

Cardiac Imaging Modalities and Appropriate Use

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KEYWORDS

• Cardiac imaging • CMR • CCTA • CAC • Appropriate use

KEY POINTS

- Advanced cardiac imaging modalities to include calcium scoring computed tomography (CT), coronary CT angiography (CCTA), and cardiac MRI (CMR) are increasing in availability and accessibility.
- Awareness of the fundamentals for each of these imaging techniques, unique imaging challenges, and appropriate use criteria is critical for ordering physicians and providers.
- CCTA is a rapid examination with numerous radiation dose optimization and contrast dose reduction strategies available with appropriate patient preparation.
- CMR is a flexible cardiac imaging modality with no ionizing radiation patient exposure concerns, which can be tailored to answer multiple clinical questions, including structure, morphology, function, viability, and flow analysis.



Video content accompanies this article at <http://www.primarycare.theclinics.com>.

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INTRODUCTION

The American Heart Association¹ estimates that 92.1 million US adults have some form of cardiovascular disease (CVD). By 2030, CVD will affect nearly half of the US population. Public awareness and secondary prevention programs targeting behaviors (eg, exercise, smoking cessation programs, diet quality, and body mass index) and risk factors (eg, blood cholesterol, blood pressure, blood glucose) have modestly (6.7% reduction) impacted CVD-related deaths. Despite this, CVD remains the most common underlying cause of death and accounts for nearly one-third of global deaths. Many patients are asymptomatic until the late stages of disease when they present with acute, life-threatening disease. Early detection, risk assessment, and behavior/health-factor intervention are essential to lower CVD morbidity and mortality.

Computed tomography (CT) and MRI can provide valuable insight for risk assessment and management of patients with known or suspected CVD. Novel acquisition schemes and technological improvements have made coronary artery calcium (CAC) scoring CT, coronary CT angiography (CCTA), and cardiac MRI (CMR) more available and clinically practical for primary care practice. Reductions in CT radiation dose, rapid imaging techniques in CMR, and increased awareness have promoted CT and MRI use for detection and surveillance of CVD. Hardware and software developments allow for faster postprocessing and manipulation of large data sets, helping to answer key clinical questions with greater efficiency and accuracy. Manufacturing efficiencies have helped make CT and MRI technology more accessible at community hospitals. CT and CMR now rival echocardiography and nuclear medicine myocardial perfusion scans (nuclear stress tests) as mainstays of cardiac imaging for risk stratification and disease diagnosis. This article reviews current appropriateness criteria for CT and CMR, highlighting use in common clinical scenarios. Patient selection and safety concerns related to application of CT and CMR in the cardiovascular patient are also reviewed.

CARDIAC COMPUTED TOMOGRAPHY: CORONARY ARTERY CALCIUM SCORING AND CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY

CAC has been a longstanding marker for the presence of coronary atherosclerotic disease (CAD).² Early attempts to identify CAC using traditional radiographs and x-ray fluoroscopy for early detection failed to gain traction, but the advent of modern cardiac CT with improved gating algorithms, faster acquisition schemes, and novel ionization radiation dose reduction strategies has made CT-based CAC scoring an available clinical option. Current technology enables CAC scoring with radiation doses of 0.37 to 1.0 mSv, an exposure that is similar to mammography (0.8 mSv).³ CAC scoring can help target risk stratification and management of asymptomatic patients, particularly those at intermediate risk,³ by serving as an adjunct to conventional risk assessment tools (eg, Framingham Risk Score). Although CAC helps assess the overall atherosclerotic plaque burden, it is not good for predicting coronary thrombosis (ie, “vulnerable plaque”) or acute myocardial infarction.² Acute coronary artery thrombosis is typically associated with acute rupture of an atherosclerotic plaque with a thin fibrous cap or erosion of an atherosclerotic plaque. In both instances, atherosclerotic plaques are often “soft plaques” with little coronary calcium.

Modern technology and refinement in clinical imaging protocols have enabled the reliable use of high-quality CCTA in community hospitals. CCTA is rapid and has low patient radiation exposures. CCTA rivals conventional catheter angiography in the ability to illustrate the coronary artery anatomy. In selected patients, it offers a viable alternative to catheter angiography at lower cost and without the conventional

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