

Heart Health

Atherosclerotic disease is a global health problem. Cardiovascular disease is the number 1 cause of death worldwide, claiming 12 billion lives annually in developing countries. In the US heart disease claims about 800,000 deaths per year. It is estimated 80% of deaths from cardiovascular disease worldwide occur in low-income and middle income countries. The high mortality is partly due to lack of access to care in many areas, but the problem will not be solved by better medical care.

Atherosclerotic is a complex process by which arteries become progressively narrowed, impairing the supply of oxygen. Impaired blood flow can result in ischemia and cause angina or intermittent claudication. Plaques can also rupture, triggering acute formation of a clot and abrupt loss of blood supply to tissues, resulting in an infarction.

Eventually, progression of atherosclerosis *generally* can manifest itself in three ways:

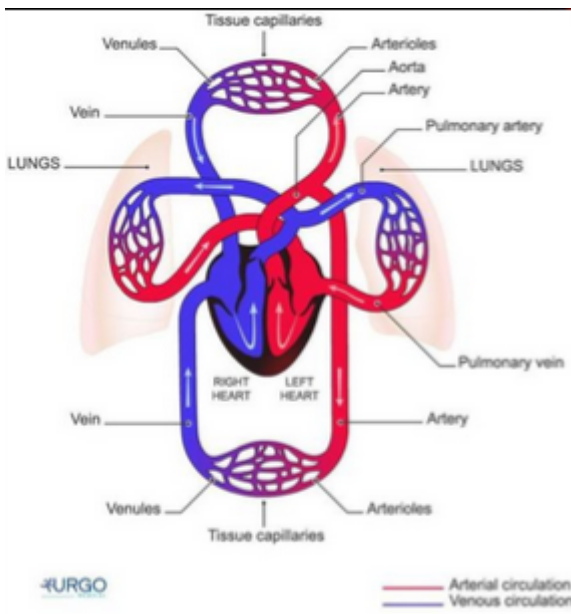
- Coronary artery disease
- Cerebrovascular disease
- Peripheral artery disease

Learning Outcomes

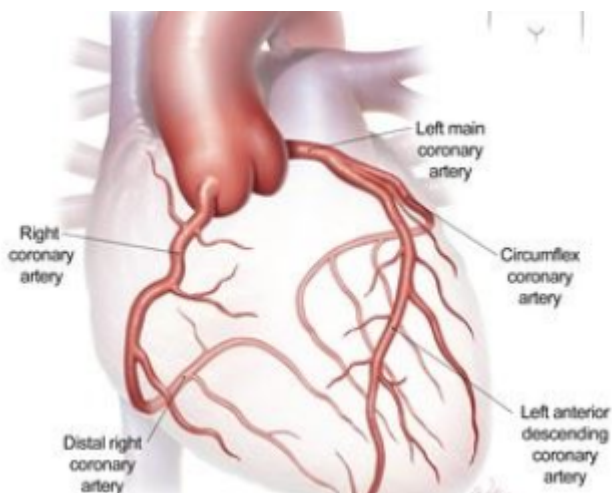
1. Define atherosclerosis and describe the basic mechanism by which it develops, including response to injury theory
2. Compare and contrast the terms ischemia and infarction
3. Explain the mechanisms by which poorly controlled diabetes and hypertension contribute to heart disease
4. Discuss the risk factors for atherosclerotic cardiovascular disease

The Cardiovascular System

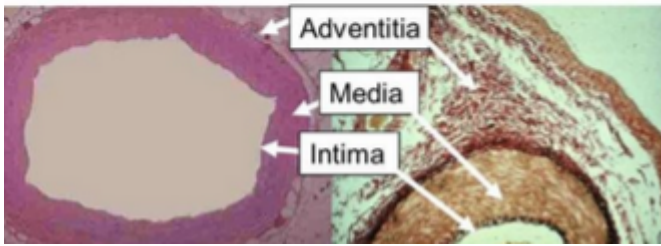
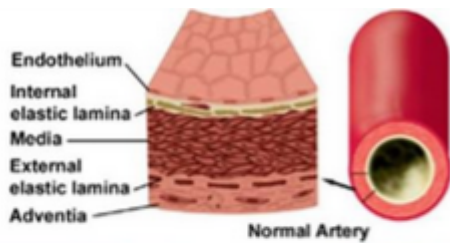
The primary function of the heart and blood vessels is to transport oxygen, nutrients, and byproducts of metabolism. Oxygen and nutrient-rich blood is delivered to tissues via the arterial system which branches into smaller and smaller blood vessels; from arteries to arterioles to capillaries (where most exchange occurs).



The heart is a discrete organ which has 4 chambers (in humans). Two chambers on the right side (right atrium and right ventricle) receive blood returning from the periphery and send it too the lungs for re-oxygenation. Blood then returns on the left side via pulmonary veins. After entering the left atrium blood enters the left ventricle and is pumped back into the aortic arch for distribution to the body.



Note also that the heart requires a continuous supply of oxygen an nutrients, just like any other tissue. The heart receives its blood supply from coronary arteries which arise from the root of the aorta.



All blood vessels (arteries and veins) have 3 primary layers: Intima, media, and adventitia. Normally, the walls of an artery are smooth to allow unobstructed blood flow. The innermost layer, intima, is lined with endothelial cells which are in direct contact with blood.

Atherosclerosis

The endothelial cells that line blood vessels provide a semi-permeable barrier that regulates exchange between blood and tissues. Endothelial cells also regulate a number of less obvious processes. They provide a unique surface that generally allows the cellular elements of blood to flow without adhering too the vessel lining unless something has perturbed the cells. When perturbation occurs, these cells secrete cytokines that trigger and maintain an inflammatory response. Endothelial cells also regulate constriction and relaxation of vessels by releasing vasodilatory molecules and vasoconstrictive molecules.

Atherosclerosis occurs when plaque builds up in the arteries. Enough can eventually lead to a heart attack or stroke. Atherosclerosis can be asymptomatic in its early stages but become serious as blood supply becomes compromised. It starts with damage to the artery wall, then calcium and blood cells begin to build on the damaged wall. Chemical reactions occur with LDL Cholesterol triggering inflammation and cells release a chemical SOS signal and white blood cells begin to eat the cholesterol, which cause the cells to turn to foam and turn to plaque.

Risk Factors

There is a direct link between risk of cardiovascular disease and concentration of cholesterol in the blood. Cholesterol is a waxy, fat-like substance that's found in all the cells in your body. Your body needs some cholesterol to make hormones, vitamin D, and substances that help you digest foods. LDL is the "bad" cholesterol that sticks to your arteries. Statins are currently the most powerful cholesterol lowering drugs, inhibiting the synthesis of cholesterol in the liver. HDL is the "good" cholesterol; Blood levels of HDL are inversely related to risk of coronary artery disease.

Obesity is associated with some cancers, Type II diabetes, hypertension, and heart disease. BMI is usually used to measure fatness, but can be inaccurate because it does not take into account muscular development or fat distribution. "Central adiposity" is fat deposition in the torso (the "apple-shaped" person) which is more indicative of cardiovascular risk.

Type 1 and 2 diabetes are risk factors for CAD. People with diabetes cannot produce insulin, which circulates in the blood and binds to insulin receptors on the muscles and fat cells triggering insertion of specialized glucose transporters to facilitate the entry of glucose from the blood to the cell.

Other factors:

- Smoking - smoking is really bad mmmkay
- Alcohol consumption - almost all studies have concluded that moderate alcohol consumption is associated with 20-40% lower incidence of CAD, compared with non-drinkers or heavy-drinkers. However, there could be an unknown confounding variable.
- Gender differences - Women tend to develop heart disease about 10 years after men
- Aspirin and Vitamins - A study in the 1900's suggested there may be a 30% risk reduction of myocardial infarction by taking aspirin.

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