

Angioplasty and Vascular Stenting

This information is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.

What are Angioplasty and Vascular Stenting?

Angioplasty with or without vascular stenting is a minimally invasive procedure performed to improve blood flow in the body's arteries and veins.

In an angioplasty procedure, imaging techniques are used to guide a balloon-tipped catheter, a long, thin plastic tube, into an artery or vein and advance it to where the vessel is narrow or blocked. The balloon is then inflated to open the vessel, deflated and removed.

During angioplasty, a small wire mesh tube called a stent may be permanently placed in the newly opened artery or vein to help it remain open. There are two types of stents: bare stents (wire mesh) and covered stents (also commonly called stent grafts).

What are some common uses of the procedures?

Angioplasty with or without vascular stenting is commonly used to treat conditions that involve a narrowing or blockage of arteries or veins throughout the body, including:

- narrowing of large arteries (aorta and its branches) due to atherosclerosis, or hardening of the arteries, a gradual process in which cholesterol and other fatty deposits, called plaques, build up on the artery walls.
- peripheral artery disease (PAD), a narrowing of the arteries in the legs or arms. In patients with PAD, angioplasty alone or angioplasty with stenting may be used to open up a blocked artery in the pelvis, leg or arm.

- renal vascular hypertension, high blood pressure caused by a narrowing of the kidney arteries. Angioplasty with stenting is a commonly used method to open one or both of the arteries that supply blood to the kidneys. Treating renal arterial narrowing is also performed in some patients to protect or improve the kidney function.
- carotid artery disease, a narrowing of the neck arteries supplying blood to the brain.
- coronary artery disease, a narrowing of the coronary arteries that carry blood and oxygen to the heart muscle.
- venous narrowings involving the central veins (in the chest or the pelvis). In some cases, stenting of the narrowed vein is also needed.
- narrowing in dialysis fistula or grafts. When there is decreased flow in the graft or fistula so that is not adequate for dialysis, angioplasty is generally the first line of treatment. Stenting may also be needed in some cases.

How should I prepare?

You should report to your doctor all medications that you are taking, including herbal supplements, and if you have any allergies, especially to local anesthetic medications, general anesthesia, or to contrast materials (also known as “dye” or “x-ray dye”). Your physician may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or a blood thinner for a specified period of time days before your procedure.

Also inform your doctor about recent illnesses or other medical conditions.

Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby.

In most cases, you can take your usual medications, especially blood pressure medications. These can be taken with some water in the morning before your procedure.

You may be instructed not eat or drink anything for several hours before your procedure. You may need to stay overnight at the hospital following your procedure. You will be given a gown to wear during the procedure.

What does the equipment look like?

In these procedures, x-ray imaging equipment, a balloon catheter, sheath, stent and guide wire are used.

The equipment typically used for this examination consists of a radiographic table, an x-ray tube and a television-like monitor that is located in the examining room or in a nearby room. When used for viewing images in real time, the image intensifier (which converts x-rays into a video image) is suspended over a table on which the patient lies. When used for taking still pictures, the image is captured either electronically or on film.

A guide wire is a thin wire used to guide the placement of the diagnostic catheter, angioplasty balloon catheter and the vascular stent. A sheath is a vascular tube placed into the access artery, such as the femoral artery in the groin, that allows catheter exchanges easily during these complex procedures.

A balloon catheter is a long, thin plastic tube with a tiny balloon at its tip. A stent is a small, wire mesh tube. Balloons and stents come in varying sizes to match the size of the diseased artery.

Stents are specially designed mesh, metal tubes that are inserted into the body in a collapsed state on a catheter and then expanded inside the vessel to prop the walls open. In some cases the stent may have a synthetic fabric covering.

Other equipment used during the procedure includes an intravenous line (IV) and equipment that monitors your heart beat and blood pressure.

How does the procedure work?

Using image guidance, an inflatable balloon mounted at the tip of a catheter is inserted through the skin into an artery and advanced to the site of an arterial blockage where the balloon is inflated and deflated. In this process, the balloon expands the artery wall, increasing blood flow through the artery. A stent may be placed at the treatment site to hold the artery open.

How is the procedure performed?

Image-guided, minimally invasive procedures such as angioplasty and vascular stenting should only be performed by a specially trained interventional radiologist in an interventional radiology suite or occasionally in the operating room.

This procedure is often done on an outpatient basis.

You will be positioned on the examining table.

You will be connected to monitors that track your heart rate, blood pressure and pulse during the procedure.

A nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm so that sedation medication can be given intravenously. You may also receive general anesthesia.

The area of your body where the catheter is to be inserted will be shaved, sterilized and covered with a surgical drape. Your physician will numb the area with a local anesthetic. A very small nick is made in the skin at the site. A sheath is first inserted into the artery.

Guided by x-rays, the catheter is then inserted through the skin and maneuvered through the artery until it reaches the site of the blockage. Once the catheter is in place, contrast material will be injected into the artery and an angiogram will be taken of the blocked artery to help identify the site of the blockage.

With x-ray guidance, a guide wire will then be moved to the site, followed by the balloon-tipped catheter. Once it reaches the blockage, the balloon will be inflated for a short period of time. The same site may be repeatedly treated or the balloon may be moved to other sites.

Additional x-rays will be taken to determine how much the blood flow has improved. When your physician is satisfied that the artery has been opened enough, the balloon catheter, the guide wire and catheter will be removed.

Many angioplasty procedures also include the placement of a stent, a small, flexible tube made of plastic or wire mesh to support the damaged artery walls. Stents can be self-expandable (opens up itself upon deployment) or balloon expandable (balloon needed to open the stent). Balloon expandable stents are typically placed over a balloon-tipped catheter so that when the balloon is expanded, it pushes the stent in place against the artery wall. When the balloon is deflated and removed, the stent remains permanently in place, acting like a scaffold for the artery. Self-expandable stents are easy to deploy, but may require additional angioplasty with balloon to obtain satisfactory dilation (opening) of the diseased vessel.

Covered stents or stent-grafts have additional advantages over bare stents and are becoming more commonly used.

Drug-coated (also called drug-eluting) stents have recently been approved for clinical use in the coronary (heart) arteries by the U.S. Food and Drug Administration (FDA). These stents are coated with a medication that is slowly released to help keep the blood vessel from re-narrowing, a condition called restenosis.

If a sheath was inserted into your arm or wrist, it will be removed. At the end of the procedure, the catheter will be removed and pressure will be applied to stop any bleeding. The opening in the skin is then covered with a dressing. No sutures are needed.

You may need to lie in bed with your legs straight for several hours. In some cases, your physician may use a device that seals the small hole in the artery, called a “closure device”, which will allow you to move around more quickly.

When the procedure is completed, you will be moved to a recovery room or to a hospital room.

Your intravenous line will be removed.

The length of the procedure varies depending on the time spent evaluating the vascular system prior to any therapy, as well as the complexity of the treatment.

What will I experience during and the procedure?

Devices to monitor your heart rate and blood pressure will be attached to your body.

You will feel a slight pin prick when the needle is inserted into your vein for the intravenous line (IV) and when the local anesthetic is injected.

The intravenous (IV) sedative will make you feel relaxed and sleepy. You may or may not remain awake, depending on how deeply you are sedated.

You may feel slight pressure when the catheter is inserted but no serious discomfort. As the contrast material passes through your body, you may get a warm feeling.

It is common for patients to feel some mild discomfort when the balloon is inflated because the artery is being stretched. Discomfort is more prominent when veins are dilated. Your discomfort should lessen as the balloon is deflated. The catheter insertion site may be bruised and sore.

For several hours, your catheter site will be checked for bleeding or swelling and your blood pressure and heart rate will be monitored.

Bleeding risk at the vascular entry site when veins are treated is less likely, therefore, you may be discharged earlier if the procedure is performed for vein disease, for example, dialysis fistula. Your physician may prescribe medication to relax your arteries, to protect against spasm of the arteries and to prevent blood clots.

If a contrast material was used during the procedure, you will urinate often to rid your body of this material. You may be asked to drink extra fluids.

After you return home, you should rest and drink plenty of fluids. You should avoid lifting heavy objects and strenuous exercise for at least 24 hours. You should avoid smoking permanently (since this is a major cause of atherosclerosis). If bleeding begins where the catheter was inserted, you should lie down, apply pressure to the site and call your physician. Any change in color in your leg, pain or a warm feeling in the area where the catheter was inserted should be promptly reported to your physician.

After an angioplasty or stent placement procedure you may be instructed to take one or more medications (such as aspirin, or blood thinners such as Plavix®, Lovenox® or Coumadin®) for a period of time. These medications can prevent blood clots from forming at the site of arterial treatment during healing. The effect of Coumadin will be monitored with frequent blood tests.

Magnetic resonance imaging (MRI) can probably be done immediately following stent placement, but make sure that you notify the MRI department that you have recently had a stent. Although stents used today may be considered safe for MRI, you may need several weeks after stent placement for MRI to be safe. Metal detectors will not affect a stent.

Who interprets the results and how do I get them?

The interventional radiologist can advise you as to whether the procedure was a technical success by comparing the pre- and post-procedure angiograms.

What are the benefits vs. risks?

Benefits

- Compared to surgical interventions such as bypass surgery, balloon angioplasty and stent placement are much less invasive and relatively low-risk, low-cost procedures.
- These procedures are performed using local anesthesia; no general anesthetic is required in the majority of patients.

- No surgical incision is needed—only a small nick in the skin that does not have to be stitched closed.
- You will be able to return to your normal activities shortly after the procedure.

Risks

- Major complications following angioplasty are uncommon. However, inserting the catheter can lead to injury of the artery. The balloon also poses a risk of blood clots or tearing the artery.
- When angioplasty is performed alone, blockages can recur, although most of these arteries can be opened again successfully. This can also occur when a stent is placed in the artery at the time of the angioplasty.
- Heavy bleeding from the catheter insertion site may require special medication or a blood transfusion.
- There is a risk of stroke when angioplasty and/or stenting are performed on the carotid artery.
- A relatively rare complication associated with balloon angioplasty is abrupt vessel closure, or occlusion. This blockage in the area treated by the balloon angioplasty typically occurs within 24 hours of the procedure. If it happens, treatment with medication into the artery to dissolve clots followed by angioplasty or stenting may be appropriate. In some cases, emergency bypass surgery may be needed.
- Other rare complications include heart attack and sudden cardiac death.
- Any procedure where the skin is penetrated carries a risk of infection.
- There is a very slight risk of an allergic reaction if contrast material is injected.
- Any procedure that involves placement of a catheter inside a blood vessel carries certain risks. These risks include damage to the blood vessel, bruising or bleeding at the puncture site and infection.
- Contrast material used during these procedures may cause renal failure, a decrease in kidney function, particularly if there is already some degree of decreased kidney function. Your physician generally checks your renal function before this procedure in order to lower this risk.

What are the limitations of Angioplasty and Vascular Stenting?

Angioplasty with vascular stenting is just one way to treat narrowed or blocked arteries. Medications and exercise are often the first step in treating atherosclerosis.

Regardless of which artery is blocked, angioplasty does not reverse or cure the underlying disease of atherosclerosis. It is extremely important for patients to make lifestyle changes, including eating a healthy diet that is low in saturated fat, exercising and not smoking. Individuals with diabetes, high blood pressure and/or high cholesterol need to follow the treatment plan prescribed by their healthcare providers.

Angioplasty may have to be repeated if the same artery becomes blocked again, a condition called restenosis. If a stent is placed at the time of the angioplasty, the chance of restenosis may be reduced but can still occur.

Only about half of patients with renal vascular hypertension caused by atherosclerosis have their blood pressure successfully treated or improved by angioplasty/stenting. By the time the procedure is done, many of these patients have disease in small arteries within the kidney that does not respond to angioplasty.

Angioplasty and vascular stenting for peripheral artery disease (PAD) affecting arteries in the pelvis and legs are less successful when there are multiple leg vessels that are narrowed or when small vessels have to be opened. Patients with PAD can benefit from smoking cessation, eating a proper diet, exercising regularly and controlling blood cholesterol.

Angioplasty and stent placement in the carotid artery has been approved by the FDA, but there is not much long-term data to know how well this works, or if there are potential complications that can develop from stents being placed in the carotid arteries. A dedicated filter device may be used during stent placement to try and help keep blood clots and other plaques from passing into the brain during the procedure, thereby lowering the risk of stroke. Surgical repair has been done for many years and has been proven effective and safe when done by skilled surgeons. You should discuss with your physician what the potential risks and benefits of carotid artery stenting are in your particular situation.

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