolic**. Blood pressure can be measured by an instrument called a **sphygmomanometer** [from the Greek words sphygmos (pulse), manos (thin), metros (measure)].

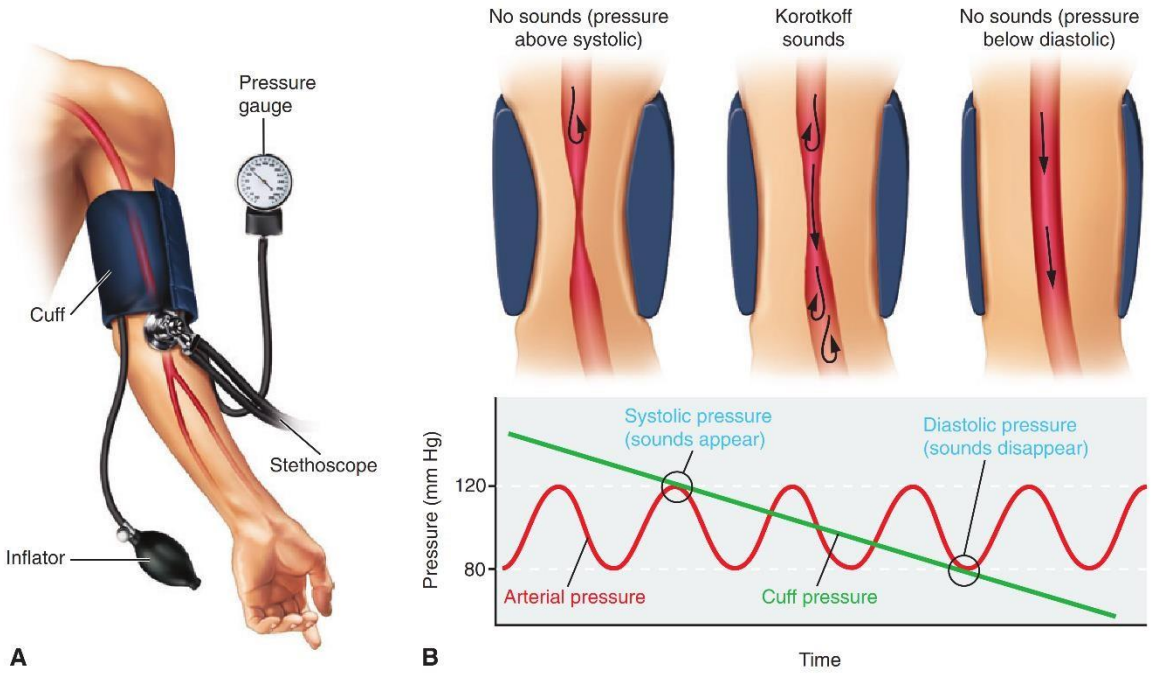


FIGURE 10-8 Measurement of blood pressure. A. A sphygmomanometer, or blood pressure cuff set to measure pressure in the left brachial artery. **B.** As the clinician lowers the cuff pressure, Korotkoff sounds begin at the systolic pressure and disappear at the diastolic pressure.

Disorders and Treatments

Coronary Artery Disease: One of the main causes of coronary artery disease is **atherosclerosis** [from the Greek word ather (groats, porridge); scler/o (hardening); -osis (abnormal condition of)], which is a progressive build-up of plaque that can cause the lumen of coronary arteries to narrow. A deficiency of blood flow and oxygen to the myocardium is called **ischemia** [from the Greek word iskhaimos (a stopping of the blood); -ia (condition)]. One cause of plaque build-up in the coronary arteries is a condition called **hyperlipidemia** [hyper- (above normal); lip/o (fat); -demia (from hema [blood])].

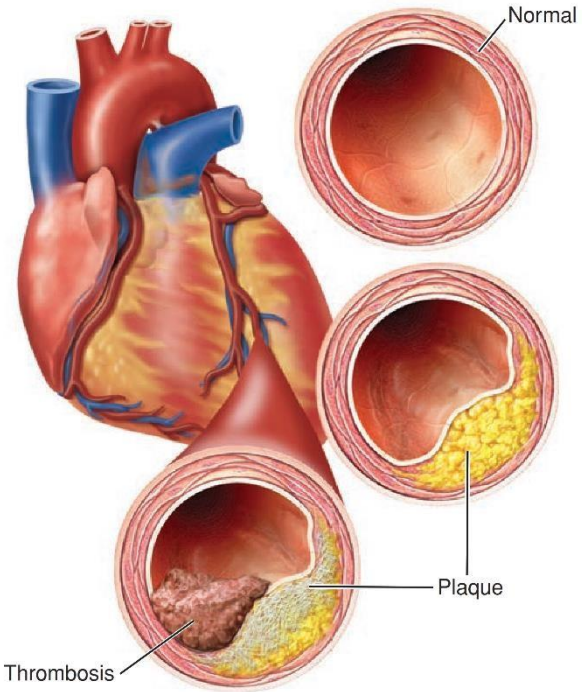


FIGURE 10-9 Coronary atherosclerosis. In this example, a branch of the left coronary artery is shown in cross-section during three stages of atherosclerosis: no plaque present (**top**), a well-formed plaque blocking 30% of the vessel lumen (**middle**), and formation of a thrombus (blood clot) (**bottom**).

Cardiomegaly [cardi/o (heart); -megaly (enlargement)]: enlargement of the heart.

Cardiomyopathy [cardi/o (heart); my/o (muscle); -pathy (disease)]: disease of the heart muscle (myocardium).

Myocardial Infarction [my/o (muscle); cardi/o (heart); -al (adjective suffix); from the Latin word infractionem (a breaking)]**:** A myocardial infarction (MI), commonly called a heart attack, results from a lack of oxygen supply to the myocardium.

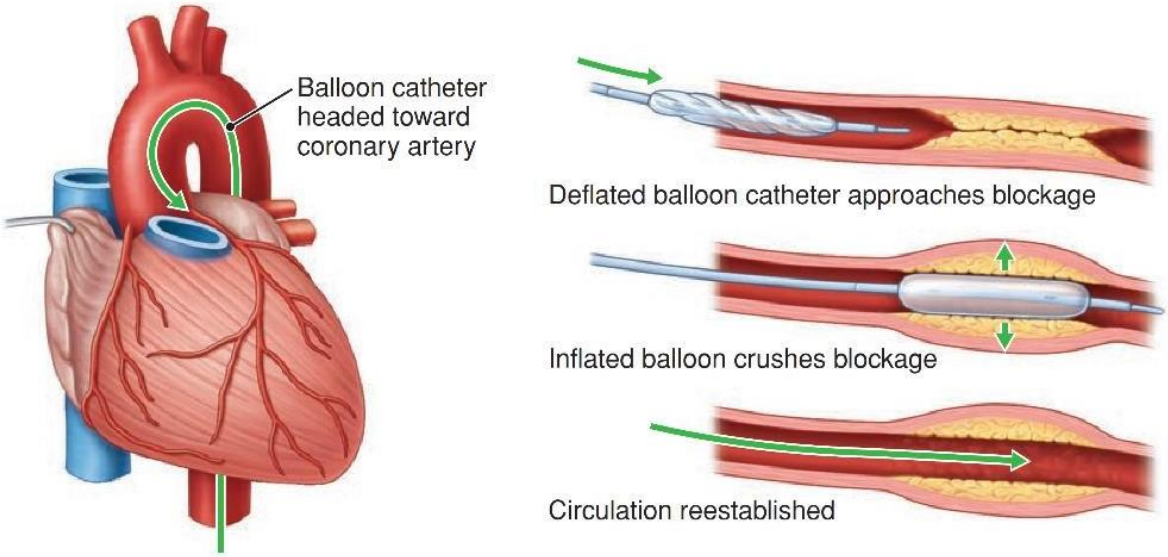


FIGURE 10-12 Coronary angioplasty (PTCA).

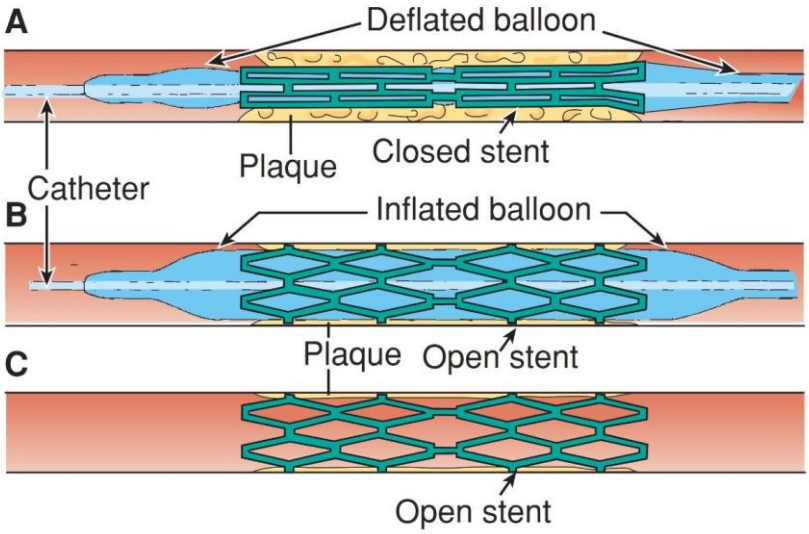


FIGURE 10-13 Arterial stent. A. Stent closed, before balloon inflation. **B.** Stent open, balloon inflated; stent will remain expanded after balloon is deflated and removed. **C.** Stent open, balloon removed.

Myocarditis [my/o (muscle); cardi/o (heart); -itis (inflammation)]: inflammation of the heart muscle.

Pericarditis [peri- (surrounding); cardi/o (heart); -itis (inflammation)]: inflammation of the pericardium.