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Ischemia

REVIEWED

By Chris at 9:59 am, Jun 11, 2020

Definition

Ischemia is an insufficient supply of blood to an organ, usually due to a blocked artery.

Description

Myocardial ischemia is an intermediate condition in [coronary artery disease](#) during which the heart tissue is slowly or suddenly starved of oxygen and other nutrients. Eventually, the affected heart tissue will die. When blood flow is completely blocked to the heart, ischemia can lead to a [heart attack](#). Ischemia can be silent or symptomatic. According to the American Heart Association, up to four million Americans may have silent ischemia and be at high risk of having a heart attack with no warning.

Symptomatic ischemia is characterized by chest [pain](#) called [angina](#) pectoris. The American Heart Association estimates that nearly seven million Americans have angina pectoris, usually called angina. Angina occurs more frequently in women than in men, and in blacks and Hispanics more than in whites. It also occurs more frequently as people age—25% of women over the age of 85 and 27% of men who are 80-84 years old have angina.

People with angina are at risk of having a heart attack. Stable angina occurs during exertion, can be quickly relieved by resting or taking nitroglycerine, and lasts from three to twenty minutes. Unstable angina, which increases the risk of a heart attack, occurs more frequently, lasts longer, is more severe, and may cause discomfort during rest or light exertion.

Ischemia can also occur in the arteries of the brain, where blockages can lead to a [stroke](#). About 80-85% of all strokes are ischemic. Most blockages in the cerebral arteries are due to a blood clot, often in an artery narrowed by plaque. Sometimes, a blood clot in the heart or aorta travels to a cerebral artery. A [transient ischemic attack](#) (TIA) is a "mini-stroke" caused by a temporary deficiency of blood supply to the brain. It occurs suddenly, lasts a few minutes to a few hours, and is a strong warning sign of an impending stroke. Ischemia can also effect intestines, legs, feet and kidneys. Pain, malfunctions, and damage in those areas may result.

Causes and symptoms

Ischemia is almost always caused by blockage of an artery, usually due to atherosclerotic plaque. Myocardial ischemia is also caused by [blood clots](#) (which tend to form on plaque), artery spasms or contractions, or any of these factors combined. Silent ischemia is usually caused by emotional or mental [stress](#) or by exertion, but there are no symptoms. Angina is usually caused by increased oxygen demand when the heart is working harder than usual, for example, during [exercise](#), or during mental or physical stress. According to researchers at Harvard University, physical stress is harder on the heart than mental stress. A TIA is caused by a blood clot briefly blocking a cerebral artery.

Risk factors

The risk factors for myocardial ischemia are the same as those for coronary artery disease. For TIA, coronary artery disease is also a risk factor.

- Heredity. People whose parents have coronary artery disease are more likely to develop it. African Americans are also at higher risk.
- Sex. Men are more likely to have heart attacks than women, and to have them at a younger age.
- Age. Men who are 45 years of age and older and women who are 55 years of age and older are considered to be at

risk.

- **Smoking.** Smoking increases both the chance of developing coronary artery disease and the chance of dying from it. Second hand smoke may also increase risk.
- High cholesterol. Risk of developing coronary artery disease increases as blood cholesterol levels increase. When combined with other factors, the risk is even greater.
- High blood pressure. High blood pressure makes the heart work harder, and with time, weakens it. When combined with **obesity**, smoking, high cholesterol, or diabetes, the risk of heart attack or stroke increases several times.
- Lack of physical activity. Lack of exercise increases the risk of coronary artery disease.
- Diabetes mellitus. The risk of developing coronary artery disease is seriously increased for diabetics.
- Obesity. Excess weight increases the strain on the heart and increases the risk of developing coronary artery disease, even if no other risk factors are present. Obesity increases blood pressure and blood cholesterol, and can lead to diabetes.
- Stress and anger. Some scientists believe that stress and anger can contribute to the development of coronary artery disease. Stress increases the heart rate and blood pressure and can injure the lining of the arteries. Angina attacks often occur after anger, as do many heart attacks and strokes.

Angina symptoms include:

- A tight, squeezing, heavy, burning, or **choking** pain that is usually beneath the breastbone—the pain may spread to the throat, jaw, or one arm
- A feeling of heaviness or tightness that is not painful
- A feeling similar to gas or indigestion
- Attacks brought on by exertion and relieved by rest.

If the pain or discomfort continues or intensifies, immediate medical help should be sought, ideally within 30 minutes.

TIA symptoms include:

- Sudden weakness, tingling, or numbness, usually in one arm or leg or both the arm and leg on the same side of the body, as well as sometimes in the face
- Sudden loss of coordination
- Loss of vision or double vision
- Difficulty speaking
- Vertigo and loss of balance.

Diagnosis

Diagnostic tests for myocardial ischemia include: resting, exercise, or ambulatory electrocardiograms; scintigraphic studies (radioactive heart scans); **echocardiography**; coronary **angiography**; and, rarely, positron emission tomography. Diagnostic tests for TIA include physician review of symptoms, **computed tomography scans** (CT scans), carotid artery ultrasound (**Doppler ultrasonography**), and **magnetic resonance imaging**. Angiography is the best test for ischemia of any organ.

An electrocardiogram (ECG) shows the heart's activity and may reveal a lack of oxygen. Electrodes covered with conducting jelly are placed on the patient's chest, arms, and legs. Impulses of the heart's activity are recorded on paper. The test takes about 10 minutes and is performed in a physician's office. About 25% of patients with angina have normal electrocardiograms. Another type of electrocardiogram, the exercise **stress test**, measures response to exertion when the patient is exercising on a treadmill or a stationary bike. It is performed in a physician's office or an exercise laboratory and takes 15 to 30 minutes. This test is more accurate than a resting ECG in diagnosing ischemia. Sometimes an ambulatory ECG is ordered. For this test, the patient wears a portable ECG machine called a Holter monitor for 12, 24, or 48 hours.

Myocardial perfusion scintigraphy and radionuclide angiography are nuclear studies involving the injection of a radioactive material (e.g., thallium) which is absorbed by healthy tissue. A gamma scintillation camera displays and records a series of images of the radioactive material's movement through the heart. Both tests are usually performed in

a hospital's nuclear medicine department and take about 30 minutes to an hour. A perfusion scan is sometimes performed at the end of a stress test.

An echocardiogram uses sound waves to create an image of the heart's chambers and valves. The technician applies gel to a handheld transducer then presses it against the patient's chest. The heart's sound waves are converted into an image on a monitor. Performed in a cardiology outpatient diagnostic laboratory, the test takes 30 minutes to an hour. It can reveal abnormalities in the heart wall that indicate ischemia, but it doesn't evaluate the coronary arteries directly.

Coronary angiography is the most accurate diagnostic technique, but it is also the most invasive. It shows the heart's chambers, great vessels, and coronary arteries by using a contrast solution and x-ray technology. A moving picture is recorded of the blood flow through the coronary arteries. The patient is awake, but sedated, and connected to ECG electrodes and an intravenous line. A local anesthetic is injected. The cardiologist then inserts a catheter into a blood vessel and guides it into the heart. Coronary angiography is performed in a **cardiac catheterization** laboratory and takes from half an hour to two hours.

Positron emission tomography (PET) is a non-invasive nuclear test used to evaluate the heart tissue. A PET scanner traces high-energy gamma rays released from radioactive particles to provide three-dimensional images of the heart tissue. Performed at a hospital, it usually takes from one hour to one hour and 45 minutes. PET is very expensive and not widely available.

Computed tomography scans (CT scans) and magnetic resonance imaging (MRI) are computerized scanning methods. CT scanning uses a thin x-ray beam to show three-dimensional views of soft tissues. It is performed at a hospital or clinic and takes less than a minute. MRI uses a magnetic field to produce clear, cross-sectional images of soft tissues. The patient lies on a table which slides into a tunnel-like scanner. It is usually performed at a hospital and takes about 30 minutes.

Treatment

Angina is treated with drug therapy and surgery. Drugs such as nitrates, beta-blockers, and **calcium channel blockers** relieve chest pain, but they cannot clear blocked arteries. **Aspirin** helps prevent blood clots. Surgical procedures include percutaneous transluminal coronary **angioplasty** and **coronary artery bypass graft surgery**.

Nitroglycerin is the classic treatment for angina. It quickly relieves pain and discomfort by opening the coronary arteries and allowing more blood to flow to the heart. **Beta blockers** reduce the amount of oxygen required by the heart during stress. Calcium channel blockers help keep the arteries open and reduce blood pressure. Aspirin helps prevent blood clots from forming on plaques.

Percutaneous transluminal coronary angioplasty and coronary artery bypass graft surgery are invasive procedures which improve blood flow in the coronary arteries. Percutaneous transluminal coronary angioplasty is a non-surgical procedure in which a catheter tipped with a balloon is threaded from a blood vessel in the thigh into the blocked artery. The balloon is inflated, compressing the plaque to enlarge the blood vessel and open the blocked artery. The balloon is deflated and the catheter is removed. The procedure is performed by a cardiologist in a hospital and generally requires a two-day stay. Sometimes a metal stent is placed in the artery to prevent closing of the artery.

In coronary artery bypass graft, called bypass surgery, a detour is built around the coronary artery blockage with a healthy leg vein or chest wall artery. The healthy vein or artery then supplies oxygen-rich blood to the heart. Bypass surgery is major surgery appropriate for patients with blockages in two or three major coronary arteries or severely narrowed left main coronary arteries, as well as those who have not responded to other treatments. It is performed in a hospital under general anesthesia using a heart-lung machine to support the patient while the healthy vein or artery is attached to the coronary artery.

There are several experimental surgical procedures: **atherectomy**, where the surgeon shaves off and removes strips of plaque from the blocked artery; laser angioplasty, where a catheter with a laser tip is inserted to burn or break down the plaque; and insertion of a metal coil, called a stent, that can be implanted permanently to keep a blocked artery open. This stenting procedure is becoming more common. Another experimental procedure uses a laser to drill channels in the heart muscle to increase blood supply.

TIAs are treated by drugs that control high blood pressure and reduce the likelihood of blood clots and surgery. Aspirin is commonly used and anticoagulants are sometimes used to prevent blood clots. In some cases, carotid **endarterectomy** surgery is performed to help prevent further TIAs. The procedure involves removing arterial plaque from inside blood vessels.

The use of **chelation therapy**, a long-term injection by a physician of a cocktail of synthetic amino acid, ethylenediaminetetracetic acid, and anticoagulant drugs and nutrients, is controversial.

Alternative treatment

Ischemia can be life-threatening. Although there are alternative treatments for angina, traditional medical care may be necessary. Prevention of the cause of ischemia, primarily **atherosclerosis**, is primary. This becomes even more important for people with a family history of heart disease. Dietary modifications, especially the reduction or elimination of saturated fats (primarily found in meat), are essential. Increased fiber (found in fresh fruits and vegetables, grains, and beans) can help the body eliminate excessive cholesterol through the stools. Exercise, particularly aerobic exercise, is essential for circulation health. Not smoking will prevent damage from smoke and the harmful substances it contains.

Abana, a mixture of herbs and **minerals** used in **Ayurvedic medicine**, can reduce the frequency and severity of angina attacks. Western herbal medicine recommends hawthorn (*Crataegus laevigata* or *C. oxyacantha*) to relieve long-term angina, since it strengthens the contractility of the heart muscles. **Nutritional supplements** and botanical medicines that act as antioxidants, for example, **vitamins** C and E, selenium, ginkgo (*Ginkgo biloba*), bilberry (*Vaccinium myrtillus*), and hawthorn, can help prevent initial arterial injury that can lead to the formation of plaque deposits. Cactus (*Cactus grandiflorus*) is a homeopathic remedy used for pain relief during an attack. Mind/body relaxation techniques such as **yoga** and **biofeedback** can help control strong emotions and stress.

Prognosis

In many cases, ischemia can be successfully treated, but the underlying disease process of atherosclerosis is usually not "cured." New diagnostic techniques enable doctors to identify ischemia earlier. New technologies and surgical procedures can prevent angina from leading to a heart attack or TIA from resulting in a stroke. The outcome for patients with silent ischemia has not been well established.

Prevention

A healthy lifestyle, including eating right, getting regular exercise, maintaining a healthy weight, not smoking, drinking in moderation, not using illegal drugs, controlling **hypertension**, and managing stress are practices that can reduce the risk of ischemia progressing to a heart attack or stroke.

A healthy diet includes a variety of foods that are low in fat, especially saturated fat; low in cholesterol; and high in fiber. Plenty of fruits and vegetables should be eaten and sodium should be limited. Fat should comprise no more than 30% of total daily calories. Cholesterol should be limited to about 300 mg and sodium to about 2,400 mg per day.

Moderate aerobic exercise lasting about 30 minutes four or more times per week is recommended for maximum heart health, according to the Centers for Disease Control and Prevention and the American College of Sports Medicine. Three 10-minute exercise periods are also beneficial. If any risk factors are present, a physician's clearance should be obtained before starting exercise.

Maintaining a desirable body weight is also important. People who are 20% or more over their ideal body weight have an increased risk of developing coronary artery disease or stroke.

Smoking has many adverse effects on the heart and arteries, so should be avoided. Heart damage caused by smoking can be improved by quitting. Several studies have shown that ex-smokers face the same risk of heart disease as non-smokers within five to ten years of quitting.

Excessive drinking can increase risk factors for heart disease. Modest consumption of alcohol, however, can actually protect against coronary artery disease. The American Heart Association defines moderate consumption as one ounce of alcohol per day—roughly one cocktail, one 8-ounce glass of wine, or two 12-ounce glasses of beer.

Commonly used illegal drugs can seriously harm the heart and should never be used. Even stimulants like ephedra and **decongestants** like pseudoephedrine can be harmful to patients with hypertension or heart disease.

Treatment should be sought for hypertension. High blood pressure can be completely controlled through lifestyle changes and medication. Stress, which can increase the risk of a heart attack or stroke, should also be managed. While it cannot always be avoided, it can be controlled.

Resources

Organizations

American Heart Association. 7320 Greenville Ave. Dallas, TX 75231. (214) 373-6300. <http://www.americanheart.org>.

National Heart, Lung and Blood Institute. P.O. Box 30105, Bethesda, MD 20824-0105. (301) 251-1222.

<http://www.nhlbi.nih.gov>.

Texas Heart Institute. Heart Information Service. P.O. Box 20345, Houston, TX 77225-0345. <http://www.tmc.edu/thi>.

Key terms

Atherosclerosis — A process in which the walls of the arteries thicken due to the accumulation of plaque in the blood vessels. Atherosclerosis is the cause of most coronary artery disease.

Coronary artery disease — A narrowing or blockage, due to atherosclerosis, of the arteries that provide oxygen and nutrients to the heart. When blood flow is cut-off, the result is a heart attack.

Plaque — A deposit of fatty and other substances that accumulate in the lining of the artery wall.

Stroke — A sudden decrease or loss of consciousness caused by rupture or blockage of a blood vessel by a blood clot or hemorrhage in the brain. Ischemic strokes are caused by blood clots in a cerebral artery.

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ischemia [is-ke'me-ah]

deficiency of blood in a part, due to functional constriction or actual obstruction of a blood vessel. *adj.*, *adj* ische'mic.

myocardial ischemia deficiency of blood supply to the heart muscle.

Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition. © 2003 by Saunders, an imprint of Elsevier, Inc. All rights reserved.

is·che·mi·a (is-kē'mē-ă),

Local loss of blood supply due to mechanical obstruction (mainly arterial narrowing or disruption) of the blood vessel.

[G. *ischō*, to keep back, + *haima*, blood]

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ischemia (ĩ-skē'mē-ə)

n.

A decrease in the blood supply to a bodily organ, tissue, or part caused by constriction or obstruction of the blood vessels.

i·sche'mic *adj.*

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ischemia Medtalk A blood flow rate through an organ that provides insufficient O₂ to maintain aerobic respiration in that organ. See [Chronic mesenteric ischemia](#), [Myocardial ischemia](#), [Silent myocardial ischemia](#).

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is·che·mi·a (is-kē'mē-ă)

Local anemia due to mechanical obstruction (mainly arterial narrowing) of the blood supply; often marked by pain and by organ dysfunction.

Synonym(s): [ischaemia](#).

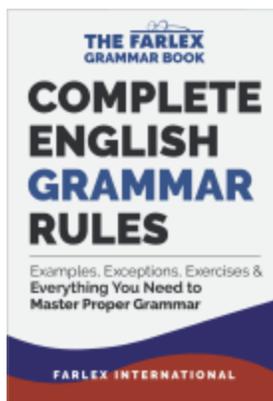
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is·che·mi·a (is-kē'mē-ă)

Local loss of blood supply due to mechanical vascular obstruction.

Synonym(s): [ischaemia](#).

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