



## Evaluating Appropriateness for Cardiac Radionuclide Imaging

### OVERVIEW

The purpose of this document is to specifically identify an approach to the appropriate selection of patients for cardiac radionuclide procedures and to provide information that serves as a standard for all nuclear cardiology laboratories. This document will cover the appropriate use of cardiac radionuclide imaging (RNI) in patients who are with and without symptoms; patients with prior cardiac imaging studies; pre-operative patients undergoing non-cardiac surgery; patients' status after an acute coronary syndrome or revascularization procedure (percutaneous coronary intervention [PCI] or coronary artery bypass grafting [CABG]); and patients primarily undergoing viability assessment or left ventricular (LV) function evaluation.

### BACKGROUND

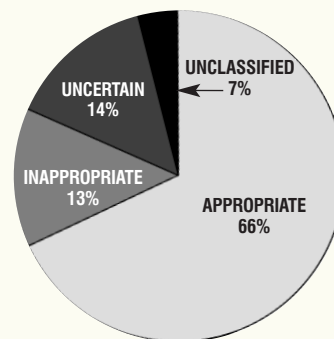
Over the last decade, there has been a marked increase in the use of all medical imaging procedures, including cardiac radionuclide procedures. This has led to increased scrutiny into the appropriate utilization of these procedures. In an effort to guide physicians in the appropriate use of imaging procedures, the American College of Cardiology Foundation (ACCF), in conjunction with the American Society of Nuclear Cardiology (ASNC) and other imaging societies, has published various appropriateness criteria documents including the recently updated *Appropriate Use Criteria for Cardiac Radionuclide Imaging* (AUC for RNI). These criteria identify 67 common indications for radionuclide imaging, and define each as Appropriate, Inappropriate, or Uncertain. The purpose of this document is to summarize these criteria and provide a guide to the appropriate selection of patients for RNI procedures.

### SUMMARY OF CURRENT UTILIZATION OF CARDIAC RADIONUCLIDE IMAGING

Recently, the results of the ACCF and UnitedHealthcare SPECT Pilot study were presented. This multicenter study used point-of-service data collection to track the clinical application of the original 2005 ACCF/ASNC *Appropriateness Criteria for Single Photon Emission Computed Tomography Myocardial Perfusion Imaging* (SPECT MPI) in an effort to determine current patterns of use. Of the 6,351 tests studied, 66% were Appropriate, 14% were Uncertain, 13% were Inappropriate, and 7% were Unclassified (See Figure 1). Among Inappropriate studies, variation between the different sites was noted (range 4-22%).

Figure 1.

ACCF/United Healthcare SPECT Pilot Study Appropriateness Classification (n = 6,351)



The top five Inappropriate indications, that accounted for 95% of all Inappropriate studies, were:

1. Detection of coronary artery disease (CAD) in asymptomatic, low coronary heart disease (CHD) risk patients (46%)
2. Asymptomatic patients, post-revascularization, less than 2 years after PCI, symptoms before PCI (25%)
3. Evaluation of chest pain, low probability patient, interpretable electrocardiogram (ECG), and ability to exercise (16%)



## Evaluating Appropriateness for Cardiac Radionuclide Imaging *continued*

- Patients who are asymptomatic or who have stable symptoms, known CAD, less than 1 year after cath or abnormal prior SPECT (4%)
- Pre-operative assessment, low-risk surgery (4%)

### APPROACH TO SYMPTOMATIC PATIENTS

In the AUC for RNI, symptoms include any “Ischemic Equivalent,” which is defined as a chest pain syndrome, an anginal equivalent, or any ischemic ECG abnormalities.

For patients with symptoms, the AUC for RNI requires the assessment of their pre-test probability of CAD. This can be performed with a variety of algorithms, including a modification of the Diamond and Forrester criteria (See Figure 2).

Among patients with acute chest pain in whom an acute coronary syndrome is possible but not confirmed, RNI is Appropriate in patients without acute ischemic ECG changes—provided that peak troponin levels are normal or no more than minimally elevated.

The appropriateness level of selected indications in symptomatic patients is:

#### Appropriate

- All patients with an ischemic equivalent (defined as a chest pain syndrome, an anginal equivalent, or any ischemic ECG abnormalities) who have an intermediate or high pre-test probability of CAD
- Patients with a low pre-test probability who have an uninterpretable ECG or who are unable to exercise
- Patients with acute chest pain/possible acute coronary syndrome, without acute ischemic ECG changes—provided that peak troponin levels are normal or no more than minimally elevated

#### Inappropriate

- Patients with an ischemic equivalent but low pre-test probability who have an interpretable ECG and are able to exercise
- Definite acute coronary syndrome

### APPROACH TO ASYMPTOMATIC PATIENTS

In patients without symptoms, the AUC for RNI requires pre-test risk assessment using the Framingham risk scoring, as reported in the Adults Treatment Panel III (ATP III). The absolute risk of developing myocardial infarction or cardiac death over the next 10 years is defined as low (<10%), intermediate (10-20%), or high (> 20%). RNI is considered Appropriate in asymptomatic, high CHD risk patients. Patients with low CHD risk are Inappropriate for RNI, and

Figure 2. Pre-test Probability of CAD by Age, Gender, and Symptoms\*

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain	Asymptomatic
< 39	Men	Intermediate	Intermediate	Low	Very low
	Women	Intermediate	Very low	Very low	Very low
40 - 49	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Low	Very low	Very low
50 - 59	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Intermediate	Low	Very low
> 60	Men	High	Intermediate	Intermediate	Low
	Women	High	Intermediate	Intermediate	Low

**High:** Greater than 90% pre-test probability      **Intermediate:** Between 10% and 90% pre-test probability  
**Low:** Between 5% and 10% pre-test probability      **Very Low:** Less than 5% pre-test probability

\* The table has been modified to reflect all age ranges.

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were the most common Inappropriate indication in the ACCF/United Healthcare SPECT Pilot (See Figure 3).

There are additional groups of patients who may not have “ischemic equivalent,” but have other findings that justify RNI. Patients with newly diagnosed LV systolic dysfunction, ventricular tachycardia, or an elevated troponin without evidence of acute coronary syndrome are Appropriate for RNI independent of Framingham risk scoring.

The appropriateness level of selected indications in asymptomatic patients or patients without any ischemic equivalent is:

#### Appropriate

- Asymptomatic high CHD risk patients, including



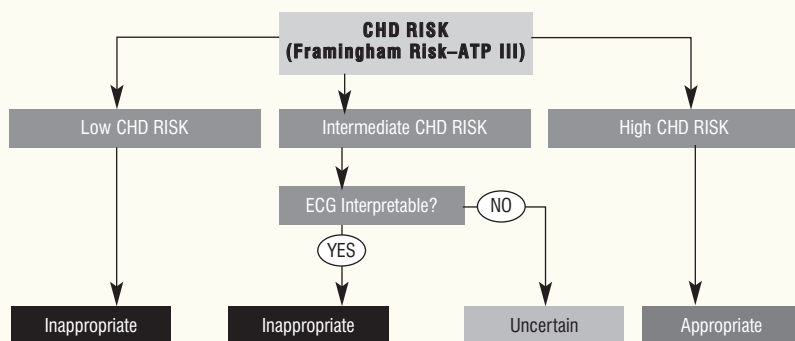
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patients with diabetes mellitus and peripheral artery disease

2. Patients with new-onset or newly diagnosed heart failure with LV systolic dysfunction, no prior CAD evaluation, and no planned coronary angiography
3. Patients with ventricular tachycardia

Figure 3.

### Asymptomatic\* Patients



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4. Patients with elevated troponin without additional evidence of acute coronary syndrome
5. Intermediate or high CHD risk patients with syncope and without any ischemic equivalent

### **Inappropriate**

1. Low CHD risk patients who are asymptomatic
2. Low CHD risk patients with syncope without any ischemic equivalent
3. Intermediate CHD risk patients with an interpretable ECG

### **APPROACH TO THOSE WITH PRIOR TEST RESULTS/KNOWN CHRONIC STABLE CAD**

If available, the results of a prior stress imaging study will impact the appropriateness for a subsequent RNI. Important factors include the presence of any new or worsening symptoms and the length of time since the prior study was performed. The AUC for RNI suggest that it is Inappropri-

ate to repeat a stress imaging test within 2 years, regardless of whether the initial stress imaging test was normal or abnormal, unless new or worsening symptoms have developed.

The appropriateness level of selected indications in patients with prior test results or known chronic stable CAD is:

### **Appropriate**

1. Patients with new or worsening symptoms and a prior abnormal imaging study or prior abnormal coronary angiogram
2. Patients with equivocal, borderline, or discordant stress imaging results when obstructive CAD remains a concern
3. Patients with a coronary stenosis of uncertain significance
4. Any patient with prior coronary CT calcium score (Agatston Score) > 400 or high CHD risk patient with an Agatston Score between 100 and 400
5. Patients with an intermediate- or high-risk Duke treadmill score on routine stress ECG testing

### **Inappropriate**

1. Patients with any normal prior stress imaging results who have a low CHD risk by Adult Treatment Panel (ATP) III criteria, and are asymptomatic or have stable symptoms
2. Patients with normal prior stress imaging results less than 2 years ago who are at intermediate to high CHD risk by ATP III criteria and are asymptomatic or have stable symptoms

### **APPROACH TO PRE-OPERATIVE RISK STRATIFICATION**

The appropriateness of the RNI for pre-operative risk stratification established in the AUC for RNI closely follows the recently updated ACC/AHA 2007 *Peri-operative Guidelines*. These guidelines recommend a stepwise approach to peri-operative cardiac assessment, primarily emphasizing the risk level of the proposed non-cardiac



### Evaluating Appropriateness for Cardiac Radionuclide Imaging *continued*

surgery. The functional capacity and presence of clinical risk factors must also be assessed among patients undergoing intermediate- or high-risk surgical procedures (including vascular surgery).

The AUC for RNI for pre-operative risk stratification are:

#### Appropriate

1. Intermediate-risk surgery or vascular surgery patients with one or more clinical risk factors\* **AND** poor or unknown functional capacity (< 4 METS)

#### Inappropriate

1. All low-risk surgery patients
2. Any patient with moderate to good functional capacity ( $\geq$  to 4 METS)
3. Any patient without peri-operative clinical risk factors\*
4. Asymptomatic patients up to 1 year post normal catheterization, noninvasive testing, or previous revascularization

\* History of ischemic heart disease, compensated or prior heart failure, cerebrovascular disease, diabetes mellitus requiring insulin, or renal insufficiency (creatinin >2.0).

### APPROACH TO PATIENTS WITHIN 3 MONTHS OF ACS

Among patients who are within 3 months of an acute coronary syndrome (ACS), RNI may be appropriate for risk stratification in patients who did not undergo coronary angiography.

The appropriateness level of selected indications in patients within 3 months of ACS is:

#### Appropriate

1. Risk stratification in patients within 3 months of ACS who are stable, have no recurrent chest pain symptoms, and who did not undergo coronary angiography

#### Inappropriate

1. Patients within 3 months of ACS who have undergone complete revascularization and are without recurrent symptoms

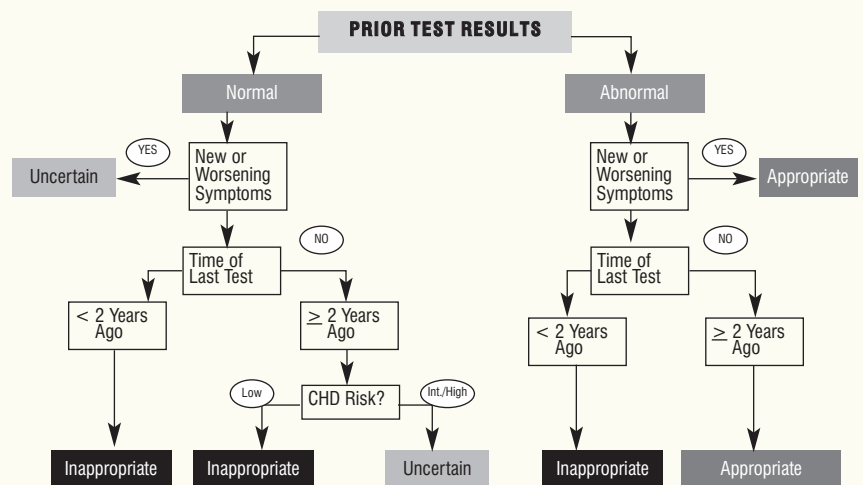
2. Patients within 3 months of ACS who are unstable and in whom coronary angiography would be preferable
3. RNI for the purpose of enrollment in cardiac rehabilitation, where an exercise ECG stress test would be preferable

### APPROACH TO PATIENTS POST REVASCULARIZATION

After a prior revascularization procedure (PCI or CABG), RNI is an appropriate test for risk assessment when new symptoms are present. In absence of new symptoms, the

Figure 4.

Prior Test Results\*



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appropriateness of RNI is less certain, but generally depends on the time interval since PCI or CABG.

The appropriateness level of selected indications in patients after revascularization is:

#### Appropriate

1. Patients post revascularization with a new ischemic equivalent (chest pain syndrome, anginal equivalent, or ischemic ECG abnormalities)
2. Patients with prior incomplete revascularization in whom additional revascularization is feasible



## Evaluating Appropriateness for Cardiac Radionuclide Imaging *continued*

3. Patients 5 years or more after CABG

### **Inappropriate**

1. Patients less than two years after PCI without new symptoms or ischemic equivalent
2. RNI for the purpose of enrollment in cardiac rehabilitation, where an exercise ECG stress test would be preferable

### **OTHERS (VIABILITY, LV FUNCTION EVALUATION)**

There are a variety of other common indications for RNI, including its use for evaluation of viability and LV function.

The appropriateness level of selected indications for viability assessment and evaluation of LV function is:

### **Appropriate**

1. Viability assessment in patients with severe LV dysfunction who are eligible for revascularization
2. Serial assessment of LV function with radionuclide angiography (RNA) (equilibrium RNA or first-pass RNA [FPRNA]) at baseline or serially after potentially cardiotoxic therapy (e.g. Doxorubicin)
3. Routine use of rest/stress ECG-gating with SPECT or positron emission tomography (PET) MPI

### **Inappropriate**

1. Routine use of rest/stress FPRNA in conjunction with rest /stress gated SPECT MPI

### **SUGGESTED READING**

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