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Computed Tomography Scan and Magnetic Resonance Imaging

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Computed tomography (CT) and magnetic resonance imaging (MRI) are currently two of the latest methods for producing computerized images of normal and diseased heart muscle. Both CT and MRI are among the most accurate tools used to assess the heart's structure and pumping function and the structures of the large vessels (aorta and pulmonary artery). When conventional imaging techniques such as a chest x-ray or echocardiogram are inadequate, these techniques often allow your doctor to make important diagnoses or decisions about treating your heart condition.

What Is a Cardiac CT Scan?

Cardiac CT scanning uses x-ray imaging to take images of the heart timed to the heartbeats to avoid motion blurring from the heart's movements. There are two different CT technologies that can be used in imaging the heart: Electron beam CT (EBCT) and multi-detector CT scans (MDCT). Although there is ongoing debate about the relative merits of these two technologies, in general, they can be considered equivalent. Cardiac CT can provide information about the extent of atherosclerosis by detecting the amount of

calcium in the coronary arteries, can detect structural abnormalities of the heart and heart lining (pericardium), and is useful for diagnosing many diseases of the larger blood vessels of the body. There is extensive research at present about the potential utility of cardiac CT for detecting blockages in the coronary arteries (coronary CT angiography). However, this use of CT scanning is unproven at this time. In general, a CT scan has the advantage of short study time (15 to 20 minutes) with high quality images. However, disadvantages include the need for radiation exposure and the use of a contrast material (dye) in most cases, which may make it inappropriate for patients with significant kidney problems.

CT Scan for Calcium Score
I have risk factors for heart artery disease but have no symptom or history of a heart problem. Should I get a CT scan for calcium score to screen for heart disease? It has been suggested that cardiac CT may be used as a screening test by detecting the amount of calcium deposited in the coronary arteries in patients with no symptoms of heart disease. Although

calcium score correlates with hardening of the heart arteries, the current consensus of the medical community is that calcium scoring does not offer additional information that would be better than conventional assessment by risk factors (family history, blood pressure, smoking, diabetes, obesity, and blood cholesterol levels) in predicting future heart attack or guiding preventive therapy. Routine screening for heart disease by calcium score in persons with no symptoms of heart disease is therefore not currently recommended. The National Institutes of Health is conducting a clinical trial (MultiEthnic Study of Atherosclerosis [MESA]) that will provide more information regarding any role of calcium scoring.

What Is an MRI of the Heart?

MRI uses a magnetic field to localize and image body structure. Apart from being one of the most accurate tests in assessing the heart's structure and function, MRI has the advantage of being able to image the heart from any angle without the use of potentially damaging radiation. MRI in general offers more accurate information than

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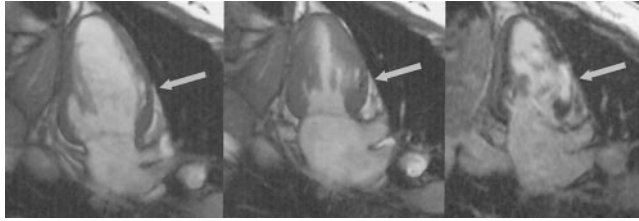


Figure 1. A patient with no history of heart disease was found to have a region of abnormal contraction of the heart by echocardiogram. MRI confirmed this abnormality as illustrated by the 2 pictures on the left. The arrows point to a region of the heart that fails to demonstrate normal thickening as the rest of the heart muscle during heart contraction. This region of the heart was confirmed to be scar tissue from a silent heart attack (bright region on the right; arrow) by MRI with contrast.

a conventional echocardiogram in assessing the heart's structure and function. MRI can also distinguish types of body tissues. This allows imaging of regions of heart damage in patients who have suffered heart attacks (Figure 1) and can predict the recovery of heart function from the repair of a narrowed heart artery by techniques such as catheter method (angioplasty) or bypass surgery. MRI is the test of choice to image arteries of the neck, kidneys, and limbs (Figure 2). Like CT, research is ongoing regarding the ability of MRI to image the coronary arteries.

Compared with CT, MRI has the advantage of not involving radiation, and the contrast material used in MRI is safer for the kidneys. On the other hand, MRI takes longer to perform and patients with claustrophobia may have

difficulty in the confined space of the MRI scanner. Currently, it takes 45 to 90 minutes to perform most MRI studies of the heart. For patients with claustrophobia, a sedative such as Valium (Roche Pharmaceuticals) is given before the MRI study so that they can comfortably undergo the MRI examination. Loud noises are present during the test, so hearing-protective devices are necessary.

Can Either CT Angiography or MR Angiography Be Used Instead of Invasive Coronary Angiography to Image the Coronary Arteries?

Although either CT angiography (CTA) or MR angiography (MRA) is excellent in detecting rare congenital abnormalities of the coronary artery, both techniques are currently experi-

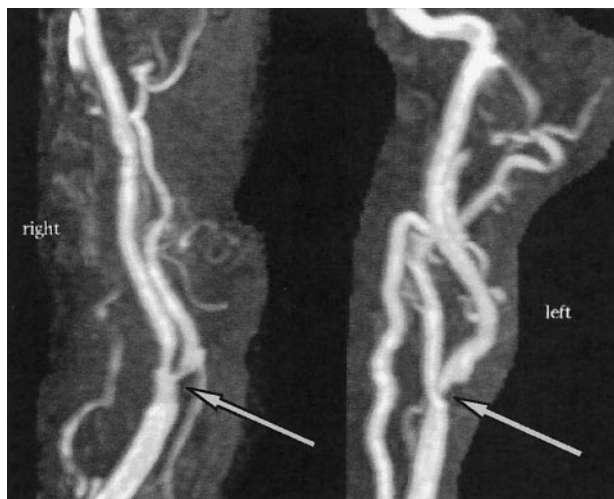


Figure 2. MRA of the arteries to the brain. Note that there are points of severe narrowing (arrows) at the junction of arteries on both the left and right sides.

PATIENTS WITH THESE COMMON BIOMEDICAL DEVICES AND FOREIGN BODIES SHOULD NOT UNDERGO A MRI SCAN:

- Cardiac pacemaker
- Cardiac internal defibrillator
- Some metallic (stainless steel) brain aneurysm clips
- Cochlear implants
- Neurostimulators and bone growth stimulators
- Bullet fragments, shrapnel, or other metallic foreign body

mental in detecting narrowing of the coronary artery from atherosclerosis. While both techniques are being actively investigated, neither CTA nor MRA can currently be routinely recommended in place of invasive coronary angiography to detect narrowing of the coronary arteries.

Are There Any Health Risks From an MRI Procedure?

Because of routine screening procedures recommended by the American College of Radiology, serious events from MRI scanning have been very rare. Minor side effects during an MRI study include nerve or muscle stimulation and warmth over parts of the body. Nerve or muscle stimulation is often experienced as involuntary muscle twitching and is not harmful unless there is accompanying pain. Patients with pacemakers, internal defibrillators, and brain aneurysm clips that are made of non-MRI-safe material may not enter an MRI scanner. Neurostimulators and bone growth stimulators are also considered hazardous, although there is a suggestion that MRI could be safely performed if strict imaging guidelines are followed. Certain metal implants and some metallic foreign bodies may cause serious problems in MRI, and patients with these devices should consult with their physician before undergoing an MRI. Implants

ADVANTAGES AND DISADVANTAGES OF MRI VERSUS CT

Advantages of MRI

- Can image at any angle without the use of potentially damaging radiation
- Excellent in diagnosing diseases of the large vessels, as well as structural changes of the heart and the heart lining
- More accurate information than conventional echocardiogram regarding the structure and function of the heart
- Test of choice to image narrowing of the arteries of the neck, kidneys, and limbs
- Test of choice to image abnormal coronary arteries from congenital causes
- Excellent tissue differentiation with or without the use of contrast material
- Contrast material currently used is safer for the kidneys than contrasts used in other techniques, such as CT or x-ray type angiography

Disadvantages of MRI

- Long study time
- Loud noises and confined space
- MRI cannot be performed in the presence of certain metallic biomedical devices or foreign bodies

Advantages of CT

- Short study time and less confining environment than MRI
- Excellent in diagnosing diseases of the large vessels and the heart lining
- Excellent in imaging abnormal coronary arteries from congenital causes

Disadvantages of CT

- Exposure to radiation
- Contrast material may worsen kidney function in patient with kidney disease

such as vascular stents (including coronary artery stents), clamps, and filters, as well as cardiac occluders if made from MRI-safe materials such

as titanium, nitinol, other alloys, or certain types of stainless steel, can undergo MRI anytime after placement. A waiting period of 6 to 8

weeks after implantation is recommended for devices made of some materials to ensure the implant's incorporation into the adjacent tissue. It is safe for patients with most artificial heart valves, including the older Starr-Edwards models, to undergo MRI unless a ruptured valve ring is suspected. Therefore, the information from the manufacturer of an implant, specifically the material used, must be known and safety-checked before an MRI examination. The safety profiles of most biomedical objects are available online. With regard to the pregnant patient, currently there is insufficient evidence supporting or refuting the safety of MRI tests. Therefore, an MRI is recommended only in the case of a critical treatment decision.

Additional Resources

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