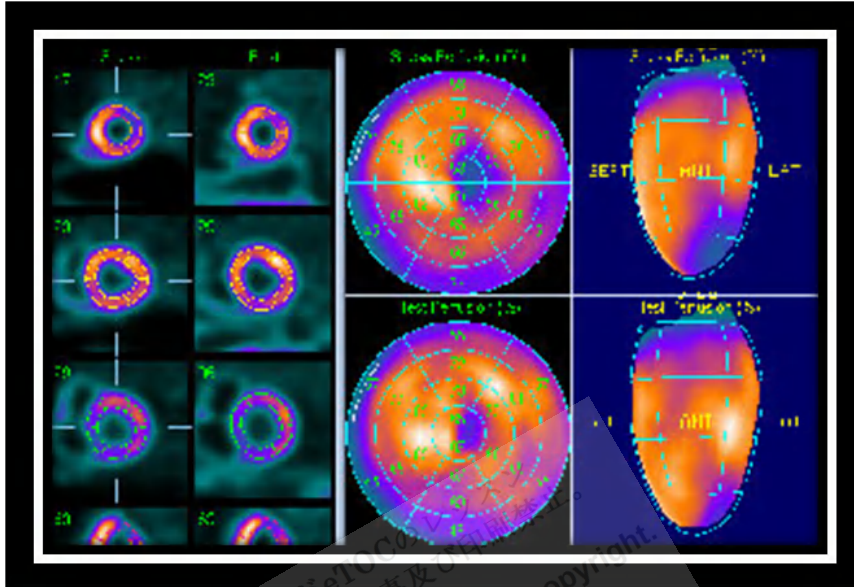


Cardiac Imaging Tests



<http://www.medpagetoday.com/upload/2010/11/15/23347.jpg>

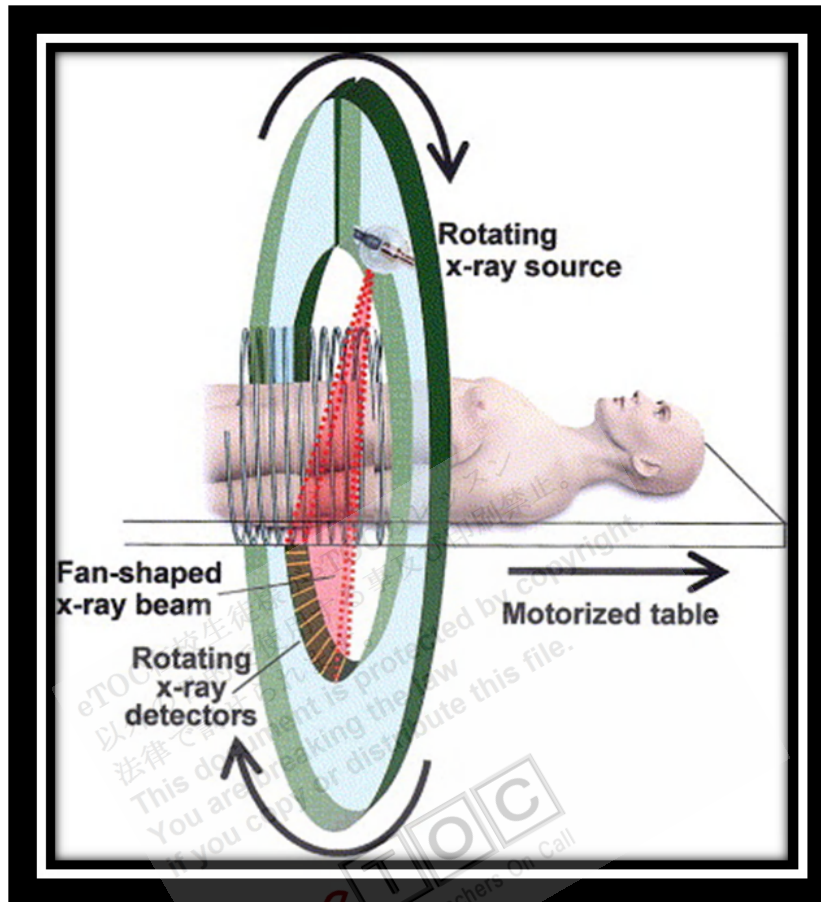
Standard imaging tests include echocardiography, chest x-ray, CT, MRI, and various radionuclide techniques. Standard CT and MRI have limited application because the heart constantly beats, but faster CT and MR techniques can provide useful cardiac images; sometimes patients are given a drug (eg, a β -blocker) to slow the heart rate during imaging. In addition, by synchronizing image recording (or reconstruction) with the ECG (ECG gating), information from several cardiac cycles can be used to create single images of selected points in the cardiac cycle. CT gating that uses the ECG to trigger the x-ray beam at the desired portion of the cardiac cycle gives less x-ray exposure than gating that simply reconstructs information from only the desired portion of the cardiac cycle (gated reconstruction) and does not interrupt the x-ray beam.

Chest x-rays: Chest x-rays are often useful as a starting point in a cardiac diagnosis.

Posteroanterior and lateral views provide a gross view of atrial and ventricular size and shape and pulmonary vasculature, but additional tests are almost always required for precise characterization of cardiac structure and function.

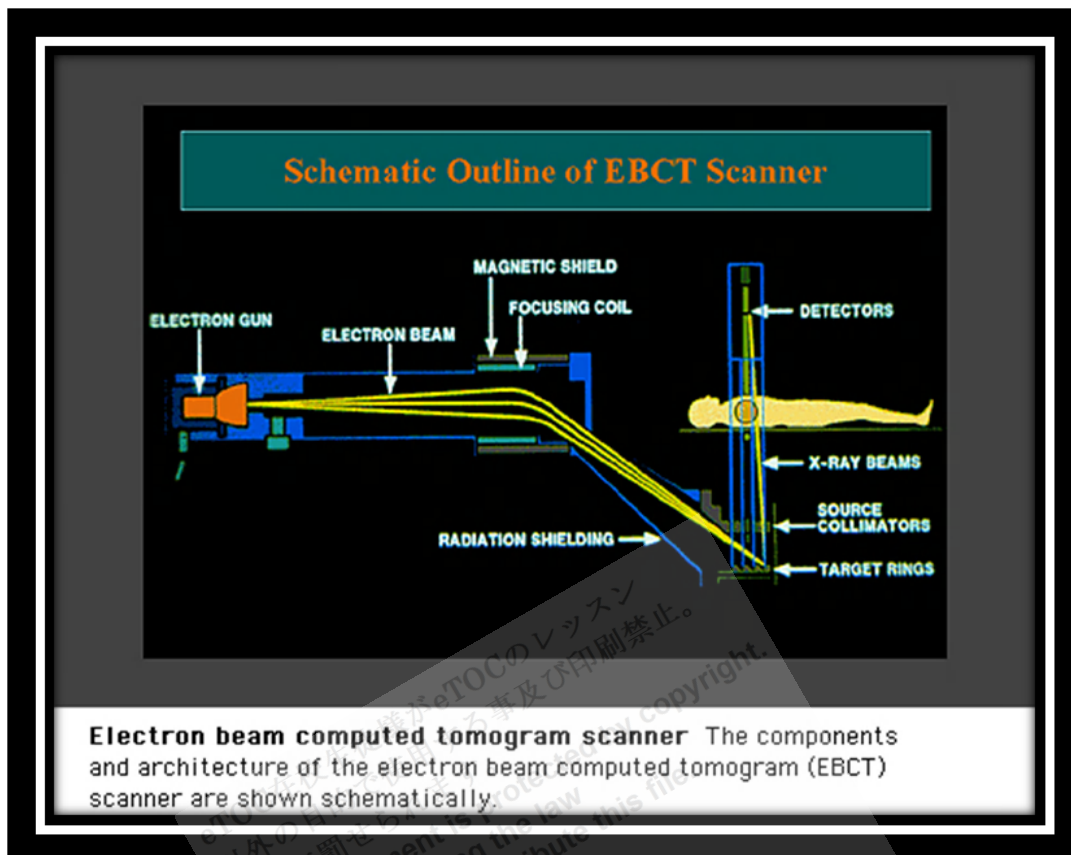
CT: Spiral (helical) CT may be used to evaluate **pericarditis**, congenital cardiac disorders (especially abnormal arteriovenous connections), disorders of the great vessels (eg, **aortic aneurysm**, **aortic dissection**), cardiac tumors, **acute pulmonary embolism**, **chronic pulmonary thromboembolic disease**, and **arrhythmogenic** right

ventricular dysplasia. However, CT requires a radiopaque dye, which may limit its use in patients with renal impairment.



<http://ars.els-cdn.com/content/image/1-s2.0-S0016508505008917-gr5.jpg>

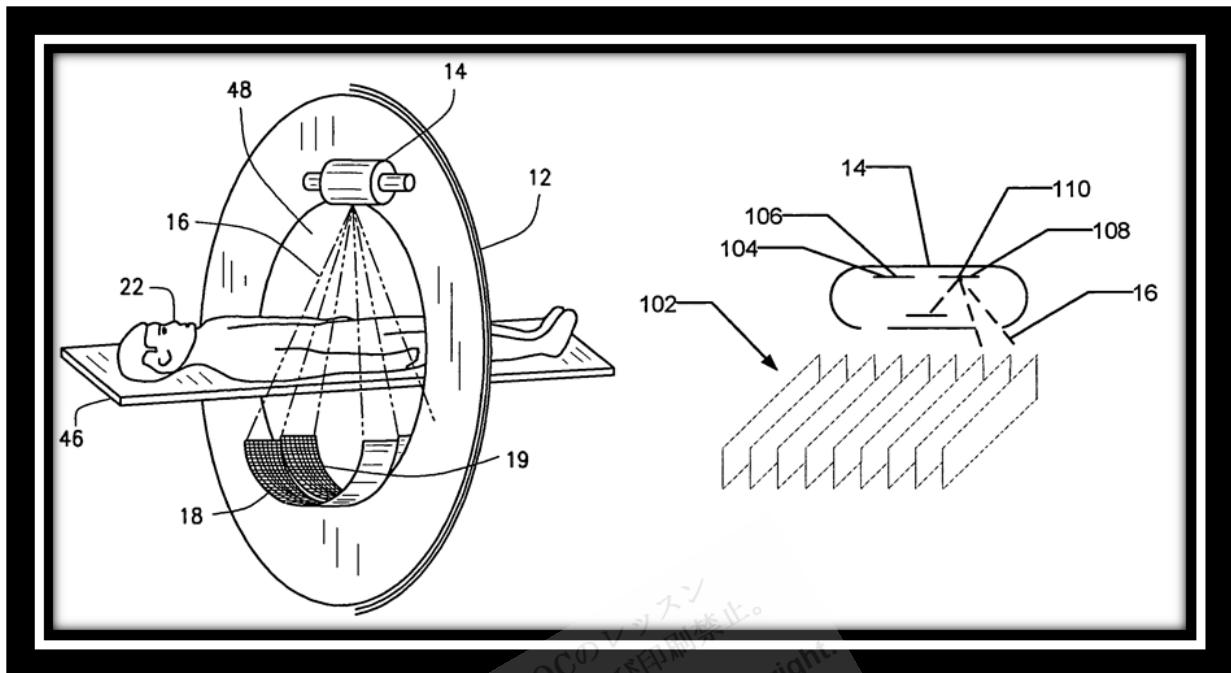
Electron beam CT, formerly called ultrafast CT or cine CT, unlike conventional CT, does not use a moving x-ray source and target. Instead, the direction of the x-ray beam is guided by a magnetic field and detected by an **array** of stationary detectors. Because mechanical motion is not required, images can be acquired in a fraction of a second (and recorded at a specific point in the cardiac cycle). Electron beam CT is used primarily to detect and quantify **coronary artery calcification**, an early sign of **atherosclerosis**. However, **spatial resolution** is poor and the equipment cannot be used for noncardiac disorders, so newer standard CT techniques are becoming preferred for cardiac use.



http://cmbi.bjmu.edu.cn/uptodate/pictures/card_pix/ebct_sca.gif

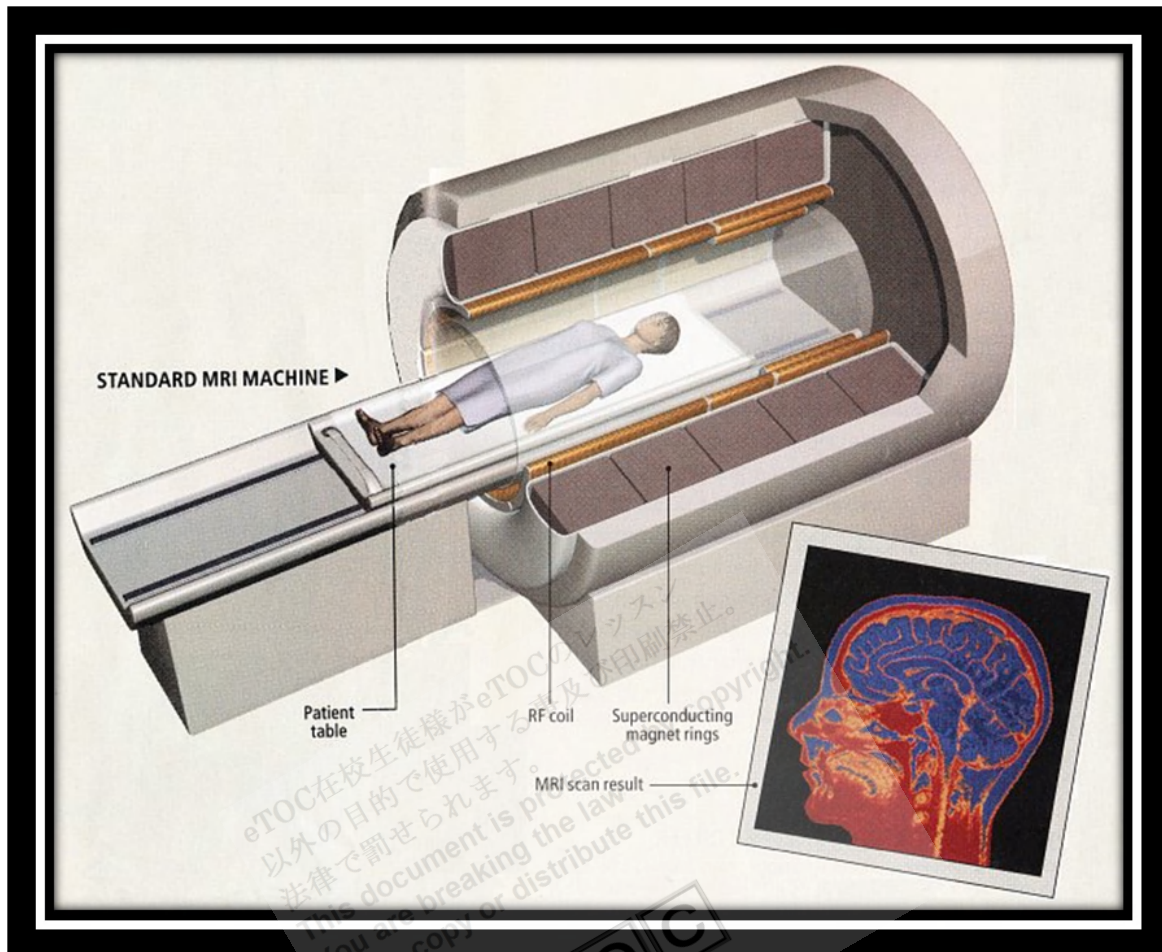
Multidetector CT (MDCT), with ≥ 64 detectors, has a very rapid scan time; some advanced machines may generate an image from a single heartbeat, although typical acquisition times are 30 sec. Dual-source CT uses 2 x-ray sources and 2 multidetector arrays on a single **gantry**, which cuts scan time in half. Both of these modalities appear able to identify coronary calcifications and flow-limiting (ie, $> 50\%$ stenosis) coronary artery obstruction. Typically, an IV contrast agent is used, although nonenhanced scans can detect coronary artery calcification.

MDCT is currently used mainly for patients with **indeterminate stress** imaging test results as a noninvasive alternative to coronary angiography. However, radiation dose is significant, about 15 mSv (vs 0.1 mSv for a chest x-ray and 7 mSv for coronary angiography). The presence of high-density calcified plaques creates imaging artifacts that interfere with interpretation.



<http://www.freepatentsonline.com/7187748-0-large.jpg>

MRI: Standard MRI is useful for evaluating areas around the heart, particularly the **mediastinum** and great vessels (eg, for studying aneurysms, dissections, and stenoses). With ECG-gated data acquisition, image resolution can approach that of CT or echocardiography, clearly **delineating** myocardial wall thickness and motion, chamber volumes, **intraluminal masses** or clot, and valve planes. Sequential MRI after injecting a paramagnetic contrast agent (gadolinium-diethylenetriamine pentaacetic acid [Gd-DTPA]) produces higher resolution of myocardial perfusion patterns than does radionuclide imaging. However, patients with impaired renal function can develop nephrogenic systemic fibrosis, a potentially life-threatening disorder, after use of **gadolinium contrast**. Using contrast, 3-dimensional information on infarct size and location can be obtained, and blood flow velocities in cardiac chambers can be measured. MRI can assess tissue viability by assessing the **contractile response** to **inotropic stimulation** with dobutamine or by using a contrast agent (eg, Gd-DTPA, which is excluded from cells with intact membranes). MRI discriminates myocardial scar from inflammation with edema. MRI measurements of ascending **aorta dilatation** in patients with Marfan syndrome is more accurate than echocardiographic measurements.



<http://miriam-english.org/files/images/standard-MRI-machine.jpg>

Magnetic resonance angiography (MRA) is used to assess blood volumes of interest (eg, blood vessels in the chest or abdomen); all blood flow can be assessed simultaneously. MRA can be used to detect aneurysms, stenosis, or occlusions in the carotid, coronary, renal, or peripheral arteries. Use of this technique to detect deep venous thrombosis is being studied.

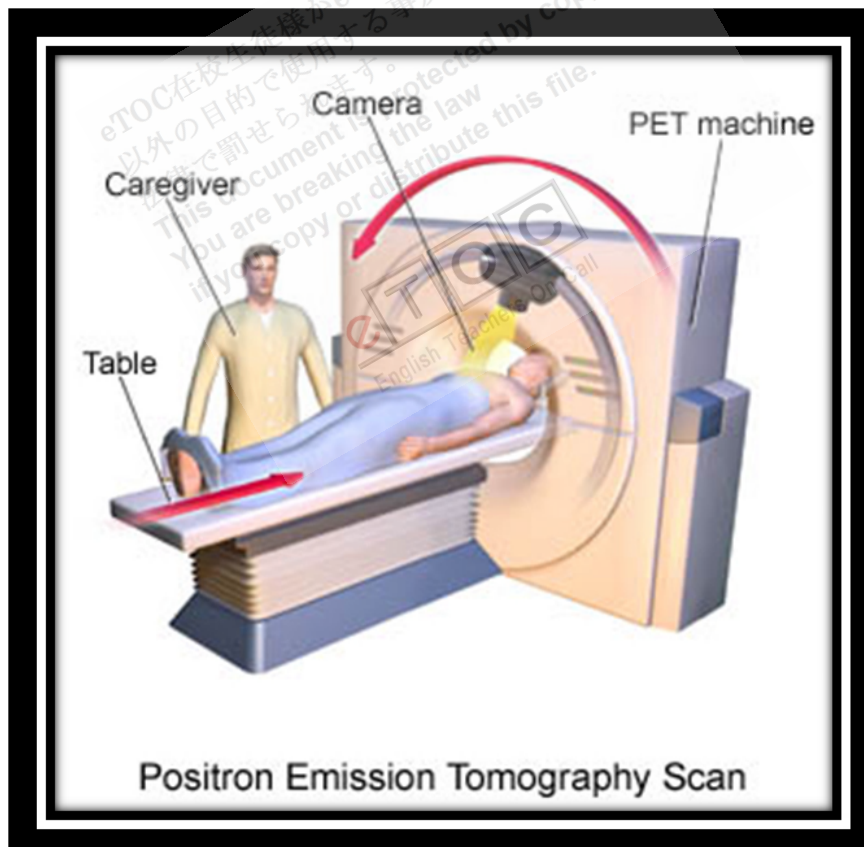


<http://healthsource.baylorhealth.com/RelatedItems/6253.img>

Positron emission tomography (PET): PET can demonstrate myocardial perfusion and metabolism.

Perfusion agents include carbon-11 (^{11}C) CO_2 , oxygen-15 (^{15}O) water, nitrogen-13 (^{13}N) ammonia, and rubidium-82 (^{82}Rb). Only ^{82}Rb does not require an on-site cyclotron.

Metabolic agents include fluorine-18 (^{18}F)–labeled deoxyglucose (FDG) and ^{11}C acetate. FDG detects the enhancement of glucose metabolism under ischemic conditions, and can thus distinguish ischemic but still viable myocardium from scar tissue. Sensitivity is greater than with myocardial perfusion imaging, possibly making FDG imaging useful for selecting patients for **revascularization** and for avoiding such procedures when only scar tissue is present. This use may justify the greater expense of PET. Half-life of ^{18}F is long enough (110 min) that FDG can often be produced off-site. Techniques that enable FDG imaging to be used with conventional single-photon emission CT (SPECT) cameras may make this type of imaging widely available.



<http://images.ddcdn.com/cg/images/en2626481.jpg>

Uptake of ^{11}C acetate appears to reflect overall O_2 metabolism by myocytes. Uptake does not depend on such potentially variable factors as blood glucose levels, which can affect FDG distribution. ^{11}C acetate imaging may better predict **post-intervention** recovery of myocardial function than FDG imaging. However, because of a 20-min half-life, ^{11}C must be produced by an on-site **cyclotron**.

Reference: <http://www.merckmanuals.com>

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