



Patient education: Stenting for the heart (Beyond the Basics)

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INTRODUCTION

In people who have coronary artery disease, the arteries that supply blood to the heart muscle get clogged with fatty deposits called plaques ([figure 1](#)). These plaques can reduce the flow of blood to the heart muscle, which can in turn cause chest pain or discomfort, especially during exertion or emotional stress. There are two main types of treatment for people with this symptom, whose medical term is "angina pectoris": medical therapy (medications) and interventional treatment (procedures to open or bypass narrowed coronary arteries). The goals of these treatments are to improve a person's quality of life and to alleviate symptoms such as angina. Medications may also delay the progression of the disease and thereby prolong life.

This topic discusses stent placement, also called "percutaneous coronary intervention." The other interventional treatment, coronary artery bypass graft surgery, is discussed in a separate topic review. (See "[Patient education: Coronary artery bypass graft surgery \(Beyond the Basics\)](#)".)

Medical therapy for coronary artery disease is discussed separately (see "[Patient education: Medications for angina \(Beyond the Basics\)](#)"). A comparison of medical treatment and interventional treatment is also available. (See "[Patient education: Angina treatment — medical versus interventional therapy \(Beyond the Basics\)](#)".)

WHAT IS STENTING?

Stenting, also known as "percutaneous coronary intervention" or PCI, is a procedure that uses a flexible plastic catheter (thin tube) to dilate narrowed arteries in the heart. A metal stent is then placed at the site of a major blockage to hold the artery open ([figure 2](#)). In this way, stenting helps to restore and preserve blood flow to the heart muscle.

Why do I need stenting? — Chest pain that is a consequence of decreased oxygen-rich blood to a portion of the heart muscle is called "angina pectoris" (often referred to as just "angina"). Angina is a signal that the heart muscle is not getting sufficient blood flow, specifically sufficient oxygen. Lack of oxygen is termed ischemia. Blood flow is most often reduced by coronary artery disease, which causes a narrowing of the arteries that carry blood to the heart muscle ([figure 1](#)). Narrowing in the coronary arteries occurs as a result of calcium and fatty deposits, called plaques.

A person with narrowed arteries may develop angina during activity, exercise, or any other physical or mental stress that increases the heart's demand for blood. Angina can be "stable" or "unstable." Angina is unstable when there is a change in the usual pattern, such as an increase in frequency, severity, duration, or precipitating cause. Unstable angina may be associated with damage to the heart muscle (or heart attack). The term "acute coronary syndrome" refers to people with unstable angina or a heart attack; these conditions require immediate evaluation in a hospital (see "[Patient education: Chest pain \(Beyond the Basics\)](#)"). In severe cases, heart attack can lead to heart failure or sudden cardiac death.

Stent candidates — Stenting may be recommended in addition to medical therapy for two groups of people with stable angina:

- People who have persistent and intolerable symptoms despite optimal medical treatment
- People who have specific patterns of arterial narrowing and a high risk of either a heart attack or death

The usefulness of stenting depends upon the location and severity of arterial narrowing. Stenting is often recommended when arterial narrowing is moderate to severe or when only one or two coronary arteries are severely narrowed. People with diabetes appear to have greater benefit from bypass surgery, especially if there are two or three vessels involved, a large amount of the heart muscle is in jeopardy, or left ventricular function is depressed.

People who have extensive coronary heart disease, including a large number of narrowed coronary arteries or narrowing of the left main coronary artery and poor pumping function of their left ventricle (lower heart chamber), tend to live longer when they have coronary

artery bypass surgery rather than medical treatment. For some patients with blockages in more than one artery, physicians might recommend using both stenting and CABG (sequentially) in order to achieve the best result. (See "[Patient education: Coronary artery bypass graft surgery \(Beyond the Basics\)](#)".)

Benefits of stenting — For patients with chronic stable angina, placement of a stent may improve symptoms and exercise capacity but has not decreased mortality or risk of myocardial infarction when compared with patients in a full medical program. However, many individual factors influence the effectiveness of interventional treatment and its continued benefit over time. It is therefore important to discuss realistic expectations for each of these procedures with a doctor.

Risks of stenting — Stenting is an invasive procedure and is associated with risks that should be discussed with a doctor. The extent of this risk depends upon many individual factors. (See '[Complications of stenting](#)' below.)

THE PROCEDURE

Preparing for stent placement — Blood tests and an electrocardiogram are usually performed before stenting. These tests help to ensure that other potential medical problems are identified and managed prior to the procedure.

Coronary angiography — Prior to stent placement, testing is done to determine which coronary arteries are blocked and to evaluate the severity of the blockage. This procedure is called "cardiac catheterization" or "coronary angiography." In patients with stable angina, it is usually performed in a hospital, often immediately before stenting is done.

Most patients are told not to eat or drink anything for six to eight hours before the catheterization procedure. People with diabetes should speak to their doctor about how much medication to take before the procedure. Anticoagulant medications such as [warfarin](#) may be decreased or even stopped temporarily before surgery, depending upon the reason the anticoagulant is used. However, [aspirin](#) and a second antiplatelet medication are usually continued. It is important to follow all of the instructions regarding medication use before surgery; the procedure may need to be canceled or delayed if instructions are not followed exactly.

The patient is given a sedative and may be given a pain medication before the procedure. Most people do not remember the procedure as a result of these medications. A tiny catheter is inserted into an artery in the leg (the femoral artery) or in the wrist (the radial artery). The catheter is guided through blood vessels to the heart. The coronary arteries are

viewed by injecting a dye (contrast) through the catheter, using an x-ray device to record a detailed image of the coronary arteries.

Based upon the results of this test, the doctor sometimes proceeds immediately with stent placement if it appears reasonable to do so. "Reasonable" is determined both by the nature of the blockage and by the patient's wishes, which are usually discussed before the catheterization.

- In some cases, stenting can be performed immediately following the catheterization.
- In other cases, treatment with medications is continued **OR** open heart surgery with bypass may be recommended. (See "[Patient education: Medications for angina \(Beyond the Basics\)](#)" and "[Patient education: Coronary artery bypass graft surgery \(Beyond the Basics\)](#)".)

How is stenting performed? — Stenting is usually performed in a hospital in an area called the catheterization laboratory. The procedure usually takes between one and two hours. The patient is given a sedative and pain medication before the procedure. Many people do not remember the procedure as a result of these medications.

To open the narrowed artery, a long, thin catheter is inserted into an artery in the leg (the femoral artery) or the wrist (the radial artery). The catheter is guided through blood vessels to the beginning of a narrowed coronary artery in the heart. The placement of the catheter is confirmed by injecting a dye into the coronary artery and using a type of x-ray machine (called a fluoroscope) to view the catheter's position.

Once the balloon catheter has expanded the narrowed artery, a stent (an expandable metal tube usually made of wire mesh) is placed to reduce the risk of narrowing in the future ([figure 3](#)). Rarely, a stent is not able to be placed, and the procedure is stopped after the treatment with the catheter alone. In some cases, use of the balloon catheter alone will be successful in restoring blood flow.

Most stents are coated with a medication (called "drug-eluting stents") to help prevent the development of excessive tissue growth. This tissue forms in an effort to "heal" the stented area and could potentially narrow or totally block the coronary artery over time. The drug-eluting stent releases a medication that helps to prevent excessive tissue growth.

Complications of stenting — Complications from stenting are relatively infrequent. The most common complications include discomfort and bleeding at the puncture site where the catheter was inserted.

Occasionally, the procedure creates a small tear (called a "dissection") of an internal layer in the coronary artery. Usually, the tear is small and heals by itself. In some cases, the tear is

corrected with a stent. If the tear is severe, causing a blockage in blood flow in the artery or, rarely, bleeding into the space around the heart, immediate treatment is given. This usually includes reinserting a catheter and putting in a stent and draining the blood with a catheter. Rarely, a person will need urgent bypass surgery, but this is necessary in less than one percent of patients.

Following stent placement, there may be a minor elevation of blood cardiac enzymes, suggesting a possible tiny amount of damage as a result of the procedure. Unless the blood enzyme reaches a level that is clinically significant, occurring in less than 1 percent of cases, this is of no consequence and is not considered a complication.

Limitations of stenting — Stenting restores blood flow and relieves symptoms in over 90 percent of cases. However, there is a risk of symptoms returning within six months, often due to recurrent narrowing of the artery ("restenosis") or further narrowing in another part of the blood vessel. In people who have a drug-eluting stent, which is most often the case, restenosis occurs less than 10 percent of the time. In people who do not get a stent or get an older type of stent, restenosis is more common (30 and 15 percent, respectively).

Some coronary artery sites are more prone to re-narrowing than others. In addition, some conditions increase the risk of narrowing, potentially requiring a repeat catheterization and reopening or bypass of the narrowed artery:

- Diabetes
- Continued cigarette smoking
- High blood pressure
- Arteries that are diffusely narrowed
- High level of bad (LDL) cholesterol
- Narrowing in a major blood vessel that is at or near the beginning of a side branch.
- A blood vessel that has had multiple stents placed
- Stents that have been placed in a vein that was grafted onto the heart during coronary artery bypass graft surgery.

Recurrent symptoms can develop as a result of other vessels that become narrowed. Some vessels that are very small and tortuous, have longstanding total blockages, or have a calcified (hardened) lesion, are more difficult to open.

Care after the procedure — Following the stenting procedure, the catheter is removed from the artery and pressure is applied to the area. In some cases, a pressure device is used to limit bleeding from the site. In other cases, the femoral artery is sealed with a special device at the time the catheter is removed.

If access uses the femoral artery, the patient must lie flat and remain still for several hours to reduce the risk of bleeding. During this time, the patient will remain in a recovery area where

his or her blood pressure, heart rate, oxygen level, temperature, and puncture site can be monitored frequently. As the sedative medication begins to wear off, pain medication may be given if needed.

Most patients will remain in the hospital overnight after stenting. A friend or family member must be available to drive the patient home. Most patients are able to walk on the day after the procedure and can resume their normal activities, including returning to work, within a week. Driving and heavy lifting and pushing or pulling is not allowed for a few days. Specific activity restrictions should be discussed with a clinician.

Questions to ask after stenting include:

- When do I restart my medications? Do I need any new medications?
- When should I see the doctor next?
- Whom do I call if I have problems after I go home?

Preventing blood clots — One of the most serious complications that can develop after stent placement is the development of a blood clot (thrombosis) inside the stent; this is called stent thrombosis. It is thought that the metal of the stent in contact with components of blood leads to clotting.

Stent thrombosis can potentially block blood flow to the heart, causing a heart attack or even death. Stent thrombosis can occur within 24 hours, 30 days, or as late as one year or more after stent placement, although most episodes occur within 30 days.

Fortunately, stent thrombosis is rare because [aspirin](#) and a second drug that prevents clotting (anticoagulant) are given before and after stent placement. These two drugs are usually given for 6 to 12 months and sometimes longer, although some people may be treated with other drugs over a different time period. These medications should not be stopped without the approval of your cardiologist.

When to seek help — After having a stent placed, seek immediate medical assistance if any of the following occur:

- Chest pain develops and is not relieved with one dose of sublingual (under the tongue) [nitroglycerin](#).
- The puncture site becomes very painful, swollen, warm, bleeds more than a few drops, or drains pus.
- A fever higher than 100.4° F (38° C) develops.

OTHER MEASURES TO SLOW OR REVERSE HEART DISEASE

In all patients with coronary artery disease, it is important to follow guidelines to reduce the risk of worsening heart disease. These guidelines, which should be discussed with a healthcare provider, include the following:

- Treat high blood pressure (see "[Patient education: High blood pressure treatment in adults \(Beyond the Basics\)](#)")
- Treat high cholesterol (see "[Patient education: High cholesterol and lipids \(Beyond the Basics\)](#)")
- Quit smoking (see "[Patient education: Quitting smoking \(Beyond the Basics\)](#)")
- Lose excess weight (see "[Patient education: Losing weight \(Beyond the Basics\)](#)")
- Reduce stress
- Exercise regularly (see "[Patient education: Exercise \(Beyond the Basics\)](#)")
- Avoid or minimize activities that provoke angina, such as exercising during cold weather or exercising vigorously, particularly after a meal.
- Learn to use [nitroglycerin](#) preventively (see "[Patient education: Medications for angina \(Beyond the Basics\)](#)").

WHERE TO GET MORE INFORMATION

Your healthcare provider is the best source of information for questions and concerns related to your medical problem.

This article will be updated as needed on our web site (www.uptodate.com/patients). Related topics for patients, as well as selected articles written for healthcare professionals, are also available. Some of the most relevant are listed below.

Patient level information — UpToDate offers two types of patient education materials.

The Basics — The Basics patient education pieces answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials.

[Patient education: Coronary artery disease \(The Basics\)](#)

[Patient education: Heart attack \(The Basics\)](#)

[Patient education: Medicines after a heart attack \(The Basics\)](#)

[Patient education: Cardiac catheterization \(The Basics\)](#)

[Patient education: Sudden cardiac arrest \(The Basics\)](#)

Beyond the Basics — Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are best for patients who want in-depth information and are comfortable with some medical jargon.

[Patient education: Coronary artery bypass graft surgery \(Beyond the Basics\)](#)

[Patient education: Medications for angina \(Beyond the Basics\)](#)

[Patient education: Angina treatment — medical versus interventional therapy \(Beyond the Basics\)](#)

[Patient education: Chest pain \(Beyond the Basics\)](#)

[Patient education: High blood pressure treatment in adults \(Beyond the Basics\)](#)

[Patient education: High cholesterol and lipids \(Beyond the Basics\)](#)

[Patient education: Quitting smoking \(Beyond the Basics\)](#)

[Patient education: Losing weight \(Beyond the Basics\)](#)

[Patient education: Exercise \(Beyond the Basics\)](#)

Professional level information — Professional level articles are designed to keep doctors and other health professionals up-to-date on the latest medical findings. These articles are thorough, long, and complex, and they contain multiple references to the research on which they are based. Professional level articles are best for people who are comfortable with a lot of medical terminology and who want to read the same materials their doctors are reading.

[Antithrombotic therapy for elective percutaneous coronary intervention: General use](#)

[Revascularization in patients with stable coronary artery disease: Coronary artery bypass graft surgery versus percutaneous coronary intervention](#)

[Intracoronary stent restenosis](#)

[Management of significant proximal left anterior descending coronary artery disease](#)

[Chronic coronary syndrome: Indications for revascularization](#)

[Periprocedural complications of percutaneous coronary intervention](#)

[Role of stress testing after coronary artery revascularization](#)

[Percutaneous coronary intervention with intracoronary stents: Overview](#)

[Percutaneous coronary intervention of specific coronary lesions](#)

The following organizations also provide reliable health information.

- National Library of Medicine

(www.nlm.nih.gov/medlineplus/angioplasty.html)

- National Heart, Lung, and Blood Institute

(www.nhlbi.nih.gov/health/dci/Diseases/Angioplasty/Angioplasty_WhatIs.html)

- American Heart Association

(www.americanheart.org)

- The American College of Cardiology

(www.acc.org)

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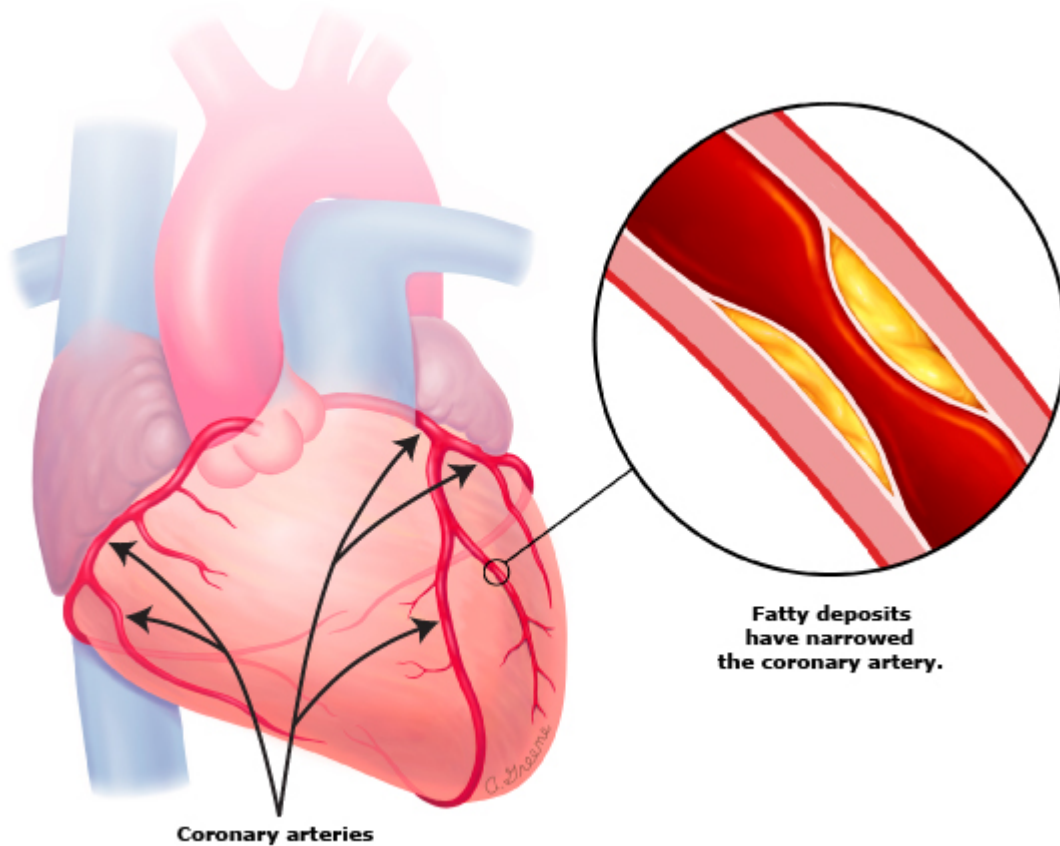
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GRAPHICS

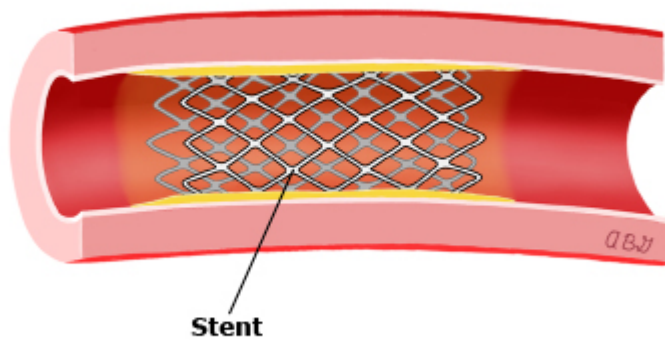
Coronary heart disease



In people with coronary heart disease, the coronary arteries get clogged with fatty deposits called plaques.

Graphic 61785 Version 5.0

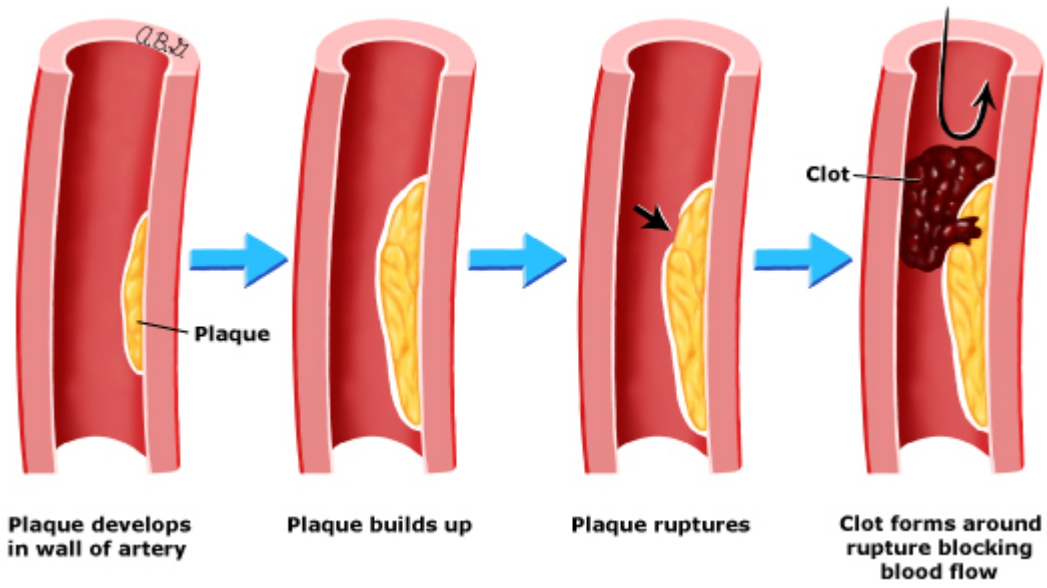
Arterial stent



A stent is a tiny metal tube that helps prop open an artery (blood vessel). Most stents are coated with a medicine that helps keep the artery from getting narrow or blocked again.

Graphic 86256 Version 2.0

Plaque formation



Graphic 78702 Version 3.0

