

CARDIOLOGY IMAGING STUDIES

Ten Things to Know About Ten Cardiovascular Disease Prevention Imaging Studies

(“ASPC Top Ten Imaging – 2021”).

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Cardiac imaging helps assess the degree of cardiovascular disease (CVD), which is important in stratifying current CVD risk and determining management strategies toward preventing future CVD events. The intent of the “American Society for Preventive Cardiology (ASPC) Top Ten Imaging” is to help primary care clinicians and cardiology specialists keep up with the ever-increasing pace of diagnostic and prognostic imaging studies applicable to preventive cardiology. Imaging studies focused on the heart are often performed by cardiologists and/or radiologists and help with diagnosis and prognosis.

PREVENTIVE CARDIOLOGY IMAGING STUDY

Coronary Artery Calcium Score (CAC)

SENSITIVITY	SPECIFICITY
98%	40%

A coronary artery calcium (CAC) score utilizes computed tomography (CT) to assess the amount of calcium found in coronary arteries.¹ In most patients, the higher the CAC score, the higher the atherosclerotic burden and the higher the risk of a subsequent cardiovascular disease (CVD) event.¹

IN A SCIENTIFIC STATEMENT FROM THE NATIONAL LIPID ASSOCIATION, CAC SCORING:

- Aids in ASCVD risk prediction, regardless of race, gender, or ethnicity
- Aids the clinician to allocate statin therapy based on ASCVD risk
- May inform decision-making about add-on therapies to statins, especially if CAC scores are very high
- Aids decision-making about aspirin and anti-hypertensive therapy

PATIENTS MOST LIKELY TO BENEFIT FROM CAC TESTING^{2,3}

Asymptomatic individuals not known to have CVD, but who are **40 years and older without diabetes mellitus**

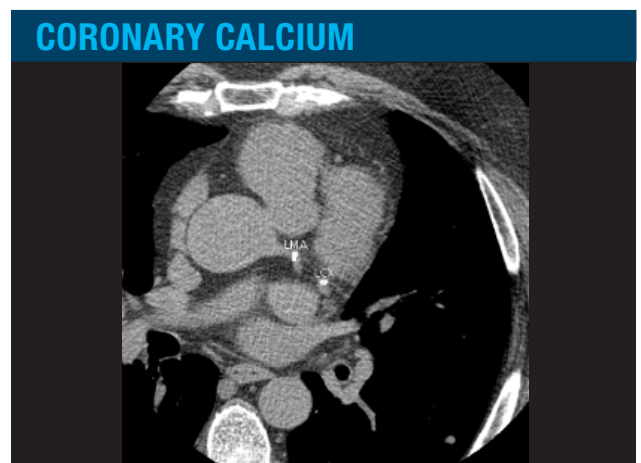
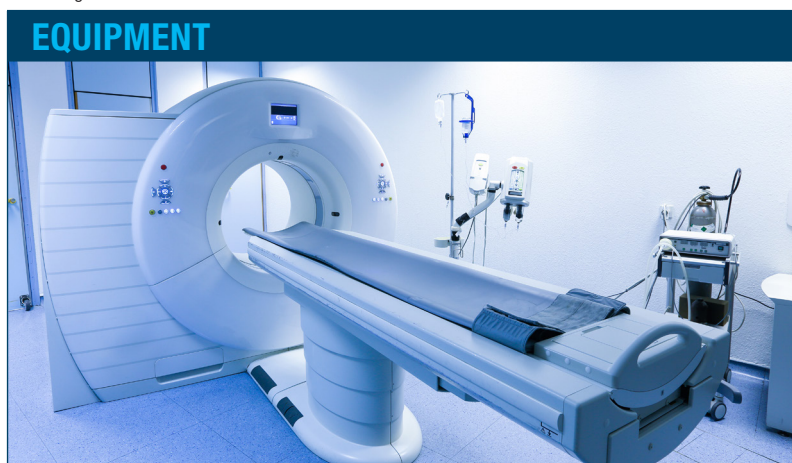
Individuals in whom **primary CVD prevention therapeutics** are being considered (e.g., statins)

Individuals having **borderline** (5-7.5%) **to intermediate** (7.5-20%) 10-year ASCVD risk estimate to further stratify risk

GUIDE TO CAC SCORING⁴⁻⁸

AU	Coronary Plaque Burden	Risk of Event	Statin Indication
0	None identified	Low over the next 8 years	N/A
1-100	Mild	2% in ~2 years	May defer, but repeat CAC in 5 years
100-400	Moderate	4% in ~2 years	Strong
>400	Severe	5% 10-year	Strong
>1000	Extreme	Very high	Strong

AU = Agatston Unit



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SENSITIVITY	SPECIFICITY
96%	82%

Coronary computed tomography angiography (CCTA) is a cardiac imaging study utilizing computed tomography (CT) with an iodine intravenous contrast that can **quantify coronary atherosclerotic burden**. CCTA has a **high negative predictive value**, such that if negative, then cardiovascular disease risk is low.²

PATIENTS MOST LIKELY TO BENEFIT FROM CCTA TESTING²

Patients without known coronary heart disease who have **chest pain and low to intermediate risk of CVD** or related symptoms

In patients with **symptoms of chest pain** where obstructive coronary artery disease cannot be reasonably established by history and physical exam alone

TIPS FOR CCTA TESTING³

✓ CCTA may be helpful to rule out left main coronary artery disease

✓ The contrast with CCTA is contraindicated in patients with contrast dye allergies.

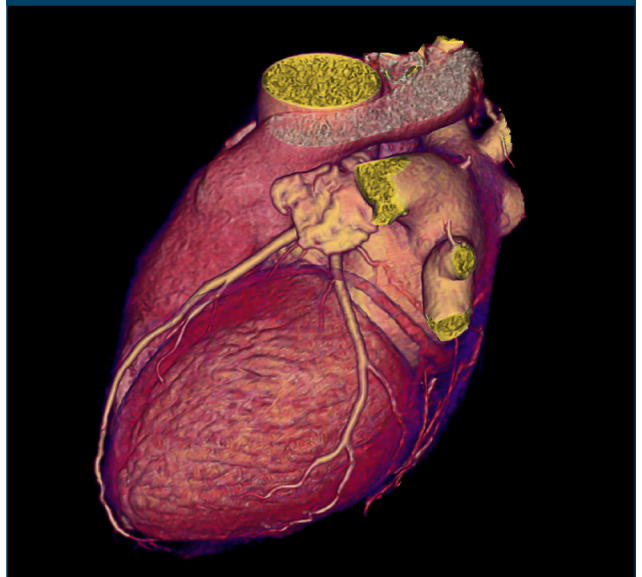
✓ When combined with fractional flow reserve (FFR), CCTA can help determine the functional significance of stenotic lesions.¹

✓ CCTA is not recommended in patients with extensive coronary calcification (which may occur with older age and kidney failure), cardiac dysrhythmias (including tachycardia), significant obesity, and in patients unable to hold their breath – all which may adversely affect image quality.

EQUIPMENT



CCTA



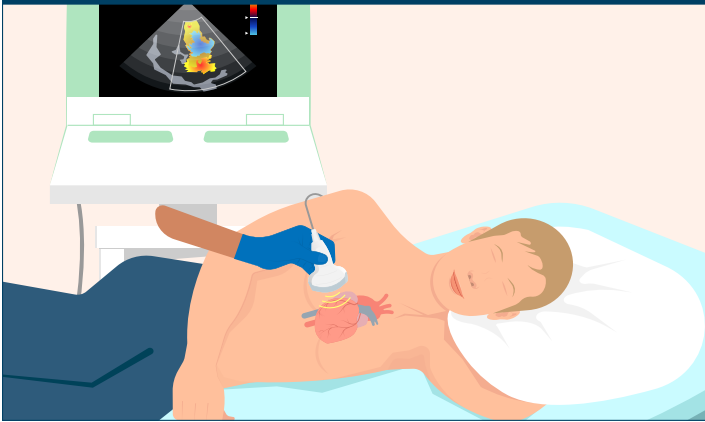
SENSITIVITY	SPECIFICITY
85%	82%

Echocardiography utilizes ultrasound waves to **provide hemodynamic information** about heart function.¹ When accompanied by stress testing, echocardiography is often used to assess myocardial ischemia (i.e., coronary artery atherosclerosis), left ventricular function (i.e. heart failure, cardiomyopathy), structural heart disease (i.e., valvulopathy, congenital heart disease, aneurysm, cardiac tumor, pericarditis, endocarditis, aortic dissection, heart chamber thrombosis).²

APPROACHES TO ECHOCARDIOGRAPHY^{2,3}

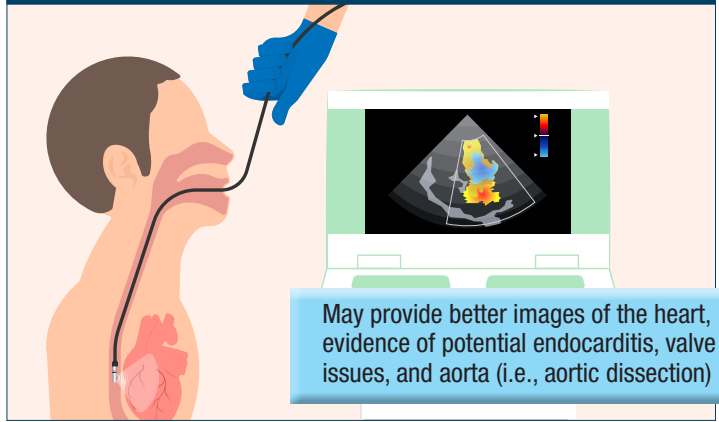
TRANSTHORACIC ECHOCARDIOGRAPHY

is the most common approach



TRANSESOPHAGEAL ECHOCARDIOGRAPHY

preferred in patients with conditions that compromise transthoracic imaging quality (e.g., obesity, certain lung conditions).

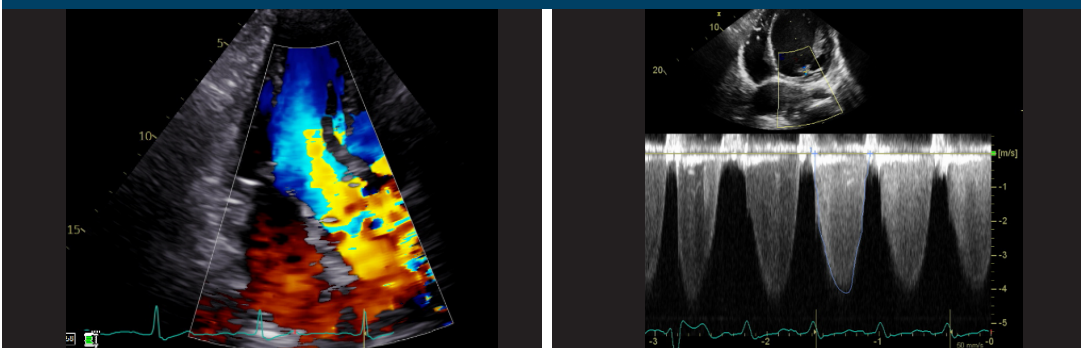


May provide better images of the heart, evidence of potential endocarditis, valve issues, and aorta (i.e., aortic dissection)

TIPS FOR ECHOCARDIOGRAPHY

- ✓ Doppler echocardiography can assess stroke volume, heart chamber pressure gradients, valvular regurgitations, and intracardiac shunts.¹
- ✓ Echocardiography is commonly used to assess left ventricular ejection fraction, which is “normally” ~ 50-70%. Heart failure with reduced ejection fraction (HFrEF) is defined as heart failure with ejection fraction < 50%.¹
- ✓ While heart failure can occur with reduced ejection fraction, symptomatic heart failure can also occur with preserved ejection fraction (HFpEF) (i.e., ejection fraction ≥ 50%).³

ECHOCARDIOGRAM



Nuclear myocardial perfusion imaging (MPI) through **single photon emission computed tomography (SPECT)** utilizes small amounts of nuclear tracer (typically technetium-99 [^{99m}Tc]) injected into the blood to assess myocardial segments that do not take up the tracer (i.e., damaged myocardium) or areas with delayed uptake of the tracer (i.e., ischemic myocardium).

Positron emission tomography (PET) perfusion imaging requires injection of radiotracer to evaluate myocardial perfusion. In both cases, imaging is performed at rest, followed by walking on a treadmill with another injection of nuclear contrast or radiotracer (“exercise technetium-99 sestamibe scan”).

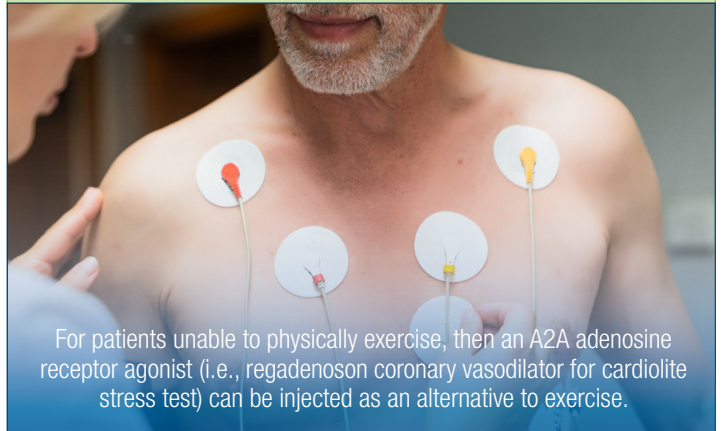
SPECT

Can help assess for mild cardiac ischemia.¹



PET

PET may help identify functional abnormalities suggestive of microvascular coronary artery disease (CAD).² Coronary flow reserve can be added to improve cardiovascular disease (CVD) risk assessment.



For patients unable to physically exercise, then an A2A adenosine receptor agonist (i.e., regadenoson coronary vasodilator for cardiolute stress test) can be injected as an alternative to exercise.

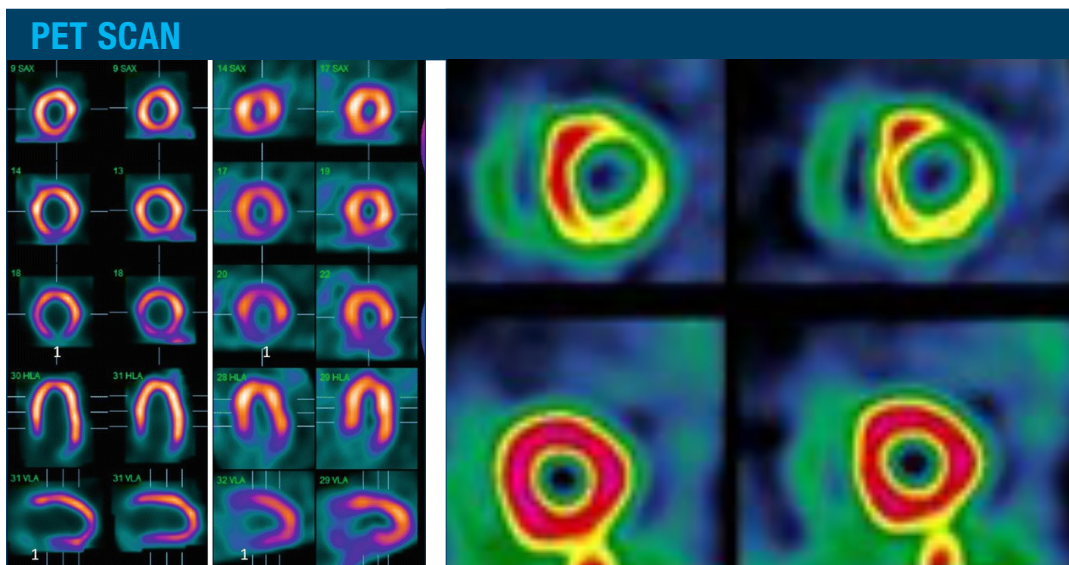
APPROPRIATE USE FOR MPI

- To assess myocardial perfusion
- To help identify obstructive coronary artery disease as the etiology of chest pain³
- In patients with¹:
 - Immobility
 - Cardiac rhythm disorders
 - Impaired kidney function
 - Presence of cardiac devices
- PET has a high sensitivity and specificity to detect anatomic and functional atherosclerotic lesions useful for CVD risk stratification
- PET may help identify functional abnormalities suggestive of microvascular CAD.⁵

STRENGTHS OF PET MPI²

- High diagnostic accuracy
- Safety with low radiation exposure (lower than SPECT)
- Efficient with 5-minute image acquisition times (may take only 30 minutes to perform)
- Ability to assess patients with large body habitus
- Ability to accommodate ill or higher-risk patients
- Ability to assess non-obstructive coronary microvascular dysfunction

PET MPI is limited by the low availability of cardiac PET machines and higher costs²



REFERENCES: 1. Bays H., Khera A., Blaha M., Budoff M., Toth P. Ten Things to Know About Ten Cardiovascular Disease Prevention Imaging Studies (“ASPC Top Ten Imaging – 2021”).
 2. Bateman TM, Dilsizian V, Beanlands RS, DePuey EG, Heller GV, Wolinsky DA. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. *J Nucl Med.* 2016;57:1654-6. 3. Patel MR, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons. *Journal of the American College of Cardiology.* 2017;69:2212-41. 4. Ryan JJ, Mehta R, Thiruvoipati T, Ward RP, Williams KA. Stress-only imaging in patients with prior SPECT MPI: a simulation study. *J Nucl Cardiol.* 2012;19:311-8. 5. Holly TA. Choosing patients for stress-first/stress-only imaging: Keep it simple. *Journal of Nuclear Cardiology.* 2018;25:1188-90. 5. Vancheri F, Longo G, Vancheri S, Henein M Coronary microvascular dysfunction. *J Clin Med* 2020;9.

SENSITIVITY	SPECIFICITY
90%	80%

Cardiac magnetic resonance (CMR) is an imaging study that utilizes magnetic, radio frequency waves (not ionizing radiation) to create cross-sectional/2-dimensional, 3-dimensional, and even 4-dimensional images.¹ CMR can help assess ventricular mass, volume, and systolic function and can help evaluate²⁻⁵:

- Valvular heart disease
- Cardiomyopathies, (i.e. restrictive, hypertrophic, and dilated cardiomyopathies)
- Cardiac tumors
- Cardiac remodeling
- Congenital heart disorders
- Pericardial disease (i.e. pericarditis)
- Ischemic heart disease

PATIENTS MOST LIKELY TO BENEFIT FROM CMR IMAGING

CMR may provide additional information for patients when an echocardiogram is inconclusive . ⁶	CMR may be useful for patients with suspected coronary microvascular angina , which may be especially important in some women. ⁷	CMR can be used to see scar burden, which cannot be obtained from an echo.	CMR can be performed in patients with many orthopedic prostheses (e.g., titanium), with some exceptions (e.g., certain screws). ⁸
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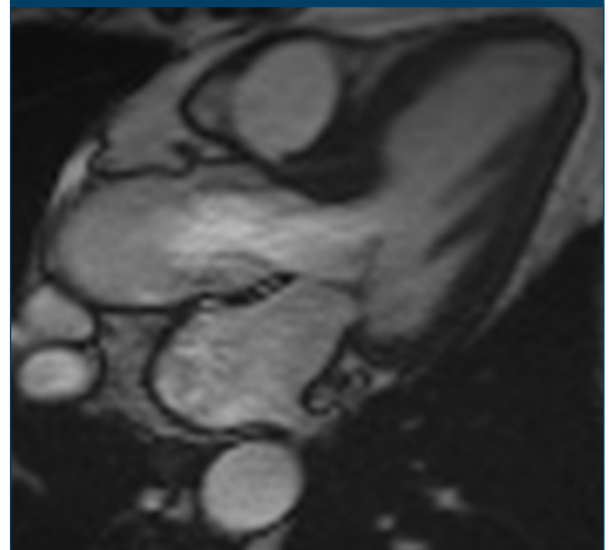
CONTRAINDICATIONS

Due to its magnetic field, CMR should only be performed on patients with devices or implants that are that are certified as CMR safe.⁹

EQUIPMENT



CMR



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