The Clinical Value of SPECT in Evaluating Coronary Artery Disease

Frontline providers are increasingly responsible for a growing, aging population at risk for coronary artery disease (CAD).

Those who see at-risk patients first may be more involved in disease evaluation and care coordination for appropriate cardiac testing.

The more we understand about the noninvasive cardiac testing options available, the more we can work together to help improve the quality of care for what matters most—the patient.

Putting It Into PerSPECTive

- An estimated 126 million US adults ≥20 years of age have some form of cardiovascular disease (CVD)\(^1\)
- CAD is the leading cause of CVD death in the US\(^1\)
- Risk of CAD increases over time as the progression of atherosclerosis (plaque buildup) partially or totally blocks myocardial perfusion to the heart\(^2,3\)
- Single-photon emission computed tomography (SPECT) can detect perfusion defects early in the disease progression\(^4\)
Why SPECT?

For more than 40 years, noninvasive myocardial perfusion imaging (MPI) has been used to detect and manage CAD.¹

SPECT is the most widely used nuclear imaging modality and plays an essential role in the risk assessment and evaluation of CAD.²

Whether you are a frontline provider³ or a cardiology specialist, the more you know about the most commonly used imaging procedure in nuclear cardiology, the better you’ll understand which patients are appropriate candidates for the test.⁴,⁵

inSPECTing the Name

You may have heard SPECT MPI referred to as one of the following terms:

- Radionuclide imaging (RNI)
- Nuclear stress test
- Noninvasive cardiac imaging
- Cardiac nuclear scan

³Frontline providers are the first to see patients at risk for CAD and may include primary care physicians (PCPs), obstetricians/gynecologists (OB/GYNs), internists, hospitalists, nurse practitioners (NPs), physician assistants (PAs), or other referring or ordering providers.
SPECT Imaging

SPECT scans are taken using a gamma camera, which captures images of photons emitted by radiotracers as they are taken up by viable myocytes proportional to the amount of blood flow to the heart. The radiotracers used in SPECT imaging are technetium-99m (Tc-99m) and thallium-201 (Tl-201). A series of images is taken to show different sections of the heart. Scans may be performed at stress and rest (Figure 1).\(^5\)\(^,\)\(^7\)\(^,\)\(^8\)

The color indicates areas of perfusion where the radiotracer has entered the myocardium. Areas that appear lighter in color at rest and darker during stress indicate stress-induced ischemia, where blood flow is blocked.\(^7\)

SPECT MPI is widely available and accessible for patients who have known or suspected heart disease.\(^6\)

Images courtesy of Kim Allan Williams, MD.
Attributes of SPECT

This advanced diagnostic cardiac imaging procedure provides valuable risk assessment information that is incremental to electrocardiogram (ECG) data. SPECT MPI helps guide clinical management decisions regarding medical management or revascularization.

When a patient’s pretest probability for CAD is intermediate to high based on risk assessment, SPECT MPI may be an appropriate modality.

Why Use SPECT?

- It can be performed with exercise or pharmacologic stress
- SPECT can help show perfusion defects in the early stages of the ischemic cascade

Clinical benefits should be weighed against potential risks, which may include radiation exposure, injury, and interpretation error. The amount of radiation used in cardiac testing with SPECT varies by protocol. Guideline-based appropriate use criteria (AUC) may help define appropriate SPECT tests for certain clinical scenarios.
What SPECT Reveals

As a functional imaging test, SPECT can help detect perfusion defects and risk stratify patients.\textsuperscript{4,5}

### What SPECT Can Do

- Uncover transient ischemic dilation, which may be associated with extensive ischemia and severe CAD\textsuperscript{4,5}
- Identify reversible perfusion defects indicating ischemia and irreversible perfusion defects indicating prior infarction\textsuperscript{5}
- Provide estimates of left ventricular ejection fraction, adding incremental prognostic information\textsuperscript{5}
- Help identify severe multivessel disease\textsuperscript{5}
- Assess perfusion status after cardiac procedures\textsuperscript{5}

### Risk Stratification

The extent and severity of stress-induced perfusion abnormalities are directly correlated with the degree of risk for ischemic events, namely cardiovascular death and myocardial infarction (MI).\textsuperscript{4}

- Normal test results are associated with a very low annual risk for cardiovascular death or MI (<1%)
- Moderate to severe abnormalities are associated with an annual risk for cardiovascular death or MI of ≥5%

Imaging results can help determine the need for further evaluation or procedures (e.g., coronary angiogram, stent, bypass surgery, medical therapy).\textsuperscript{5,10} Gathering ECG information and data on exercise capacity is also important for diagnosis and prognosis.\textsuperscript{4}
What SPECT Reveals

SPECT Scan Analysis

Figure 2 shows how sections of the myocardium are imaged in 3 axes to view perfusion defects at different angles.\textsuperscript{5}

Figure 2. SPECT Scan Analysis

Images courtesy of Kim Allan Williams, MD.
Ischemic Cascade

Figure 3 shows where a SPECT scan can detect perfusion defects in the ischemic cascade.\(^4\)
**What SPECT Reveals**

**SPECT Perfusion Defects**

Figure 4 shows how perfusion defects may be reversible, with perfusion abnormalities at stress and normal perfusion at rest, or fixed, with perfusion defects visible on both stress and rest images, indicating greater risk for MI.  

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**Figure 4. SPECT Perfusion Defects**

- **Reversible**
  - Stress
  - Rest

- **Fixed**
  - Stress
  - Rest
Advances in SPECT Scanners and Software

SPECT continues to be a valuable tool in the evaluation and risk assessment for CAD.\textsuperscript{5,6}

Recently, several enhancements have been made to SPECT camera hardware and software.\textsuperscript{5}

- New cameras acquire images in a fraction of the time and improve image quality\textsuperscript{5,6}
- Rapid protocols reduce the amount of radiotracer needed, cutting radiation exposure by half\textsuperscript{5}
- Novel reconstruction algorithms lead to better spatial resolution and improved accuracy\textsuperscript{5}
- New techniques and multiposition imaging help minimize motion artifacts and improve patient comfort and tolerability\textsuperscript{5}
- New cameras allow for simultaneous imaging and quantification of myocardial blood flow, which is used to detect microvascular disease\textsuperscript{5}

Recent advances greatly expand the clinical applications for SPECT.\textsuperscript{5}
Appropriate Patients for SPECT

SPECT is a noninvasive imaging test that can help evaluate patients at risk for CAD. But how do you know whether a SPECT test is right for your patient?

The ACCF Multimodality AUC provide recommendations for performing the right test on the right patient at the right time.

The ultimate objective is to improve patient care and health outcomes in a cost-effective manner.

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ACCF = American College of Cardiology Foundation.
### Appropriate Patients for SPECT

**Determining Who Is Appropriate for a SPECT Test**

According to the ACCF Multimodality AUC, SPECT can be considered an appropriate test for the following indications.\(^9\)

<table>
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<tr>
<th>Patients with symptoms and</th>
<th>Patients with or without symptoms and</th>
<th>Patients with poor or unknown functional capacity and</th>
<th>Patients with new or worsening symptoms and</th>
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<td>An uninterpretable ECG,</td>
<td>Other cardiovascular conditions (such as newly diagnosed heart failure or syncope and intermediate to high CAD risk), or In postrevascularization for evaluation of ischemic equivalent symptoms or where additional revascularization is feasible</td>
<td>Prior to kidney or liver transplant, or Prior to vascular surgery with ≥1 clinical risk factors</td>
<td>Normal or abnormal exercise ECG results, Nonobstructive CAD on angiography or normal prior stress imaging study results, Obstructive CAD on coronary computed tomography angiography (CCTA) or invasive coronary angiography, or Abnormal calcium score (Agatston score &gt;100)</td>
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Appropriate Patients for SPECT

Determining Who Is Appropriate for a SPECT Test

According to the ACCF Multimodality AUC, SPECT can be considered an appropriate test for the following indications.\(^9\)

- Patients with abnormal prior results (≤90 days) and
  - Abnormal rest ECG, or
  - Abnormal prior exercise ECG test, or
  - Obstructive CAD on prior CCTA or prior invasive coronary angiography, or
  - Abnormal prior CCT calcium (Agatston Score >100)

- Patients with uncertain prior results (≤90 days) and
  - Prior exercise ECG test, or
  - Prior CCTA, or
  - Prior angiography showing coronary stenosis or anatomic abnormality of unclear significance

Appropriate SPECT testing has important implications for clinical decision-making. Perfusion data provide prognostic information about risk for a cardiac event, which may affect patient management choices.\(^5\)
Preparing Patients for SPECT Imaging

Once SPECT has been deemed appropriate, it is important to prepare patients for the test by helping them understand what is expected (Figure 5).

**Figure 5. What Patients Can Expect During a SPECT Test**

**Stress Test**
Patient ECG, heart rate, and blood pressure are monitored during stress. While exercise is the preferred stress method, patients who are unable to achieve adequate exercise should be given a pharmacologic stress agent. Pharmacologic stress simulates exercise effects by increasing blood flow to the heart.⁴,⁷

**Radiotracer Injection**
A small amount of radioactive tracer is injected into the patient’s arm. The radiotracer is distributed throughout the myocardial tissue proportional to blood flow.⁵

**Radionuclide Imaging**
A gamma camera captures images of myocardial perfusion after stress and at rest for comparison, if needed.⁵,⁷

To help your patients prepare for a stress test, download educational resources from the [Resources](#) section.
For more than 25 years, Astellas has offered practical resources to help providers make decisions focused on patient-centered care. The educational materials are designed to help increase understanding of cardiac testing and encourage communication between providers—all to help each patient get the right cardiac test at the right time.

For the latest information about cardiovascular care, go to AllForOneCardiovascular.com. There you can:

- Read about risk assessment and AUC
- Learn about potential nuclear lab challenges and ways to help overcome them
- Download and review hypothetical patient scenarios
- Download educational resources for your patients and practice

This image may not reflect the most current version of the website.
Resources About Cardiac Testing

Patient Resources

Download these educational resources to help your patients prepare for a stress test, which can help avoid delays and improve the patient experience.

Patient Heart Imaging Test Guide

Getting Ready Patient Handout

Patient Prep Test Checklist

These images may not reflect the most current versions of the educational resources.
Download the Multimodality AUC App. Based on the ACCF/AHA Multimodality AUC, this app allows providers to review the appropriateness of 7 cardiac testing modalities for the detection and risk assessment of stable ischemic heart disease.

AHA = American Heart Association.

The Multimodality AUC App is not intended to diagnose, treat, or prevent any disease or condition. It is also not a qualified Clinical Decision Support Mechanism (CDSM). Thus, the Multimodality AUC App must not be used to try and comply with the Centers for Medicare & Medicaid Services (CMS) AUC program requirements. The Multimodality AUC App is for informational purposes only.


