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American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET

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PREAMBLE

Many patients with suspected or known coronary artery disease (CAD) benefit from the information provided by a noninvasive cardiac imaging test. Cardiac imaging tests can provide information regarding the presence, extent, and severity of CAD, estimate risk for early and late major adverse cardiac events, and assist in determining the most appropriate treatment, including medical therapy and/or coronary revascularization. Valuable information can also be provided from a normal scan result that can obviate the need for further cardiac tests, reduce unnecessary medication expenses, lead to expeditious referrals for assessment of other causes of symptoms, and relieve anxiety over potential life-threatening etiologies for symptoms.

An important goal of imaging is to provide a high-quality appropriate test for the right patient at the right time. There needs to be confidence and certainty in distinguishing normal from an abnormal study, and avoidance of equivocal interpretations which would result in redundant testing, delay of timely care, and increased downstream cost. This is consistent with the Centers for Medicare & Medicaid Services (CMS) implementation of quality initiatives to assure quality health care. These goals include effective, safe, efficient, patient-centered, equitable, and timely care. The imaging properties of myocardial perfusion positron emission tomography (PET) meet all of these quality goals. PET myocardial perfusion imaging is effective (high diagnostic accuracy), safe (low radiation exposure), efficient (short, 5-min image acquisition times), and patient-centered (accommodates ill or higher-risk patients as well as those with large body habitus), providing equitable (independent of patient characteristics and condition) and timely care.

Among available noninvasive cardiac imaging options, the American Society of Nuclear Cardiology and the Society of Nuclear Medicine and Molecular Imaging have noted significant underutilization of myocardial perfusion PET relative to its demonstrated advantages for patients being assessed for suspected clinically important CAD, and to its current wide availability in the United States. The purpose of this joint Society Recommendation is to succinctly summarize the properties that make myocardial perfusion PET most useful in the diagnosis and management of the CAD patient, and to provide general guidance as to when it should be considered for optimal patient care.

IMPORTANT PROPERTIES OF MYOCARDIAL PERFUSION PET

1. **High diagnostic accuracy:** Myocardial perfusion PET has high sensitivity and specificity for angiographically significant obstructive CAD, and has been shown in meta-analyses to outperform other noninvasive approaches. Its high sensitivity improves recognition of multivessel CAD, and its high specificity improves recognition of absence of multivessel CAD. Furthermore, the combination of information gained from consistent and high-quality perfusion images, peak stress regional and global contractile function, and quantitation of myocardial blood flow permits identification of very low-risk patients that can obviate the need for further cardiac tests, reduce unnecessary medication expenses, lead to expeditious referrals for assessment of other causes of symptoms, and relieve anxiety over potential life-threatening etiologies for symptoms. The presence of coronary artery calcium can also be identified when patients are imaged using a PET/CT scanner, ensuring that an otherwise normal perfusion scan is not misinterpreted by patients and referring physicians as indicating absence of any CAD.
2. **Consistent high-quality images:** Myocardial perfusion PET images have high myocardial counts, high spatial and contrast resolution, high signal-to-noise ratio, and accurate and reliable correction for the effects of tissue attenuation and scatter.

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Image quality is relatively unaffected by body shape or size, distinguishing PET from all other cardiac imaging modalities.

3. **Low radiation exposure:** A complete rest-stress myocardial perfusion PET scan routinely exposes patients to less than 5 mSv and as little as 1 mSv effective dose using 3D imaging protocols, well below levels known to be associated with long-term adverse effects, and low in comparison to most radiation-based cardiac assessments. This is an important safety concern for patients with established CAD, who are likely to be repetitively exposed over their lifetimes to radiation-based studies, and to younger patients with longer time frames for cancers to develop.
4. **Short acquisition protocols:** A complete rest-stress study can be acquired in less than one hour if rubidium-82 is used. In addition to the obvious convenience to patients, this is an advantage for acutely ill or high-risk patients, such as those in emergency departments or acute chest pain units. The 5-min acquisition times are also helpful for those patients who find it difficult to remain still for more than a few minutes, reducing the likelihood of nondiagnostic scans due to patient motion artifact.
5. **Quantification of myocardial blood flow:** Blood flow quantification at rest and stress is used to measure myocardial flow reserve. It allows verification of adequate stress response, further improving interpretation confidence. Regional flow reserve shows the physiological significance of epicardial CAD, analogous to invasive fractional flow reserve (FFR). In the absence of epicardial CAD, flow reserve allows the assessment of microcirculatory function. The ability to routinely quantify myocardial blood flow in ml/min/gram is unique to PET and improves accuracy, risk stratification, and patient selection for interventions.
6. **Strong prognostic power:** Myocardial perfusion PET, particularly when myocardial blood flow data are included, provides high discrimination between different levels of risk in all patient populations for whom myocardial perfusion imaging is appropriate, including obese and nonobese people, men and women, diabetics, and patients with renal dysfunction.

All of the above properties are generally applicable to both dedicated PET and PET/CT scanners. In the case of the increasingly used PET/CT scanners, in which low-dose CT is used to generate a transmission map for attenuation correction, coronary artery calcium can also be identified, without any additional radiation exposure.

CLINICAL INDICATIONS

The American Society of Nuclear Cardiology and the Society of Nuclear Medicine and Molecular Imaging have concluded that the properties of myocardial perfusion PET according to the published literature are sufficient to advance recommendations for its use in clinical practice. These recommendations are general in intent and should not be interpreted as either inclusive or exclusive of specific clinical scenarios. However, they reflect the current understanding based on extensive clinical investigations as to when myocardial perfusion PET will provide best clinical value.

i. **Preferred:** Rest-stress myocardial perfusion PET is a first line preferred test for patients with known or suspected CAD who meet appropriate criteria for a stress imaging test and are unable to complete a diagnostic-level exercise stress imaging study. There are no clinical scenarios where PET should not be considered a preferred test for patients who meet appropriate criteria for a stress imaging test and who require pharmacologic stress.

ii. **Recommended:** Rest-stress myocardial perfusion PET is recommended for patients with suspected active CAD, who meet appropriate criteria for a stress imaging test, and who also meet one or more of the following criteria:

a. Prior stress imaging study that was of poor quality, equivocal or inconclusive, affected by attenuation artifact, or discordant with clinical impressions or other diagnostic test results including findings at coronary angiography.
b. Body characteristics that commonly affect image quality. Some examples include large breasts, breast implants, obesity (BMI greater than 30), protuberant abdomen, chest wall deformities, pleural effusions, and inability for proper body positioning such as inability to position arms outside of a SPECT scanner's field of view.
c. High-risk patients in whom diagnostic errors carry even greater clinical implications. Some examples include chronic kidney disease stage 3, 4, or 5; diabetes mellitus; known or suspected potentially high-risk CAD such as left main, multivessel, or proximal LAD disease or when extensive coronary disease is known such as following coronary bypass surgery or coronary interventions; suspected transplant coronary vasculopathy; when ischemia is suspected in patients with left ventricular dysfunction; and patients for whom revascularization carries increased morbidity and mortality risk.
d. Young patients with established CAD who are anticipated to need repeated exposures to radiation-associated cardiac imaging procedures, in order to minimize accumulated life-time exposure.
e. Patients in whom myocardial blood flow quantification is identified by clinicians to be a needed adjunct to the image findings, to better identify or exclude multivessel CAD, for improved risk stratification, and when assessment of microcirculatory function is needed for clinical decision making.

CONCLUSION

The purpose of this joint Society Position Statement is to highlight the attributes that make rest-stress myocardial perfusion PET both **Preferred** and **Recommended** in the era of high-value initiatives for appropriate patients. Myocardial perfusion PET image quality, high diagnostic accuracy that is relatively independent of body habitus, ability to accurately risk stratify patients with a wide array of clinical presentations, short acquisition times, safety by virtue of low radiation exposure, and its unique ability to quantify myocardial blood flow are all significant and clinically important properties. The American Society of Nuclear Cardiology and the Society of Nuclear Medicine and Molecular Imaging encourage providers to consider this imaging option for appropriate clinical situations.

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Note: The American Society of Nuclear Cardiology maintains a comprehensive and up-to-date listing of key references in myocardial perfusion PET that can be accessed at www.asnc.org