Nuclear Cardiology

Cardiology Services

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Nuclear Cardiology

Myocardial Perfusion Imaging (MPI) Guideline

NOTICE
Individuals at intermediate to high risk, with stable chest pain and no known coronary artery disease (CAD) are recommended to use coronary computed tomography angiography (CCTA) in CAD diagnosis, risk stratification and treatment planning, per the *2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain* as a grade 1A recommendation. [11]

A myocardial perfusion imaging (MPI) (planar or single photon emission computerized tomography (SPECT)) may be medically appropriate when the medical record demonstrates **ANY** of the following: ***NOTE**: **STRONG RECOMMENDATION:** *An EKG within 30 days of request for a myocardial perfusion imaging is strongly recommended. The findings on the resting EKG may be important in determining the need for imaging, the selection of appropriate imaging protocol and may show evidence of ischemia at rest or interval myocardial infarction.*

- Coronary artery disease (CAD) is known and **ANY** of the following:
  - Asymptomatic or stable symptoms and **ANY** of the following:
    - Fractional flow reserve (FFR) 0.80 or less, or stenosis 70% of the diameter or more of a major vessel or ischemia (on stress test) and **NO** evaluation of coronary artery disease within the past 3 years.[1]
    - Organ transplant is planned or history of cardiac transplant and **NO** CAD evaluation within the past year. [38]
  - Symptoms (palpitations, nasuea/vomiting, anxiety, general weakness, fatigue, exercise-induced dizziness, lightheadedness or near syncope) are new or progressing and **ANY** of the following: ***NOTE**: *if typical myocardial ischemia symptoms, cardiac catheterization is more appropriate than MPI.*
    - Exercise (treadmill) test is inconclusive, nondiagnostic or incomplete.
    - Repeat testing request: prior MPI completed in the past year is negative.
    - Stenosis is more than 70% or fractional flow reserve (FFR) is 0.8 or less (on MPI, cardiac PET, stress echo or coronary angiography (CCTA or invasive))

[1]Guideline directed medical therapy (GDMT) is to be optimized during this time.

- Myocardial infarction or unstable angina occurred within the past 90 days and **NO** CAD evaluation in the past 90 days. [1]
- Revascularization (coronary artery bypass graft (CABG) or percutaneous coronary intervention (PCI)) history or planned and **ANY** of the following:
  - CABG was incomplete and **NO** MPI occurred in the past 3 years.
  - CABG was more than 5 years ago and **ALL** of the following:
    - Asymptomatic and stable
    - **NO** CAD evaluation in the past 2 years. *__NOTE__: *Stress ECHO is also acceptable.*
  - Left ventricular ejection fraction is less than 55% and to evaluate cardiac viability prior to revascularization (via a rest redistribution thallium scan)
  - PCI was more than 3 years ago and **ALL** of the following:
    - Asymptomatic and stable
    - **NO** CAD evaluation in the past 3 years. *__NOTE__: *Stress ECHO is also acceptable.*
  - Symptoms are new or worsening and imaging is necessary for treatment planning.[9] [38] *__NOTE__: *MPI or stress echo is acceptable; if symptomatic for myocardial ischemia, cardiac catheterization may be recommended.*
  - Revascularization is planned and left ventricular ejection dysfunction is less than 35%. [46]

- Coronary artery disease (CAD) is <u>suspected</u>, there is a contraindication to CCTA and **ANY** of the following:
  - Symptoms are new or progressing and **NO** CAD evaluation in the past 60 days and **ANY** of the following: [9] [11] [38]
    - Comorbid condition of: abdominal aortic aneurysm (AAA), peripheral vascular disease (PVD), stroke, transient ischemic attack (TIA), carotid endarterectomy (CEA), high grade carotid stenosis (more than 70%), chronic renal insufficiency, renal failure and/or diabetes.
    - High or intermediate risk atherosclerotic cardiovasular disease (ASCVD) and **ANY** of the following:
      - Angina, atypical or angina equivalent symptoms (dyspnea, pain in neck, jaw, arm, epigastric, back, diaphoresis or exercise-induced syncope). [9]
      - Chest pain [11] [16]

        - Documented new or progressing symptoms (palpitations, nausea/vomiting, anxiety, general weakness, fatigue, exercise-induced dizziness, lightheadedness or near syncope).
    - Intermediate or low risk ASCVD with functional capacity and physical exercise limited.
    - Organ transplant planned or cardiac transplant history.
- Symptoms are stable and **ANY** of the following: (*__Note:__ *MPI/SPECT is* **NOT** *appropriate for initial testing when asymptomatic).* [17]
    - **NO** CAD evaluation within the past 3 years and **ANY** of the following:
        - Functional capacity and physical exercise are limited.
        - High risk for CAD [11]
        - Intermediate risk and occupation is high risk (eg, possibility to endanger others)
        - Stress testing is nondiagnostic and target heart rate not achieved.
        - Symptoms (cardiac) change (new or progressing) and comorbid conditions of: abdominal aortic aneurysm (AAA), peripheral vascular disease (PVD), stroke, transient ischemic attack (TIA), carotid endarterectomy (CEA), or high grade carotid stenosis (more than 70%), chronic renal insufficiency or renal failure and/or diabetes.
    - Organ transplant planned or cardiac transplantation history and **NO** CAD evaluation in the past year. [9]

- Exercise treadmill test has abnormal findings (eg, chest pain, ST-segment change, blood pressure response abnormal, complex ventricular arrhythmias) and **NO** prior cardiac imaging and **ANY** of the following:
    - Antiarrhythmic class IC (eg, Propafenone, Flecainide) medication monitoring, initial and annually
    - Cardiac arrhythmia, new onset [9]
    - CAD is known or intermediate or high risk CAD is suspected.
    - Premature ventricular contractions (30 or more an hour on remote monitoring)
    - Ventricular tachycardia (sustained or non-sustained) [9]
- Heart failure (HF) or left ventricular dysfunction, new onset [9]*__NOTE:__ *High risk for CAD, a cardiac catheterization may be more appropriate.*
- Kawasaki's disease related coronary aneurysm surveillance; large or multiple aneurysm(s) monitor annually; small to medium aneurysm(s) monitor every 2 years. [26]

- Preoperative for intermediate to high risk surgery with **NO** prior cardiac imaging in the past year and **ANY** of the following: [2]
  - Cerebrovascular disease (CVD) (eg, stroke, transient ischemic attack (TIA))
  - Coronary artery disease
  - Diabetes
  - Functional capacity is limited/poor (eg, unable to climb flight of stairs or walk up a hill, functional capcity measure is less than 4 metabolic equivalent (METs), unable to reach at least 85% of maximum age-sex predicted heart rate on Bruce protocol exercise testing). [42] [46]
  - Heart failure (ie, ejection fraction of 35% or less) [6]
  - Renal failure or chronic renal insufficiency [42]
- Prior imaging (eg, cardiac CT or CCTA) is abnormal and **ANY** of the following:
  - Asymptomatic or symptoms are stable and **NO** CAD evaluation in the past 3 years and **ANY** of the following:
    - Coronary artery calcium score is more than 400 Agastston units. [5]
    - CCTA supports intermediate severity of coronary stenosis.
  - Symptoms are new or progressing and **ANY** of the following:
    - Coronary artery calcium score is more than 400 Agastston units.
    - Prior imaging (eg, CCTA, cardiac catheterization) supports intermediate severity of coronary stenosis.
- Radiation therapy to the anterior or left chest for surveillance every 5 years.
- Stress echocardiogram within the past 60 days is abnormal, inconclusive, indeterminate, non-diagnostic and myocardial ischemia cannot be ruled out. [24]

Contraindications to Myocardial Perfusion Imaging (MPI)

Contraindications to myocardial perfusion imaging (MPI) may include **ANY** of the following:

- Body Mass Index (BMI) is more than 40 (relative contraindication due to suboptimal image quality).
- Pregnant or lactating women

[2]Revised Cardiac Risk Index for Pre-Operative Risk tool can be found at: https://www.mdcalc.com/revised-cardiac-risk-index-pre-operative-risk

Myocardial Infarct Imaging Guideline

Myocardial infarct imaging (planar or single photon emission computerized tomography (SPECT)) may be medically appropriate when the medical record demonstrates **ANY** of the following: * **NOTE:** *optimally performed 48-72 hours post-event.*

- Evaluation for subendocardial (non-Q-wave) infarction versus ischemia
- Post Cardioversion
- Post-surgical, major cardiac procedure
- Significant chest trauma presenting with chest pain
- Suspected acute myocardial infarction in the prior 7 days (evaluation of abnormal baseline ECG, left bundle branch block, negative cardiac enzymes)

Multiple Gated Acquisition (MUGA) Scan and Cardiac Blood Pool Imaging Guideline

Cardiac Blood Pool Imaging (eg, MUGA) may be medically appropriate when the medical record demonstrates **ANY** of the following: [9]

- Left ventricular dysfunction evaluation and **ANY** of the following:
  - Cardiac resynchronization therapy (CRT) device optimization following implantation (for initial post operative evaluation or for adjustment after new symptoms present) [9]
  - Cardiotoxic chemotherapy for initial evaluation or ongoing therapy [9] [38] [39] [36]
  - Coronary artery disease (CAD), valvular heart disease, myocardial disease, cardiomyopathy or congenital heart disease and prior imaging (TEE preferred) demonstrates **ANY** of the following:
    - Transthoracic echocardiogram (TTE) non-diagnostic, inconclusive or conflicting [21]
    - Transesophageal echocardiogram (TEE) supports systolic dysfunction or ejection fraction of less than 50%
  - Heart failure is known or suspected, for evaluation or reevaluation [9]
  - Pre or post-operative cardiac transplant [33] [47]
  - Ventricular assist device optimization
- Right ventricular dysfunction is known or suspected. [35]

LCD 33457
See also , **LCD 33457** : Cardiac Radionuclide Imaging at https://www.cms.gov/medicare-coverage-database/search.aspx *if appropriate to healthplan membership.*

LCD 33560
See also, **LCD 33560**: Cardiovascular Nuclear Medicine at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

LCD 33960
See also, **LCD 33960**: Cardiovascular Nuclear Medicine at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

LCD 35083
See also, **LCD 35083**: Cardiology Non-emergent Outpatient Stress Testing at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

LCD 38396
See also, **LCD 38396**: Cardiology Non-Emergent Outpatient Stress Testing at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

NCD 220.12
See also, **NCD 220.12**: Single Photon Emission Computed Tomography (SPECT) at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

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Procedure Codes

Table 1. Myocardial Perfusion Imaging Associated Procedure Codes

CODE	DESCRIPTION
78451	Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)
78452	Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or reinjection
78453	Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)
78454	Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or reinjection

Procedure Codes

Table 1. Infarction Imaging Associated Procedure Codes

CODE	DESCRIPTION
78466	Myocardial imaging, infarct avid, planar; qualitative or quantitative
78468	Myocardial imaging, infarct avid, planar; with ejection fraction by first pass technique
78469	Myocardial imaging, infarct avid, planar; tomographic SPECT with or without quantification

Procedure Codes

Table 1. Cardiac Blood Pool Imaging (Multigated Acquisition (MUGA) and Planar) Associated Procedure Codes

CODE	DESCRIPTION
78472	Cardiac blood pool imaging, gated equilibrium; planar, single study at rest or stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without additional quantitative processing
78473	Cardiac blood pool imaging, gated equilibrium; multiple studies, wall motion study plus ejection fraction, at rest and stress (exercise and/or pharmacologic), with or without additional quantification
78481	Cardiac blood pool imaging (planar), first pass technique; single study, at rest or with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification
78483	Cardiac blood pool imaging (planar), first pass technique; multiple studies, at rest and with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification
78494	Cardiac blood pool imaging, gated equilibrium, SPECT, at rest, wall motion study plus ejection fraction, with or without quantitative processing

Definitions/Key Terms

Acute Coronary Syndrome (ACS) A sudden, severe event in which the obstruction of a coronary artery interferes with blood flow to the heart muscle encompassing acute ischemic heart disease (eg, angina, myocardial infarction). ACS is diagnosed on the basis of rapidly accelerating symptoms of myocardial ischemia coupled with objective evidence of acute ischemia from the electrocardiogram and/or elevated circulating markers of myocardial injury.
Angina Pectoris is the medical term for chest pain or discomfort due to coronary heart disease. It occurs when the heart muscle doesn't get as much blood as it needs. This may happen because one or more of the heart's arteries is narrowed or blocked, also called ischemia.

- Atypical chest pain or discomfort that lacks the characteristics of typical angina and is described as sharp or stabbing, or burning brought on by deep breathing or coughing, or movement of arms or torso, and lasting for seconds. The term non-cardiac should be used if heart disease is not suspected.
- Microvascular angina is a type of angina or chest pain that may be a symptom of coronary microvascular disease (MVD). Coronary MVD is a heart disease that affects the heart's smallest coronary artery blood vessels. Spasms within the walls of these very small arterial blood vessels cause reduced blood flow to the heart muscle leading to a type of chest pain referred to as microvascular angina. Angina that occurs in coronary MVD may differ from the typical angina that occurs in heart disease in that the chest pain usually lasts longer than 10 minutes, and it can last longer than 30 minutes.
- Prinzmetal angina may also be referred to as variant angina, Prinzmetal's variant angina or angina inversa. Prinzmetal's angina almost always occurs when a person is at rest, usually between midnight and early morning. These attacks can be very painful. The pain from variant angina is caused by a spasm in the coronary arteries (which supply blood to the heart muscle). The coronary arteries can spasm as a result of any of the following: exposure to cold weather, stress, medicines that tighten or narrow blood vessels, smoking or cocaine use. [1]
- Typical angina, also known as stable angina or angina pectoris, is defined as: 1) substernal/retrosternal chest pain, pressure, tightness or squeezing, described as dull, heavy, or crushing, and /or radiating to the mid-sternal or anterior chest; 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- Unstable angina is defined as angina that is of new onset, occurring at rest or with minimal exertion, and worsening from a previously stable pattern of pain occurrence in terms of frequency or duration of attacks, resistance to previously effective medications, or provocation with decreasing levels of exertion or stress.

[1]American Heart Association, "Heart Topics." [Online]: Available: www.heart.org

ASCVD Risk Estimator Plus

ASCVD Risk Estimator Plus by the American College of Cardiology is a tool to estimate an individual's 10 year ASCVD risk. The optimal recommended use is to establish a reference point, evaluate the impact of interventions, monitor risk over time, and use to engage health care discussions and care planning.

The information required to estimate ASCVD risk includes age, sex, race, total cholesterol, HDL cholesterol, systolic blood pressure, blood pressure lowering medication use, diabetes status, and smoking status. The ASCVD Risk Estimator Plus is available online at http:// http://tools.acc.org/ASCVD-Risk-Estimator/.

The ASCVD measures are:

- Low-risk is less than 5%
- Borderline risk is 5% to 7.4%
- Intermediate risk is 7.5% to 19.9%
- High risk is 20% or more

Cardiac/myocardial perfusion single photon emission computed tomography (SPECT) study, also called a cardiac stress-rest test, is used to evaluate the heart's blood supply. Two sets of images showing blood flow are obtained: the first following a period of rest and the second following a period of stress. Myocardial perfusion SPECT is used to evaluate damage that might have been caused by a myocardial infarction and to assess the presence and extent of myocardial ischemia.

Coronary Artery Bypass Graft (CABG) is a surgical procedure performed to shunt blood around a narrowing or blockage in the coronary artery of the heart that usually involves grafting one end of a segment of blood vessel (such as a vein of the leg) removed from another part of the body into the aorta and the other end of the segment into the coronary artery beyond the obstructed area to allow for increased blood flow.

Coronary artery calcium (CAC) scan is a computed tomography (CT) imaging test. It takes cross-sectional images of the vessels that supply blood to the heart muscle to check for the buildup of calcified plaque. CAC scan measures the calcium in the lining of your coronary arteries, called the **coronary artery calcium score**. The CAC score (sometimes called an Agatston score) is calculated based on the amount of plaque observed in the CT scan. It may be converted to a percentile rank based on age and gender. The score can help identify risk for heart disease.

Coronary Artery Disease (CAD) is the most common type of heart disease in the United States. It is sometimes called coronary heart disease or ischemic heart disease. CAD is caused by plaque buildup in the walls of the arteries that supply blood to the heart (called coronary arteries) and other parts of the body.

Coronary Computed Tomography Angiography (CCTA) uses an injection of iodine-containing contrast material and CT scanning to examine the arteries that supply blood to the heart and

determine whether they have been narrowed. The images generated during a CT scan can be reformatted to create three-dimensional (3D) images that may be viewed on a monitor, printed on film or by a 3D printer, or transferred to electronic media.

Ejection Fraction (EF) is a measurement of how much blood the left ventricle pumps out with each contraction. It is measured in percentages with a normal measurement usually between 50 to 70%.

Fractional flow reserve (FFR) is a ratio of the maximal myocardial blood flow in the presence of a stenosis to the theoretical normal maximal flow in the same distribution. FFR is simply calculated by using the distal coronary pressure of the stenosis divided by the aortic pressure during maximal hyperemia.

Functional Capacity is a measure of the patient's exercise tolerance that can be impacted by uncontrolled variables (familiarity with the exercise equipment, level of training, and environmental conditions in the exercise laboratory). MET is a common unit in capacity calculations. Capacity is a strong predictor of mortality and cardiovascular complications across the adult population.

Guideline-Directed Medical Therapy (GDMT) refers to the optimal course of treatment for each stage of a chronic cardiac condition (eg, angina, heart failure), including those at high risk of disease progression, but without structural heart disease or symptoms. The goal is titration of medications to maximally tolerated doses.

Heart failure (HF) (also known as **Congestive Heart Failure [CHF]**) is a condition that develops when the heart doesn't pump enough blood for the body's needs. This can happen if the heart can't fill up with enough blood or is too weak to pump properly.

High-Risk Occupation is a job in which the related job duties are associated with public safety. Common occupations include pilots (ship, airline), drivers (train, bus), police officers, firefighters, toll bridge workers, and heavy equipment operators.

Kawasaki disease is a disease that involves inflammation of the blood vessels. It is typically diagnosed in young children, but older children and adults can also develop this condition. Kawasaki disease begins with a fever that lasts at least five days. Other classic symptoms may include red eyes, lips, and mouth; rash; swollen and red hands and feet; and swollen lymph nodes. Sometimes the disease affects the coronary arteries which carry oxygen-rich blood to the heart, which can lead to serious heart problems.

Multigated acquisition (MUGA) scan is a noninvasvie nuclear imaging test also known as radionucleotide ventriculography (RVG) and gated equilibrium radionucleotide angiography (ERNA). that uses a radioactive isotope called technetium tagged to red blood cells (RBC) to evaluate the filling and pumping properties of the heart and physical structures by comparing the illuminated blood pool to the darkened walls on the image. Single or multiple measurements of left and/or right ventricular function are obtained. The method can be used to assess regional and global wall motion; cardiac chamber size and morphology and ventricular systolic and diastolic function, including left and right ventricular ejection fractions.

Myocardial Perfusion Imaging is a non-invasive imaging test that shows how well blood flows through (perfuses) your heart muscle. It can also show how well the heart muscle is pumping. This test is often called a nuclear stress test.

Percutaneous coronary intervention (PCI) is a non-surgical procedure that uses a catheter (a thin flexible tube) to place a small structure called a stent to open up blood vessels in the heart that have been narrowed by plaque buildup, a condition known as atherosclerosis.

Pre-Test Probability is a validated measure of the probability that an individual with chest pain has coronary artery disease (CAD). The test results are useful for making decisions on the appropriate diagnostic testing and planning based on an individual's characteristics. Characteristics measured include: age, sex, type of chest pain, comorbidities, smoking history and Coronary Calcium Scale (if available). The Diamond and Forrester model and the Duke clinical score are two examples of pre-test probability scoring tools that are often recommended to estimate the pretest probability of CAD in patients presenting with stable chest pain. Pretest probability tools may be found at https://qxmd.com/calculate/calculator_287/pre-test-probability-of-cad-cad-consortium. [2]

Transesophageal echocardiography (TEE) uses high-frequency sound waves (ultrasound) to make detailed pictures of the heart and the arteries that lead to and from it. Unlike a standard echocardiogram, the echo transducer that produces the sound waves for TEE is attached to a thin tube that passes through your mouth, throat, and into your esophagus. The esophagus is close to the upper chambers of the heart and clear images of those heart structures and valves can be obtained. [3]

Transthoracic Echocardiogram (TTE) an echocardiogram (ECHO) involves placing a device called a transducer on the chest. The device sends ultrasound waves through the chest wall to the heart. As the ultrasound waves bounce off the structures of the heart, a computer converts them into pictures on the computer screen. An ECHO uses sound waves to create pictures of the heart chambers, valves, walls and the blood vessels attached to your heart. The test is also called echocardiography or diagnostic cardiac ultrasound. [4]

[2]Calculate by QxMD, "Pre-test probability of CAD (CAD consortium)." [Online]. Available: https://qxmd.com/calculate/calculator_287/pre-test-probability-of-cad-cad-consortium; Diamon GA, Forrester JS. Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease. New England Journal of Medicine 1979 June 14, 300(24): 1350-8.
[3]American Heart Assocation (AHA). "Health Topics." [Online]. Available: www.heart.org
[4]American Heart Association (AHA). "Health Topics." [Online]. Available: www.heart.org

Disclaimer

Purpose

The purpose of the clinical guidelines is to assist healthcare professionals in selecting the medical service that may be appropriate and supported by evidence to improve patient outcomes. These clinical guidelines neither preempt clinical judgment of trained professionals nor advise anyone on how to practice medicine. Healthcare professionals using these clinical guidelines are responsible for all clinical decisions based on their assessment.

Medical Evidence and Clinical Review

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