New Challenges in Nuclear Cardiology Practice

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President, ASNC 2016

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Director, Cardiovascular Imaging
Cardiovascular Institute, Rhode Island, Miriam and Newport Hospitals
Providence, Rhode Island, USA
New Challenges in Nuclear Cardiology Practice

• Training and education (PET)
• Isotope shortages
• Appropriate use
• Emerging technologies and techniques
• Radiation dose reduction strategies
• International Growth of Nuclear Cardiology
Nuclear Cardiology Training
USA

- Cardiologists learn Nuclear Cardiology as part of Cardiology Fellowship
- Some Nuclear Medicine and Radiologists
- Most Nuclear Cardiology is outpatient SPECT with small “Cardio-focal” cameras
- Compared to other countries less coronary angiography as first test
- CTA being used more widely
AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY AND SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR IMAGING JOINT POSITION STATEMENT ON THE CLINICAL INDICATIONS FOR MYOCARDIAL PERFUSION PET

Writing Group:
Timothy M. Bateman MD (Co-Chair), Vasken Dilsizian MD (Co-Chair), Rob S. Beanlands MD, E. Gordon DePuey MD, Gary V. Heller MD, PhD, David A. Wolinsky MD

ASNC imaging guidelines/SNM/MI procedure standard for positron emission tomography (PET) nuclear cardiology procedures

Vasken Dilsizian, MD, Stephen L. Bacharach, PhD, Rob S. Beanlands, MD, Steven R. Bergmann, MD, PhD, Dominique Delbeke, MD, Sharmila Dorbala, MD, MPH, Robert J. Gropler, MD, Juhani Knuuti, MD, PhD, Heinrich R. Schelbert, MD, PhD, and Mark I. Travin, MD
US Training Guidelines in Nuclear Cardiology
(for Cardiologists)

• Focus on SPECT MPI
  – Principles of imaging, interpretation
  – Radiation safety

• Limited access to Cardiac PET
  – Only a minority of the 190 Cardiology Fellowships have Cardiac PET

• Gain knowledge rather than experience

• ASNC- PET Curriculum and Certification
Cardiac PET

• Perfusion (Rb-82 or N-13 NH3)
• Quantitative Myocardial Blood Flow
• PET perfusion and CTA anatomy
• Sarcoidosis with FDG-PET
• Amyloidosis with Tc-99m Pyrophosphate
Hybrid PET/CTA

A: Normal
B: RCA, mild defect elsewhere
C: LAD, large anterior defect
D: No CAD, diffuse abnormal CFR

Danad et al, J Nucl Cardiol 2013
Rb-82 PET Flow Quantification

Adjusted Cardiac Event Free Survival

Event rate (%/year)

Days

0.75 0.80 0.85 0.90 0.95 1.00

SSS<4 MFR<2
SSS≥4 MFR≥2
SSS<4 MFR<2
SSS≥4 MFR<2

* SSS<4 MFR<2 vs ≥2:
HR 2.4 (1.4, 4.4) P=0.003

** SSS≥4 MFR<2 vs ≥2:
HR 4.6 (2.2, 9.7) P<0.001

Ziadi M. JACC 2011;58:740
PET Imaging Cardiac Sarcoidosis

Rb82

FDG
PET Imaging Cardiac Amyloidosis
Tc-99m Pyrophosphate

Differentiation of Amyloid Types

Control  AL  TTR

Florbetapir PET/CT
PYP SPET/CT
Amnion PET/CT

Amyloid
TTR
Perfusion
Potential Required for Cardiac PET Training

• Development of Clinical Competency statement specific to PET
• Identification of PET training sites
• Enhanced educational opportunities in PET for life long learning, CME
• Technologist training
  – PET as part of Nuclear Medicine
  – Training in CT
Challenges in Nuclear Cardiology Practice

• Training and Education
• Isotope shortages
• Appropriate use
• Emerging technologies and techniques
• Radiation dose reduction strategies
• International Growth of Nuclear Cardiology
Concerning Pattern: Decreasing Rate of Technetium Use

Proportion of SPECT MPI with Tc-99m

Moly-99M Shortage

Rate of Catheterization within 90 Days After SPECT MPI

Murthy, et al. JAMA Cardiology 2016 1:616-7
Medicare Trends: Alternative Testing

Murthy, et al. JAMA Cardiology 2016 1:616-7
Medicare Trends: Use of Tc-99 and Downstream Catheterization

During Shortage:
Odds Ratio of 1.09 [95% CI 1.07-1.10] for Downstream Cath

Excess of 5715 Cardiac Caths in Medicare Alone During 6 Months

Murthy, et al. JAMA Cardiology 2016 1:616-7
Strategies to Cope with Mo-99m Supply Disruption

- Reduce activity administered
  - Stress only/stress first imaging
  - Advanced reconstruction / CZT cameras

- Alternative testing
  - PET
  - CTA
  - Echo
  - MRI

- Thallium-201 SPECT
Challenges in Nuclear Cardiology Practice

• Training and Education
• Isotope shortages
• Appropriate use
• Emerging technologies and techniques
• Radiation dose reduction strategies
• International Growth of Nuclear Cardiology
Physician Specialty Appropriate and Inappropriate Use Rate

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Year</th>
<th>Specialist AUC</th>
<th>Specialist Inappropriate</th>
<th>Internist AUC</th>
<th>Internist Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress Echo 2008</td>
<td>Appropriate</td>
<td>0.57 (0.34, 0.79)</td>
<td>1 study</td>
<td>0.64 (0.53, 0.75)</td>
<td>1 study</td>
</tr>
<tr>
<td></td>
<td>Inappropriate/rarely appropriate</td>
<td>0.25 (0.03, 0.46)</td>
<td>1 study</td>
<td>0.06 (0.02, 0.096)</td>
<td>1 study</td>
</tr>
<tr>
<td>Stress Echo 2011</td>
<td>Appropriate</td>
<td>0.41 (0.35, 0.47)</td>
<td>2 studies</td>
<td>0.71 (0.54, 0.87)</td>
<td>2 studies</td>
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<tr>
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<td>Inappropriate/rarely appropriate</td>
<td>0.32 (0.26, 0.38)</td>
<td>2 studies</td>
<td>0.26 (0.19, 0.34)</td>
<td>2 studies</td>
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<tr>
<td>Stress MPI 2005</td>
<td>Appropriate</td>
<td>0.81 (0.58, 1.03)</td>
<td>2 studies</td>
<td>0.69 (0.44, 0.95)</td>
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<td>Inappropriate/rarely appropriate</td>
<td>0.09 (0.06, 0.12)</td>
<td>3 studies</td>
<td>0.16 (0.11, 0.21)</td>
<td>3 studies</td>
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<tr>
<td>Stress MPI 2009</td>
<td>Appropriate</td>
<td>0.73 (0.63, 0.83)</td>
<td>6 studies</td>
<td>0.69 (0.44, 0.95)</td>
<td>3 studies</td>
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<td>Inappropriate/rarely appropriate</td>
<td>0.15 (0.1, 0.19)</td>
<td>7 studies</td>
<td>0.24 (0.12, 0.46)</td>
<td>4 studies</td>
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</tbody>
</table>

Appropriate Use of Cardiac Stress Testing with Imaging: A Systematic Review and Meta-Analysis.
Teaching Appropriate Use

Stress SPECT Studies

Overall P=0.018
P=0.34
P=0.004
P=0.06

Inappropriate studies (%)

<table>
<thead>
<tr>
<th>Month</th>
<th>Inappropriate Studies</th>
</tr>
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<tbody>
<tr>
<td>May 2005</td>
<td>14.4</td>
</tr>
<tr>
<td>October 2006</td>
<td>7.0</td>
</tr>
<tr>
<td>March 2008</td>
<td>11.7</td>
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</tbody>
</table>

Rarely Appropriate Tests

Table 1.
Most Common Inappropriate Studies for Stress SPECT by Appropriateness Table and Specific Indication

<table>
<thead>
<tr>
<th>Appropriateness Table No.</th>
<th>Indication</th>
<th>Description</th>
<th>n  (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>10</td>
<td>Asymptomatic; low risk</td>
<td>45 (48)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Preoperative; intermediate-risk surgery, good exercise capacity</td>
<td>16 (17)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Symptomatic; low pretest probability, interpretable ECG, able to exercise</td>
<td>12 (13)</td>
</tr>
<tr>
<td>5</td>
<td>31</td>
<td>Preoperative; low-risk surgery</td>
<td>9  (10)</td>
</tr>
</tbody>
</table>

Percent listed is the percent of inappropriate studies (n=94). See Reference 8.
ASNC Joins Choosing Wisely® Campaign

An initiative of the ABIM Foundation, Choosing Wisely is focused on encouraging physicians, patients and other health care stakeholders to think and talk about medical tests and procedures that may be unnecessary, and in some instances can cause harm.

As part of the campaign, ASNC developed the following evidence-based recommendations that should be discussed to help make wise decisions about the most appropriate care based on a patient’s individual situation.

1. Don’t perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms unless high-risk markers are present.

Asymptomatic, low-risk patients account for up to 45 percent of inappropriate stress testing. Testing should be performed only when the following findings are present: diabetes in patients older than 42 years old, peripheral arterial disease, and greater than 2 percent yearly coronary heart disease event rate.

2. Don’t perform cardiac imaging for patients who are at low risk.

Chest pain patients at low risk of cardiac death and myocardial infarction (based on history, physical exam, electrocardiograms and cardiac biomarkers) do not merit stress radionuclide myocardial perfusion imaging or stress echocardiography as an initial testing strategy if they have a normal electrocardiogram (without baseline ST-abnormalities, left ventricular hypertrophy, pre-excitation, bundle branch block, intraventricular conduction delay, paced rhythm or on digoxin therapy) and are able to exercise.

3. Don’t perform radionuclide imaging as part of routine follow-up in asymptomatic patients.

Performing stress radionuclide imaging in patients without symptoms on a serial or scheduled pattern (e.g., every one to two years or at a heart procedure anniversary) rarely results in any meaningful change in patient management. This practice may lead to unnecessary invasive procedures and excess radiation exposure without any proven impact on patients’ outcomes. An exception to this rule would be for patients more than five years after a bypass operation.

4. Don’t perform cardiac imaging as a pre-operative assessment in patients scheduled to undergo low- or intermediate-risk non-cardiac surgery.

Non-invasive testing is not useful for patients undergoing low-risk non-cardiac surgery or with no cardiac symptoms or clinical risk factors undergoing intermediate-risk non-cardiac surgery. These types of testing do not change the patient’s clinical management or outcomes and will result in increased costs. Therefore, it is not appropriate to perform cardiac imaging procedures for non-cardiac surgery risk assessment in patients with no cardiac symptoms, clinical risk factors or who have moderate to good functional capacity.

5. Use methods to reduce radiation exposure in cardiac imaging, whenever possible, including not performing such tests when limited benefits are likely.

The key step to reduce or eliminate radiation exposure is appropriate selection of any test or procedure for a specific person, in keeping with medical society recommendations, such as appropriate use criteria. Health care providers should incorporate new methodologies in cardiac imaging to reduce patient exposure to radiation while maintaining high-quality test results.
Focus: Use Rates of Stress Echocardiography and MPI by Patient Enrollment Year

<table>
<thead>
<tr>
<th>Source</th>
<th>Enrollment year</th>
<th>Country</th>
<th>Np patients</th>
<th>appropriate (95% CI)</th>
<th>%</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress Echocardiography, AUC</td>
<td>2008-2010</td>
<td>USA</td>
<td>291</td>
<td>0.02 (0.01, 0.03)</td>
<td>22.8</td>
<td>100.00</td>
</tr>
<tr>
<td>Appropriate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Results:**
- The study included a total of 506 patients from various countries.
- The appropriate use rates varied from 0.02 to 0.63.
- The highest weight was assigned to studies with a larger sample size (Np patients).
- The percentage of appropriate use ranged from 13.0% to 95.4%.

**Graphical Representation:**
- The graph shows a distribution of appropriate use rates across different enrollment years.
- The X-axis represents the patient enrollment year, while the Y-axis shows the percentage of appropriate use.
- The shaded area represents the 95% confidence interval (CI) for each study.

**Discussion:**
- The data suggests a trend towards increased appropriate use rates over time.
- Further studies are needed to validate these findings and explore potential factors influencing appropriate use.
# Inappropriate/Rarely Appropriate Use Rates of Stress Echocardiography and MPI by Patient Enrollment Year

![Graph showing Inappropriate/Rarely Appropriate Use Rates of Stress Echocardiography and MPI by Patient Enrollment Year](image)

### Table: Source, Enrollment Year, Country, No. Currents, Inappropriate (95% CI), % Weight

<table>
<thead>
<tr>
<th>Source</th>
<th>Enrollment Year</th>
<th>Country</th>
<th>No. Currents</th>
<th>Inappropriate (95% CI)</th>
<th>% Weight</th>
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</thead>
<tbody>
<tr>
<td>McCullin et al., 2009</td>
<td>2006</td>
<td>USA</td>
<td>269</td>
<td>0.19(0.13, 0.25)</td>
<td>17.05</td>
</tr>
<tr>
<td>Nance et al., 2009</td>
<td>2009</td>
<td>USA</td>
<td>269</td>
<td>0.17(0.13, 0.23)</td>
<td>17.14</td>
</tr>
<tr>
<td>Wilkes et al., 2010</td>
<td>2010</td>
<td>USA</td>
<td>269</td>
<td>0.30(0.24, 0.36)</td>
<td>19.79</td>
</tr>
<tr>
<td>Schmuhl et al., 2012</td>
<td>2012</td>
<td>USA</td>
<td>269</td>
<td>0.11(0.07, 0.14)</td>
<td>17.64</td>
</tr>
<tr>
<td>Line et al., 2013</td>
<td>2013</td>
<td>USA</td>
<td>111</td>
<td>0.38(0.31, 0.45)</td>
<td>14.55</td>
</tr>
<tr>
<td>Brinza et al., 2013</td>
<td>2013</td>
<td>USA</td>
<td>362</td>
<td>0.49(0.43, 0.55)</td>
<td>17.54</td>
</tr>
<tr>
<td>Sufficient (I-squared = 54.5%, p &lt; 0.0001)</td>
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<tr>
<td>Cottler et al., 2014</td>
<td>2014</td>
<td>USA</td>
<td>1152</td>
<td>0.16(0.11, 0.21)</td>
<td>13.69</td>
</tr>
<tr>
<td>Hamele et al., 2013</td>
<td>2013</td>
<td>USA</td>
<td>269</td>
<td>0.21(0.17, 0.26)</td>
<td>18.59</td>
</tr>
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<td>2013</td>
<td>USA</td>
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<td>0.19(0.16, 0.22)</td>
<td>17.59</td>
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<tr>
<td>Gent et al., 2014</td>
<td>2014</td>
<td>USA</td>
<td>46</td>
<td>0.16(0.11, 0.21)</td>
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<td>Batsch et al., 2014</td>
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<td>USA</td>
<td>269</td>
<td>0.11(0.07, 0.14)</td>
<td>17.41</td>
</tr>
<tr>
<td>Brinza et al., 2013</td>
<td>2013</td>
<td>USA</td>
<td>362</td>
<td>0.42(0.39, 0.45)</td>
<td>13.12</td>
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<td>Wilkes et al., 2012</td>
<td>2012</td>
<td>USA</td>
<td>171</td>
<td>0.25(0.21, 0.29)</td>
<td>9.07</td>
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<td>Sufficient (I-squared = 52.5%, p &lt; 0.0001)</td>
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<td>0.14(0.11, 0.18)</td>
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<td>10.87</td>
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<td>Stone et al., 2010</td>
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<td>USA</td>
<td>123</td>
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<td>Sufficient (I-squared = 87.5%, p &lt; 0.0001)</td>
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**Note:** Weights are from random-effects analysis.
Appropriate Use of Stress MPI by Non-Cardiologists Improved with Education

- Direct contact
- Case Discussions with requesting providers
- Educational Case Vignette series.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015 (Q1-3)</th>
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<tbody>
<tr>
<td>Appropriate</td>
<td>224 (76.7%)</td>
<td>184 (72.2%)</td>
<td>194 (89.4%)</td>
<td>102 (87.9%) *</td>
</tr>
<tr>
<td>Maybe</td>
<td>5 (1.7%)</td>
<td>12 (4.7%)</td>
<td>1 (0.5%)</td>
<td>9 (7.8%) **</td>
</tr>
<tr>
<td>Appropriate</td>
<td>60 (20.6%)</td>
<td>58 (22.8%)</td>
<td>21 (9.7%)</td>
<td>5 (4.3%) ***</td>
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<td>Rarely</td>
<td>3 (1.0%)</td>
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<td>1 (0.5%)</td>
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</table>

J Am Coll Cardiol. 2016;67(13_S):1625-6
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</tr>
<tr>
<td>Rarely</td>
<td>3 (1.0%)</td>
<td>1 (0.4%)</td>
<td>1 (0.5%)</td>
<td>0</td>
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<tr>
<td>Indeterminate</td>
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Use of a Learning Community and Online Evaluation of Utilization for SPECT Myocardial Perfusion Imaging

Formation of Optimal Cardiovascular Utilization Strategies (FOCUS)

Stage 1
- Participants enter patient cases (prospective or retrospective) to establish a baseline

Stage 2
- Develop and implement action plan and goals
- Enter patient cases again
- Incorporates quality improvement activities to support appropriate use of imaging

Stage 3
- Enter final set of patient cases
- View effects of implementation
- Evaluation of intervention period (stage 2)

J Am Coll Cardiol Img. 2013;6(7):823-829
Challenges in Nuclear Cardiology Practice

- Training and Education
- Isotope shortages
- Appropriate use
- Emerging technologies and techniques
- Radiation dose reduction strategies
- International Growth of Nuclear Cardiology
High Efficiency SPECT Cameras
Common Features of New Camera Systems

• Multiple solid state, digital detectors
  – Improved energy and spatial resolution
• Collimators with larger effective diameter or multi-pinhole design
• Field of view limited to heart
• CT attenuation correction on some systems
SPECT Camera Age in US

ASNC/ Medaxiom Survey, 2013
New Technologies Improve Image Quality

Iterative Reconstruction
Scatter Correction
Resolution Recovery
Attenuation Correction
New Technology not in Widespread Use

• Cost
  – CZT and PET cameras
  – PET radiotracers, Rb82 or Cyclotron
• Declining Reimbursement for Nuclear Cardiology procedures
• Declining Utilization (AUC, Payors)
• Attenuation correction not reimbursed
• Lack of CT training with SPECT and PET
Challenges in Nuclear Cardiology Practice

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Radiation Exposure by Protocol

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Stress dose</th>
<th>Rest dose</th>
<th>~ mSv Radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI-201</td>
<td>3.5 mCi</td>
<td>1 mCi</td>
<td>35 mSv</td>
</tr>
<tr>
<td>Dual isotope</td>
<td>30 mCi Tc-99m</td>
<td>3.5 mCi TI-201</td>
<td>30 mSv</td>
</tr>
<tr>
<td>Tc-99m Anger camera</td>
<td>30 mCi</td>
<td>10 mCi</td>
<td>12 mSv</td>
</tr>
<tr>
<td>Tc-99m Anger camera stress only</td>
<td>30 mCi</td>
<td></td>
<td>9 mSv</td>
</tr>
<tr>
<td>Tc-99m Anger camera SO (new software)</td>
<td>10 mCi</td>
<td></td>
<td>3 mSv</td>
</tr>
<tr>
<td>Tc-99m CZT</td>
<td>4 mCi</td>
<td>12 mCi</td>
<td>5 mSv</td>
</tr>
<tr>
<td>Tc-99m stress-only</td>
<td>4 mCi</td>
<td></td>
<td>1.2 mSv</td>
</tr>
<tr>
<td>Rb-82 PET</td>
<td>30 mCi</td>
<td>30 mCi</td>
<td>2.7 mSv</td>
</tr>
<tr>
<td>NH₃-ammonia PET</td>
<td>20 mCi</td>
<td>20 mCi</td>
<td>3 mSv</td>
</tr>
</tbody>
</table>

Bateman *J Nucl Cardiol* 2015
Stress Testing Protocols

ASNC IMAGING GUIDELINES FOR NUCLEAR CARDIOLOGY PROCEDURES

Stress protocols and tracers

Milena J. Henzlova, MD,a Manuel D. Cerqueira, MD,b Christopher L. Hansen, MD,c Raymond Taillefer, MD,d and Siu-Sun Yao, MD,e

**EXERCISE STRESS TEST**

Exercise is the preferred stress modality in patients who are able to exercise to an adequate workload (at least 85% of age-adjusted maximal predicted heart rate).

(a) Patients with an intermediate pretest probability of CAD based on age, gender, and symptoms.

(b) Patients with high-risk factors for CAD (e.g., diabetes mellitus, peripheral, or cerebral vascular

- Stress- first protocols
- Radiation dose reduced avoiding unnecessary rest images
89% of patients had either a history of CAD (31%) or at least intermediate risk for CAD (58%).

Stress-Only vs. Additional Rest Imaging

Log-rank p=0.02 (unadjusted)

p=0.89 (adjusted)

Stress-only MPI

Pooled annual event rates in 22,443 patients

RR=0.85 (CI: 0.63-1.15, p=0.29)

- 0.67% N=10,436
- 0.93% N=12,057

Shaw LJ et al, J Nucl Cardiol 2012
EDITORIAL

Stress-only imaging: We can rest assured

Brian G. Abbott, MD, FACC, FASNC

J Nucl Cardiol June 2010
High Efficiency SPECT Camera
Solid State CZT
Stress Only
5 mCi Tc-99m Tetrofosmin

Supine 8 min

Effective Dose <2 mSv
Radiation Dose Reduction

• Avoid Thallium 201
• Stress-first protocols- low dose
• High Sensitivity CZT SPECT Camera
• Software for processing low dose studies
• PET for lower radiation exposure
• Attenuation Correction- less false positive studies, reduce unnecessary angiography
Median 10.4 mSv

Einstein AJ, Pascual TN, Mercuri M et al. INCAPS. *Eur Heart J* 2015
Challenges in Nuclear Cardiology Practice

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Disability Adjusted Life-Years Lost due to Cardiovascular Disease per 100,000

- <900
- 900-1650
- 1650-2300
- 2300-3000
- 3000-3700
- 3700-4400
- 4400-5100
- 5100-5800
- 5800-6500
- >7900

Utilization of SPECT Myocardial Perfusion Imaging per 100,000

• 4500 Members in US and Worldwide
  – Physicians
  – Nuclear Medicine Technologists
  – Physicists
• Education
• Quality standards, appropriate use criteria
• Guidelines
• Research
ASNC International Membership

South America 35%
Europe 21%
Africa 4%
Asia 32%
Australia 8%

> 400 International Members
62 Countries
ASNC International
Emerging Markets Membership

Physicians and scientists who have earned an advanced academic degree (MD, DO, PhD, or equivalent), are in good standing in their respective communities, and are actively engaged in Nuclear Cardiology clinically and/or research.

Membership Fee: $75.00 USD

www.asnc.org
Collaborations

Society of Nuclear Medicine and Molecular Imaging
Certification Board of Nuclear Cardiology

American Society of Echocardiography
American College of Physicians
Society for Cardiovascular Magnetic Resonance
International Atomic Energy Agency
European Society of Cardiology
European Association of Nuclear Medicine
Heart Failure Society of America

American College of Cardiology
Heart Rhythm Society
Society of Cardiovascular Computed Tomography
Canadian Association of Nuclear Medicine
European Society of Cardiovascular Imaging
Younger Academy of the ESC
The Society for Cardiovascular Angiography and Interventions
ASNC
HFSA
EANM
SCAI
IAEA
CanM
ACMN
XXV Congreso ALASBIIMN 2015 URUGUAY

EACVI
European Society of Cardiology

SCMR
Society for Cardiovascular Magnetic Resonance

Medaxiom
Synergic Healthcare Solutions

China Society of Nuclear Medicine
GUÍAS PARA LOS PROCEDIMIENTOS DE IMAGEN EN CARDIOLOGÍA NUCLEAR DE LA AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY (ASNC)

Tomografía por emisión de fotones únicos (SPECT)

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Traducción realizada por Fernando Mut, MD, y Néstor Alejandro Vita, MD, y revisada por Jeffrey Rosenblatt, MD, FACC, FASNC, para la ASNC.

ASNC
核心脏病学程序 ASNC 成像指南

单光子发射计算机断层扫描
Chinese translation reviewed by: 李亚明，李剑明

Thomas A. Holly, MD\textsuperscript{a}、Brian G. Abbott, MD\textsuperscript{b}、Mouaz Al-Mallah, MD\textsuperscript{c}、Dennis A. Cainon, MD\textsuperscript{d}、Mylan C. Cohen, MD, MPH\textsuperscript{e}、Frank P. DiFilippo, PhD\textsuperscript{f}、Edward P. Ficaro, PhD\textsuperscript{g}、Michael R. Freeman, MD\textsuperscript{h}、Robert C. Hendel, MD\textsuperscript{i}、Diwakar Jain, MD\textsuperscript{j}、Scott M. Leonard, MS, CNMT, RT(N)\textsuperscript{k}、Kenneth J. Nichols, PhD\textsuperscript{l}、Donna M. Polk, MD, MPH\textsuperscript{m}及 Prem Soman, MD, PhD\textsuperscript{n}
The first cardiovascular registry to focus on SPECT and PET imaging studies

- Appropriate Use
- Performance Measures
- Radiation Dose
- Laboratory “Report Card”
- Quality Improvement
- Free to ASNC members

www.asnc.org/imageguide
SAVE THE DATE
7-9 May 2017, Vienna AUSTRIA

Call for abstracts & clinical cases
15 Sept – 21 Nov 2016

Early registration fee deadline
27 February 2017