Choosing Modalities for Carotid Stenosis

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One of the leading causes of stroke and transient ischemic attack (TIA) is carotid artery disease (CAD). With technology changing at such a rapid rate, it is difficult for physicians to decide on the gold standard of care when it comes to visualizing carotid stenosis. This article will explain CAD and the various modalities for visualizing it.

A Silent Disease

With CAD, plaque builds up over time in the carotid arteries, which are the large blood vessels on either side of the neck that supply blood to the head and brain. The buildup of plaque is a silent disease, until small particles break away and are carried to smaller arteries, where they block the flow of blood, causing TIA or stroke. Carotid stenosis refers to the occlusion of the carotid arteries due to atherosclerosis.

Atherosclerosis is a common arterial disorder characterized by plaques of cholesterol, lipids, and cellular debris in the inner layers of the arterial walls. The most common symptom of carotid stenosis is a TIA. A TIA temporarily impairs the blood flow to the brain, causing symptoms such as momentary loss of vision, usually in one eye, numbness on one side of the body, and possible slurred speech.

Carotid stenosis can also be asymptomatic. This variety is usually found during normal annual physical exams. Using a stethoscope, a physician can listen to the patient's carotid arteries. In some cases, the physician will hear a bruit or noise in the patient's artery that suggests the possibility of carotid stenosis.

Visualizing Carotid Artery Stenosis

The current gold standard of care for evaluating carotid artery stenosis is digital subtraction angiography (DSA). However, less invasive modalities such as magnetic resonance angiography (MRA), computed tomography angiography (CTA), and color flow Doppler ultrasound (CFD) have made gains and are competing with the sensitivity of DSA.

Usually, CFD is the first modality to be used for the evaluation of possible carotid artery stenosis, because it is non-invasive and the least expensive modality. It is a test that shows the blood vessels, blood flow, and the rate at which the blood travels. Ultrasound waves are used to make an image of the arteries. This image can be used to determine if there is an abnormality or blockage of the vessel being imaged. Because the procedure is done without inserting anything into the patient's body and the procedure does not use contrast media, there is little or no risk involved.

Some of the difficulties associated with CFD studies are that inaccurate readings can occur due to mural calcification, air trapping, or hematomas, and that it is operator dependent. If carotid artery stenosis is seen or suspected in a patient, there are many routes a primary care physician can take. The modalities in radiology that may be considered and used next are computed CTA, MRA, and DSA.

Images in 3-D

DSA is performed using radiation to produce x-ray images. These images are taken while x-ray contrast is injected directly into the carotid arteries, usually with a catheter placed in the femoral artery (groin) and maneuvered into the carotid arteries. New technology such as rotational digital subtraction angiography has proven to be as effective for three-dimensional imaging as the MRA and CTA.

The rotational digital subtraction angiography unit takes pictures while the C-Arm is rotating around the patient's area of interest resulting in images in a 180-degree or more rotation, which can be used to help reconstruct 3-D images. This provides

more information than standard digital subtraction angiography, which is imaged in only one plane at a time. There are, however, risks to DSA. Rare contrast reaction, artery damage, and stroke can occur.

CTA is a relatively new modality that has been shown to be both accurate and safe for evaluating carotid artery stenosis. CTA is an examination that uses x-rays to produce 3-D images of arteries throughout the body, from arteries serving the brain to those bringing blood to the lungs, kidneys, and the arms and legs. CTA combines the use of x-rays with computerized analysis of the images. Beams of x-rays are passed from a rotating device through the area of interest in the patient's body from several different angles to create cross-sectional images. Those images are then assembled by computer into a 3-D picture of the area being studied.

Compared to catheter angiography, which involves placement of a catheter and injecting contrast material into an artery, CTA is a much less invasive and more patient-friendly procedure. Contrast material is administered into an IV rather than an artery. This exam has been used to screen large numbers of individuals for arterial disease. CTA is most commonly performed as an outpatient procedure.

One of the benefits that CTA has over other modalities is that it can be used to examine blood vessels in almost any area of the body. CTA displays the detailed structure more precisely than MRA or CFD. As a result, CTA has become a popular screening method because it is a safer and cost-effective procedure.

There are some risks associated with CTA, such as a risk of an allergic reaction to the contrast media used in the procedure. CTA should be avoided in patients with kidney disease or severe diabetes because contrast media may further damage or impair the kidneys, causing them to go into renal failure. For women who are pregnant, another modality test should be considered.

Images Via Magnetic Field

Magnetic resonance imaging (MRI) is a method of producing extremely detailed pictures of body tissues and organs without the need for x-rays. The electromagnetic energy that is released when exposing a patient to radio waves in a strong magnetic field is measured and analyzed by a computer, which forms two- or three-dimensional images that may be viewed on a TV monitor.

MRA is a MRI study of the blood vessels. It uses MRI technology to detect, diagnose, and aid the treatment of heart disorders, stroke, and blood vessel diseases. MRA provides detailed images of blood vessels without using any contrast material, although today a special form of intravenous contrast is usually given to make the MRI images even clearer. Patients who are claustrophobic may have to be sedated or another modality may need to be considered.

One of the benefits that MRA has over other modalities is that MRA gives very detailed images of the blood vessels without insertion of a catheter into the artery. Further, an MRA procedure requires only IV contrast, which has less recovery time than conventional digital subtraction angiography in which an arterial puncture is needed for contrast injections. MRA also costs less than conventional digital subtraction angiography. Contrast media used for MRA is safer and less damaging to the kidneys than the contrast media used for conventional DSA or CTA. Another reason MRA is beneficial is that it does not use radiation.

Some of the problems associated with MRA are that any metal present in the body may cause artifacts or cause pain at the location of the metal implant. Patients who have cardiac pacemakers are restricted from having these procedures performed. Patients in certain professions, such as metal workers or mechanics, may not be candidates for MRA because metal shavings may be present in their eyes. X-rays of the eyes should be done on all patients before the procedure is started. MRA is generally avoided during the first trimester of pregnancy.

Cost, Risk Affect Choices

Each modality for visualizing carotid stenosis has it benefits and risks. The choice most physicians make is CFD followed by CTA, unless the patient has renal failure or laboratory values are too high. In those cases, most physicians would choose MRA.

The last choice of most physicians today is DSA, because of the cost and risk factors associated with this procedure. Physicians also exclude DSA if the patient's complication cannot be fixed while doing the angiographic procedure. Patients

want to have as little discomfort and the least expensive examination possible. All these factors should be taken into consideration when deciding on a modality for visualizing carotid stenosis.

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Article citation:
Wiley, Sean. "Choosing Modalities for Carotid Stenosis." *Journal of AHIMA* 74, no.9 (October 2003): 90,92,94.