

## Carotid Ultrasound Imaging

*This procedure 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 is Ultrasound Imaging of the Carotid Artery?

Ultrasound imaging, also called ultrasound scanning or sonography, involves exposing part of the body to high-frequency sound waves to produce pictures of the inside of the body. Ultrasound exams do not use ionizing radiation (x-ray). Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organ, as well as blood flowing through blood vessels.

Ultrasound imaging is usually a painless medical test that helps physicians diagnose and treat medical conditions.

An ultrasound of the body's two carotid arteries, which are located on each side of the neck and carry blood from the heart to the brain, provide detailed pictures of these blood vessels.

A Doppler ultrasound study may be part of a carotid ultrasound examination.

Doppler ultrasound is a special ultrasound technique that evaluates blood as it flows through a blood vessel, including the body's major arteries and veins of the arms, legs and neck.

### What are some common uses of the procedure?

The carotid ultrasound is most frequently performed to detect narrowing, or stenosis, of the carotid artery, a condition that substantially increases the risk of stroke.

It may also be performed if a patient has high blood pressure or a carotid bruit (pronounced brU-E)—an abnormal sound in the neck that is heard with the stethoscope. Other risk factors calling for a carotid ultrasound are:

- advanced age
- diabetes
- elevated blood cholesterol
- a family history of stroke or heart disease

A carotid ultrasound is also performed to:

- locate a hematoma, a collection of clotted blood that may slow and eventually stop blood flow
- detect dissection of the carotid artery, a split between layers of the artery wall that may lead to obstruction of blood flow or a weakening of the wall of the artery
- check the state of the carotid artery after surgery to restore normal blood flow
- verify the position of a metal stent placed to maintain carotid blood flow.

Doppler ultrasound images can help the physician to see and evaluate:

- blockages to blood flow (such as clots)
- narrowing of vessels (which may be caused by plaque)
- tumors and congenital malformation

### How should I prepare?

You should wear comfortable, loose-fitting clothing for your ultrasound exam. You will need to remove all clothing and jewelry in the area to be examined.

A loose-fitting, open necked shirt or blouse is ideal.

No other preparation is required.

## What does the equipment look like?

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to scan the body. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. The transducer sends out a high frequency sound wave and then listens for a returning sound wave or “echo”.



The ultrasound image is immediately visible on a nearby screen that looks much like a computer or television monitor. The image is created based on the amplitude (strength), frequency and time it takes for the sound signal to return from the patient to the transducer.

## How does the procedure work?

Ultrasound imaging is based on the same principles involved in the sonar used by bats, ships and fishermen. When a sound wave strikes an object, it bounces backward, or echoes. By measuring these echo waves it is possible to determine how far away the object is and its size, shape, consistency (whether the object is solid, filled with fluid, or both) and uniformity.

In medicine, ultrasound is used to detect changes in appearance and function of organs, tissues, or abnormal masses, such as tumors.

In an ultrasound examination, a transducer both sends the sound waves and records the echoing waves. When the transducer is pressed against the skin, it directs a stream of inaudible, high-frequency sound waves into the body. As the sound waves bounce off of internal organs, fluids and tissues, the sensitive microphone in the transducer records tiny changes in the sound's pitch and direction. These signature waves are instantly measured and displayed by a computer, which in turn creates a real-time picture on the monitor. These live images are usually recorded on videotape and one or more frames of the moving pictures are typically captured as still images.

Doppler ultrasound, a special application of ultrasound, measures the direction and speed of blood cells as they move through vessels. The movement of blood cells causes a change in pitch of the reflected sound waves (Doppler effect). A computer collects and processes the

sounds and creates graphs or pictures that represent the flow of blood through the blood vessels.

## How is the procedure performed?

For most ultrasound exams, the patient is positioned lying face-up on an examination table that can be tilted or moved.

A clear gel is applied to the area of the body being studied to help the transducer make secure contact with the body and eliminate air pockets between the transducer and the skin. The sonographer or radiologist then presses the transducer firmly against the skin and sweeps it back and forth over the area of interest.

Doppler sonography is performed using the same transducer.

When the examination is complete, the patient may be asked to dress and wait while the ultrasound images are reviewed. However, the sonographer or radiologist is often able to review the ultrasound images in real-time as they are acquired and the patient can be released immediately.

This ultrasound examination is usually completed within 30 minutes.

## What will I experience during and after the procedure?

Most ultrasound examinations are painless, fast and easy.

After you are positioned on the examination table, the radiologist or sonographer will spread some warm gel on your skin and then press the transducer firmly against your body, moving it back and forth over the area of interest until the desired images are captured. There may be varying degrees of discomfort from pressure as the transducer is pressed against the area being examined.

If scanning is performed over an area of tenderness, there may be pressure or minor pain associated with the procedure.

It may be necessary to tilt or rotate your head for the best exposure, as the transducer is swept over the entire length of your neck on both sides to obtain views of the artery from different perspectives. It also helps to keep your arm and shoulder down. Your head will be supported to keep it still.

If a Doppler ultrasound study is performed, you may actually hear pulse-like sounds that change in pitch as the blood flow is monitored and measured.

Once the imaging is complete, the gel will be wiped off your skin.

After an ultrasound exam, you should be able to resume your normal activities.

## Who interprets the results and how do I get them?

A radiologist, a physician specifically trained to supervise and interpret radiology examinations, will analyze the images and send a signed report to your primary care or referring physician, who will share the results with you. In some cases the radiologist may discuss preliminary results with you at the conclusion of your examination.

## What are the benefits vs. risks?

### Benefits

- Ultrasound scanning is noninvasive (no needles or injections) and is usually painless.
- Ultrasound is widely available, easy-to-use and less expensive than other imaging methods.
- Ultrasound imaging uses no ionizing radiation.
- Ultrasound scanning gives a clear picture of soft tissues that do not show up well on x-ray images.
- Ultrasound causes no health problems and may be repeated as often as is necessary if medically indicated.
- If a carotid ultrasound exam shows narrowing of one or both carotid arteries, measures can be taken to restore the free flow of blood to the brain. Many strokes are prevented as a result.

### Risks

- For standard diagnostic ultrasound there are no known harmful effects on humans.
- In nearly 50 years of experience, carotid ultrasound has proved to be a risk-free procedure.

## What are the limitations of Carotid Ultrasound Imaging?

- Carotid ultrasound may be difficult or impossible if a patient has a dressing covering a wound or surgical scar in the neck.
- An occasional patient is difficult to examine because of the size or contour of the neck.
- Calcium deposits in the wall of the carotid artery may make it difficult to evaluate the vessel.
- A small amount of soft plaque that produces low-level echoes may go undetected.
- Ultrasound may not clearly depict the end segment of the carotid artery, but this is very seldom a site of disease.

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