



## Ultrasound - Carotid

Carotid ultrasound uses sound waves to produce pictures of the carotid arteries in the neck which carry blood from the heart to the brain. A Doppler ultrasound study – a technique that evaluates blood flow through a blood vessel – is usually part of this exam. It's most frequently used to screen patients for blockage or narrowing of the carotid arteries, a condition called stenosis which may increase the risk of stroke.

Little or no special preparation is required for this procedure. Leave jewelry at home and wear loose, comfortable clothing. A loose-fitting, open necked shirt or blouse is ideal.

## What is Carotid Ultrasound Imaging?

Ultrasound is safe and painless, and produces pictures of the inside of the body using sound waves. Ultrasound imaging, also called ultrasound scanning or sonography, involves the use of a small transducer (probe) and ultrasound gel placed directly on the skin. High-frequency sound waves are transmitted from the probe through the gel into the body. The transducer collects the sounds that bounce back and a computer then uses those sound waves to create an image. Ultrasound examinations do not use ionizing radiation (as used in x-rays), thus there is no radiation exposure to the patient. Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organs, as well as blood flowing through blood vessels.

Ultrasound imaging is a noninvasive 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, provides detailed pictures of these blood vessels and information about the blood flowing through them.

A Doppler ultrasound study is usually an integral part of a carotid ultrasound examination.

Doppler ultrasound, also called color Doppler ultrasonography, is a special ultrasound technique that allows the physician to see and evaluate blood flow through arteries and veins in the abdomen, arms, legs, neck and/or brain (in infants and children) or within various body organs such as the liver or kidneys.

## 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.

The major goal of carotid ultrasound is to screen patients for blockage or narrowing of their carotid arteries, which if present may increase their risk of having a stroke. If a significant narrowing is detected, a comprehensive treatment may be initiated.

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. In some cases, it is also performed in preparation for coronary artery bypass surgery. Other risk factors calling for a carotid ultrasound are:

- 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.
- 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
- tumors and congenital vascular malformations
- reduced or absent blood flow to various organs
- greater than normal blood flow to different areas, which is sometimes seen in infections

In children, Doppler ultrasound is used to:

- evaluate blood flow.
- predict a higher risk of stroke in children with sickle cell disease.
- detect abnormalities in the blood vessels, lymph nodes and lymphatic vessels.

## How should I prepare?

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

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

Ultrasound examinations are very sensitive to motion, and an active or crying child can prolong the examination process. To ensure a smooth experience, it often helps to explain the procedure to the child prior to the exam. Bringing books, small toys, music or games can help to distract the child and make the time pass quickly. The ultrasound exam room may have a television. Feel free to ask for your child's favorite channel.

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 do the scanning. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out high-frequency sound waves (that the human ear cannot hear) into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines.

The ultrasound image is immediately visible on a video display screen that looks like a computer or television monitor. The image is created based on the amplitude (loudness), frequency (pitch) and time it takes for the ultrasound signal to return from the area within the patient that is being examined to the transducer (the device placed on the patient's skin to send and receive the returning sound waves), as well as the type of body structure and composition of body tissue through which the sound travels. A small amount of gel is put on the skin to allow the sound waves to travel from the transducer to the examined area within the body and then back again. Ultrasound is an excellent modality for some areas of the body while other areas, especially air-filled lungs, are poorly suited for ultrasound.

## 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 back, or echoes. By measuring these echo waves, it is possible to determine how far away the object is as well as the object's size, shape and consistency (whether the object is solid or filled with fluid).

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

In an ultrasound examination, a transducer both sends the sound waves into the body and receives the echoing waves. When the transducer is pressed against the skin, it directs small pulses of inaudible, high-frequency sound waves into the body. As the sound waves bounce off internal organs, fluids and tissues, the sensitive receiver 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. One or more frames of the moving pictures are typically captured as still images. Short video loops of the images may also be saved.

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 (called the Doppler effect). A computer collects and processes the sounds and creates graphs or color pictures that represent the flow of blood through the blood vessels.

## How is the procedure performed?

For most ultrasound exams, you will be positioned lying face-up on an examination table that can be tilted or moved. Patients may be turned to either side to improve the quality of the images.

A clear water-based 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 that can block the sound waves from passing into your body. The sonographer (ultrasound technologist) or radiologist then places the transducer on the skin in various locations, sweeping over the area of interest or angling the sound beam from a different location to better see an area of concern.

Doppler sonography is performed using the same transducer.

When the examination is complete, you may be asked to dress and wait while the ultrasound images are reviewed.

The branches of the carotid arteries inside the head cannot be seen directly but can be evaluated with Doppler ultrasound in children with sickle cell disease. It is performed by placing the transducer over the child's temple and recording the blood flow in the center of the skull.

This ultrasound examination is usually completed within 30 to 45 minutes.

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

Ultrasound examinations are painless and easily tolerated by most patients.

After you are positioned on the examination table, the radiologist or sonographer will apply some warm water-based gel on your skin and then place the transducer firmly against your body, moving it back and forth over the area of interest until the desired images are captured. There is usually no discomfort from pressure as the transducer is pressed against the area being examined.

If scanning is performed over an area of tenderness, you may feel pressure or minor pain from the transducer.

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 clear ultrasound gel will be wiped off your skin. Any portions that are not wiped off will dry quickly. The ultrasound gel does not usually stain or discolor clothing.

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

## 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 physician, or to the physician or other healthcare provider who requested the exam. Usually, the referring physician or health care provider will share the results with you. In some cases, the radiologist may discuss results with you at the conclusion of your examination.

Follow-up examinations may be necessary. Your doctor will explain the exact reason why another exam is requested. Sometimes a follow-up exam is done because a potential abnormality needs further evaluation with additional views or a special imaging technique. A follow-up examination may also be necessary so that any change in a known abnormality can be monitored over time. Follow-up examinations are sometimes the best way to see if treatment is working or if a finding is stable or changed over time.

## What are the benefits vs. risks?

### Benefits

- Most ultrasound scanning is noninvasive (no needles or injections).
- Occasionally, an ultrasound exam may be temporarily uncomfortable, but it should not be painful.
- Ultrasound is widely available, easy-to-use and less expensive than other imaging methods.
- Ultrasound imaging is extremely safe and does not use any ionizing radiation.
- Ultrasound scanning gives a clear picture of soft tissues that do not show up well on x-ray images.
- If a carotid ultrasound exam shows narrowing of one or both carotid arteries, treatment 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 cannot visualize the entire length of the vessel because the last portion of the carotid artery travels through the bone at the base of the skull. For a more complete assessment, patients may need to undergo a CT or MRI of the carotid arteries.

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