Myocardial Perfusion Imaging (A Nuclear Stress Test), Guidelines, Imaging Techniques and Challenges

Presented By
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American Society of Nuclear Cardiology (ASNC)

www.asnc.org

Updated Imaging Guidelines for Nuclear Cardiology Procedures

If your lab is Intersocietal Accredited in Nuclear Cardiology, you must follow ASNC guidelines
Manage Your Practice

Guidelines and Standards

ASNC served as the author or co-author on each of the documents listed below. The date shown with each guideline or statement reflects the most recent date of approval or endorsement.

Appropriateness Criteria for SPECT MPI (Single-Photon Emission Computed Tomography Myocardial Perfusion Imaging)
Published by ACCF/SCCT/NASCN/ASNC, endorsed by the AHA and the American Society of Nuclear Cardiology
September 2005

Appropriateness Criteria for Thallium-201 and Technetium-99m SPECT Imaging
Published by ACCF/SCCT/NASCN/ASNC, endorsed by the AHA and the American Society of Nuclear Cardiology
September 2005

Appropriateness Criteria for Thallium-201 and Technetium-99m SPECT Imaging: Case of Myocardial Perfusion SPECT Scintigraphy
Published by ACCF/SCCT/NASCN/ASNC, endorsed by the AHA and the American Society of Nuclear Cardiology
Statement — June 2003

Clinical Use of Cardiac Radionuclide Imaging
ACC/AHA/ASNC Guideline — June 2003

Computed Tomographic Imaging Within Nuclear Cardiology
ASNC Information Statement — November 2004

Cost-Effectiveness of Myocardial Perfusion Imaging
ASNC Information Statement — September 2005

DICOM and Interconnectivity Update
ASNC Information Statement — September 2003

Imaging Guidelines for nuclear Cardiology Procedures, Part 1
ASNC Guideline — November 2000

Imaging Guidelines for nuclear Cardiology Procedures, Part 2
ASNC Guideline — June 1998

PET Myocardial Glucose Metabolism and Perfusion Imaging Guidelines
ASNC Guideline — October 2003

Reporting of Radionuclide Myocardial Perfusion Imaging Studies
ASNC Information Statement — August 2003

Suspected Acute Ischemic Syndromes in the Emergency Department or Chest Pain Center
ASNC Position Statement — September 2001

Women and Coronary Artery Disease: The Role of Myocardial Perfusion Imaging
ASNC Consensus Statement — September 2002
Program Outline

- **Patient Prep**
  - Food
  - Caffeine
  - Alcohol
  - Medications

- **Study Time Frame**
  - One day
  - Two day
  - Dual Isotope

- **Sestamibi vs. Tetrofosmin**
  - Subtle differences
  - ASNC Guidelines
Program Outline

- Methods of Stress Testing
  - Exercise
    - Treadmill
    - Bicycle
  - Chemical
    - Adenosine
    - Regadenoson (Lexiscan)
    - Dipyridamole (Persantine)
    - Dobutamine
    - Low level exercise combined with chemical stress

- Extra: Satisfaction Surveys
  - Patient
  - Physician
Program Outline

- Technical Challenges/Decisions
  - Artifact
    - Beta Blocker
    - Diaphragmatic
    - Breast
    - GI
    - LBBB
    - Motion
    - Low counts
Patient Preparation

1. NO:
   - Food (2-4 hrs)
   - Alcohol (4-6 hrs)
   - Caffeine (12-24 hrs)

2. Comfortable clothes and shoes

3. Bring Medications

4. Discontinue Medications
   - Diagnostic vs. Functional Scan

Medications
- Insulin - Take ½ of dose
- Nitroglycerin - 4-6 hours
- Nitrates - 12 hours
- Diuretics - 12 hours
- Bronchodilators - 24 hours
- Beta Blockers - 48 hours
- Calcium Channel Blockers - 24 hours
- Caffeine - 12-24 hours

Beta Blockers – 48 hours
- Acebutolol hydrochloride
- Atenolol
- Betaxolol hydrochloride
- Bisoprolol fumarate
- Labetalol hydrochloride
- Metoprolol tartrate
- Nadolol
- Pindolol
- Propanolol hydrochloride
- Timolol

- Sectral
- Tenormin, Tenoretic
- Kerlone
- Zebeta
- Normodyne, Trandate
- Betaloc, Lopressor, Toprol
- Cordard, Corzide
- Visken
- Betachron, Inderal
- Blocañren, Apo-timolol, Ziac
# Patient Preparation

## Calcium Channel Blockers - 24 hrs
- Amlodipine
- Diltiazem
- Felodipine Plendil
- Isradipine DynaCirc
- Nicardipine hydrochloride Cardene
- Nifedipine Adalat, Procardia
- Nimodipine
- Nisoldipine
- Verapamil hydrochloride Calan Isoptin, Verelan, Cardura, Lotrel, Cartia

## Bronchodilators - 24 hours
- Aerolate
- Aminophylline
- Aquaphyllin
- Asmalix
- Choledyl
- Elizophylline Slo-bid
- Slo-Phyllin
- Theo-Dur
- Theovent

## Meds Containing Caffeine - 24 hrs
- Anacin
- Carredrine
- Cardiotea
- Exedrin
- Fioricet
- Fiorinal
- Hycomine
- Norgesic
- Repan
- Vivarin

## Miscellaneous Meds – 24 hrs
- Aggrenox
- Cafergot
- Dipyridamole
- Trental
- Plental
Video

(Note, DOBUTAMINE is least common chemical stress test in Nuclear Medicine)
Examination One Day Protocol
Single Isotope Rest/Stress

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Inject Radiopharmaceutical low dose 10 mCi Tc99m Sestamibi or Tetrofosmin
- Waiting period
- Image
- Stress (Rpx injection again, high dose 30 mCi Tc99m Sestamibi or Tetrofosmin)
- Waiting period
- Have your Patient Drink a Glass of Cold Water
- Image
- Review Images
- Remove IV
- CUT PATIENT LOOSE!!
### (ASNC)

<table>
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<th>Rest</th>
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Single Isotope Stress/Rest

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- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Stress (Rpx injection, low dose 10 mCi Tc99m Sestamibi or Tetrofosmin)
- Waiting period
- Image
- Inject Radiopharmaceutical high dose 30 mCi Tc99m Sestamibi or Tetrofosmin
- Waiting period
- Have your Patient Drink a Glass of Cold Water
- Image
- Review Images
- Remove IV
- CUT PATIENT LOOSE!!
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Examination Two Day Protocol
Day One Single Isotope

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Stress Patient and inject radiopharmaceutical high dose 30 mCi Tc99m Sestamibi or Tetrofosmin
- Waiting period
- Have your Patient Drink a Glass of Cold Water
- Image
- Review Images
- Remove IV
- CUT PATIENT LOOSE!!
Examination Two Day Protocol

Day Two Single Isotope

- Verify the Patient Identity
- Verify Patient is Prepped
- Explanation of Exam refresher of what will happen that day
- Answer Questions
- Start IV or straight stick
- Inject radiopharmaceutical high dose 30 mCi Tc99m Sestamibi or Tetrofosmin
- Waiting period
- Have your Patient Drink a Glass of Cold Water
- Image
- Review Images
- Remove IV if you started one
- CUT PATIENT LOOSE!!
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Examination One Day Protocol

Dual Isotope

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Inject Radiopharmaceutical Tl 201 3.5 mCi
- Waiting period
- Image
- Stress (Rpx injection again, 30 mCi Tc99m Sestamibi or Tetrofosmin)
- Waiting period
- Have your Patient Drink a Glass of Cold Water
- Image
- Review Images
- Remove IV
- CUT PATIENT LOOSE!!
<table>
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<th>Rest</th>
<th>Stress</th>
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<td>20% symmetric 167 keV</td>
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Examination Thallium Only
Alternate Protocol Tc99 Shortage

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Stress patient and Inject Radiopharmaceutical Tl 201 3.5 mCi
- Image within 10 minutes
- Review images
- Remove IV
- Patient leaves and returns 4 hours later
- Image
- Review Images
- CUT PATIENT LOOSE!!
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<tr>
<td>Inj to Imaging</td>
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Examination Thallium Only Alternate Protocol Tc99 Shortage with reinjection

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV
- Stress patient and Inject Radiopharmaceutical Tl 201 3.5 mCi
- Image within 10 minutes
- Review images
- Patient leaves and returns 4 hours later
- Inj 1 mCi Tl201
- Image
- Review Images
- Remove IV
- CUT PATIENT LOOSE!!
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<td><strong>Delay time</strong></td>
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<tr>
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<td>Standard</td>
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<tr>
<td>Matrix</td>
<td>64 X 64</td>
<td>Same</td>
<td>Standard</td>
</tr>
<tr>
<td>Time/projection</td>
<td>40 s (32 fr) 25 s (64 fr)</td>
<td>Same</td>
<td>Standard</td>
</tr>
<tr>
<td>No Gate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examination Viability Protocol

- Verify the Patient Identity
- Verify Order
- Obtain Patient History
- Verify Patient is Prepped
- Explanation of Exam
- Answer Questions
- Consent
- Start IV or straight stick
- Inject Radiopharmaceutical Tl 201 4 mCi
- Waiting period
- Image
- Review images
- Remove IV if one was started
- Patient leaves and returns 24 hours later
- Image
- Review Images
- CUT PATIENT LOOSE!!
<table>
<thead>
<tr>
<th><strong>Dose</strong></th>
<th>2.5-3.5 mCi Tl201</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position</strong></td>
<td>Supine</td>
<td>Standard</td>
</tr>
<tr>
<td><strong>Delay time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inj to Imaging</td>
<td>20-30 minutes</td>
<td>Standard</td>
</tr>
<tr>
<td>Inj to 2nd Imaging</td>
<td>24 hrs</td>
<td>Standard</td>
</tr>
<tr>
<td><strong>Acquisition protocol</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy window</td>
<td>25-30% symmetric 70 keV</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>20% symmetric 167 keV</td>
<td></td>
</tr>
<tr>
<td>Collimator</td>
<td>LEAP</td>
<td>Preferred</td>
</tr>
<tr>
<td>Orbit</td>
<td>180 (45 RAO to 45 LPO)</td>
<td>Preferred</td>
</tr>
<tr>
<td>Orbit type</td>
<td>Circular</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>Noncircular</td>
<td>Standard</td>
</tr>
<tr>
<td>Pixel size</td>
<td>6.4 ± .4 mm</td>
<td>Standard</td>
</tr>
<tr>
<td>Acquisition type</td>
<td>Step and shoot</td>
<td>Standard</td>
</tr>
<tr>
<td>Number of proj</td>
<td>32-64</td>
<td>Standard</td>
</tr>
<tr>
<td>Matrix</td>
<td>64 X 64</td>
<td>Standard</td>
</tr>
<tr>
<td>Time/proj day 1</td>
<td>40 s (32 fr) 25 s (64 fr)</td>
<td>Standard</td>
</tr>
<tr>
<td>Time/proj day 2</td>
<td>60 s (32 fr) 45 s (64 fr)</td>
<td></td>
</tr>
<tr>
<td>No Gate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Study Time Frame
Study time frame varies by selected protocols and Radiopharmaceutical; however a typical One Day Protocol with low dose rest Tc99m and high dose stress Tc99m is normally completed in approximately 2 to 3 hours. (This is approximately the same when using a dual isotope protocol using Tl201 at rest)

Thallium only initially takes about 45 minutes, then the patient returns four hours later and that part takes only the imaging time, so 30 minutes tops

Two Day Protocols and Viability studies do require the patient to return 24 hours later with each day taking approximately 1 to 1.5 hours to complete.
Efficiency Evaluation*: Comparison of Tc99m Tetrofosmin and Tc99m Sestamibi

<table>
<thead>
<tr>
<th>Study</th>
<th>Tc99m Tetrofosmin</th>
<th>Tc99m Sestamibi</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>47.7 ± 21.7</td>
<td>74.3 ± 25.8</td>
<td>0.00001</td>
</tr>
<tr>
<td>Stress</td>
<td>42.9 ± 23.3</td>
<td>48.4 ± 25.0</td>
<td>0.0066</td>
</tr>
<tr>
<td>Rest + stress</td>
<td>90.0 ± 32.7</td>
<td>124.0 ± 37.0</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

*1,134 imaging studies.

Rescan Rate*: Comparison of Tc99m Tetrofosmin and Tc99m Sestamibi

<table>
<thead>
<tr>
<th>Study</th>
<th>Tc99m Tetrofosmin</th>
<th>Tc99m Sestamibi</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>10.0 (26/261)</td>
<td>21.4 (75/351)</td>
<td>0.001</td>
</tr>
<tr>
<td>Stress</td>
<td>5.8 (15/259)</td>
<td>9.9 (26/263)</td>
<td>0.082</td>
</tr>
<tr>
<td>Rest + stress</td>
<td>7.9 (41/520)</td>
<td>16.4 (101/614)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*Rescans due to liver and combined liver and bowel activity. Physician blinded study.

If you can scan faster and have less liver artifact, why would you not use Tetrofosmin??

Physician preference or..... because with the release of generic Sestamibi a few years ago, it is less money going out up front. Even though reimbursement will be what you paid (it is straight across the board) the is less money going out up front.
ASNC Guidelines: Injection to Scan Time

- Tetrofosmin Rest: 30 minutes
- Sestamibi Rest: 60 minutes
- Thallium Rest: 15 minutes
- Tetrofosmin Treadmill Stress: 10-15 minutes
- Sestamibi Treadmill Stress: 15-20 minutes
- Tetrofosmin Pharma Stress: 30 minutes
- Tetrofosmin Pharma Stress: 60 minutes
Radiopharmaceutical Doses

- **Tl-201** 2.5 to 3 mCi
- **Tc99m Agents**
  - Two-day protocol: 15-30 mCi
  - One-day protocol: 1:3 ratio 10 and 30 mCi
  - Overweight patients (based on 70 kg/155 lb patient)
    - Low dose (.11 mCi/kg)
    - High dose (.31 mCi/kg)
Methods of Stress Testing

Bicycle Ergometer or Arm Ergometer

Treadmill

- Bruce Protocol
- Modified Bruce Protocol
- Naughton

Pharmacological

- Dipyridamole (Persantine)
- Adenosine
- Dobutamine
- A2A Adenosine Agonists Regadenoson (Lexiscan)
Bicycle Ergometer

- Patients pedal at constant speed beginning at a workload of 25 to 50 W and increasing by 25 W every 3 min
Arm Ergometer

- Cycling speeds of 60 to 75 revolutions per minute must be maintained. Work rate increments of 10 W per 2-minute stage are suggested
The Bruce protocol is a diagnostic test used in the evaluation of cardiac function, developed by Robert A. Bruce.

He developed the multistage test, consisting of several stages of progressively greater workloads. It was this multistage test, a description of which was first published in 1963, that became known as the Bruce Protocol.
Bruce Protocol

- In the initial paper, Bruce reported that the test could detect signs of such conditions as angina pectoris, a previous heart attack, or a ventricular aneurysm. Bruce and colleagues also demonstrated that exercise testing was useful in screening apparently healthy people for early signs of coronary artery disease.
**Bruce Protocol**  (each stage is 3 min)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Minutes</th>
<th>% Grade</th>
<th>MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>10</td>
<td>1.7</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>12</td>
<td>2.5</td>
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<tr>
<td>3</td>
<td>9</td>
<td>14</td>
<td>3.4</td>
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<tr>
<td>4</td>
<td>12</td>
<td>16</td>
<td>4.2</td>
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<td>15</td>
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<tr>
<td>7</td>
<td>21</td>
<td>22</td>
<td>6.0</td>
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</table>
## Modified Bruce Protocol
(each stage is 3 min)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Minutes</th>
<th>% Grade</th>
<th>MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>0</td>
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<tr>
<td>2</td>
<td>6</td>
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<td>1.7</td>
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<tr>
<td>3</td>
<td>9</td>
<td>10</td>
<td>1.7</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
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<td>3.4</td>
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<td>4.2</td>
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<tr>
<td>7</td>
<td>21</td>
<td>18</td>
<td>5.0</td>
</tr>
</tbody>
</table>
This video is of Treadmill Stress only with no injection, but it’s funny! FYI, you can hold on to the rails! (Modified Bruce)
## Naughton Stress (Low Level each stage is 2 min)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Minutes</th>
<th>% Grade</th>
<th>MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
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<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>3.5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>7</td>
<td>2</td>
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<tr>
<td>5</td>
<td>10</td>
<td>10.5</td>
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<tr>
<td>6</td>
<td>12</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>17.5</td>
<td>2</td>
</tr>
</tbody>
</table>
There are currently three vasodilator agents available:

- Dipyridamole
- Adenosine
- Regadenoson

They all work by producing stimulation of A2A receptors

Dobutamine

- Dobutamine infusion results in direct b1 and b2 stimulation with a dose-related increase in heart rate, blood pressure, and myocardial contractility.
Dipyridamole

Dipyridamole is administered at 0.56 mg/kg intravenously over a 4-minute period (142 mcg/kg/min). Although an infusion pump is preferable, Dipyridamole can also be administered by hand injection or drip. The radiotracer is injected 3-5 minutes after the completion of Dipyridamole infusion. The half-life of Dipyridamole is approximately 30-45 minutes.
Dipyridamole

- Side Effects: Over 50% of patients develop side effects (flushing, chest pain, headache, dizziness, or hypotension). Aminophylline (125-250 mg intravenously) is often required to reverse these side effects. Aminophylline should also be used in the presence of ischemic ECG changes after Dipyridamole.
Adenosine should be given as a continuous infusion at a rate of 140 mcg/kg/min over a 6-minute period. The tracer is injected at 3 minutes and the infusion continues for another 3 minutes. A shorter-duration adenosine infusion, lasting 4 minutes, has been found to be equally effective for the detection of CAD compared to the standard 6-minute infusion. For shorter duration protocols, the minimum time to tracer injection should be 2 minutes and the infusion should continue for at least 2 minutes after tracer injection.
Adenosine

- Minor side effects are common and occur in approximately 80% of patients. The common side effects are flushing (35-40%), chest pain (25-30%), dyspnea (20%), dizziness (7%), nausea (5%), and symptomatic hypotension (5%). Chest pain is nonspecific and is not necessarily indicative of the presence of CAD. AV block occurs in approximately 7.6% of cases. However, the incidence of second-degree AV block is only 4%, and that of complete heart block is less than 1%. Most cases (95%) of AV block do not require termination of the infusion. ST-segment depression of 1 mm or greater occurs in 5-7% of cases. However, unlike chest pain, this is usually indicative of significant CAD. Fatal or nonfatal myocardial infarction is extremely rare. Due to an exceedingly short half-life of adenosine (\(10\) seconds), most side effects resolve in a few seconds after discontinuation of the adenosine infusion, and aminophylline infusion is only very rarely required.
Regadenoson

The recommended intravenous dose of Regadenoson is 5 mL (0.4 mg Regadenoson) and should be given as a rapid (approximately 10 seconds) injection into a peripheral vein using a 22 gauge or larger catheter or needle. Administer a 5-mL saline flush immediately after the injection of Regadenoson. Administer the radionuclide myocardial perfusion imaging agent 10-20 seconds after the saline flush. The radionuclide may be injected directly into the same catheter as Regadenoson.
Regadenoson

- The most common reactions to administration of Regadenoson during MPI are shortness of breath, headache, and flushing. Less common reactions are chest discomfort, angina pectoris or ST, dizziness, chest pain, nausea, abdominal discomfort, and feeling hot. In patients with a prior adenosine stress study, rhythm or conduction abnormalities were seen in 26% with Regadenoson (30% for Adenosine). First degree AV block was detected in 3% with Regadenoson (7% with adenosine), second degree AV block in 0.1% (1% with adenosine). Most adverse reactions begin soon after dosing and generally resolve within approximately 15 minutes, except for headache which resolves in most patients within 30 minutes. Aminophylline may be administered in doses ranging from 50 to 250 mg by slow intravenous injection (50-100 mg over 30-60 seconds) to attenuate severe and/or persistent adverse reactions to Regadenoson.
Dobutamine

- Dobutamine is infused incrementally starting at a dose of 5-10 mcg/kg/min, which is increased at 3-minute intervals to 20, 30, and 40 mcg/kg/min. The half-life of Dobutamine is approximately 2 minutes. As with exercise stress, achieving 85% of the predicted heart rate is desirable. The tracer is injected at 85%
Dobutamine

- Side effects occur in about 75% of patients. The common side effects are palpitation (29%), chest pain (31%), headache (14%), flushing (14%), dyspnea (14%), and significant supraventricular or ventricular arrhythmias (8-10%). Ischemic ST-segment depression occurs in approximately one-third of patients undergoing Dobutamine infusion. Severe side effects may require IV administration of a short-acting b-blocker (esmolol, 0.5 mg/kg over 1 minute).
Technical Challenges/Decisions

- The Unprepped Patient
  - Reschedule Patient

- Diaphragmatic and Breast Attenuation
  - Prone Imaging
  - Breast Taped

- Other Artifact
  - Increased Gut Activity/Loop of Bowel/Stomach/Liver
  - Motion
    - LBBB

- Obese Patients
  - 2 Day Tc/Tc Protocol

Taillefer et al tested 21 patients at baseline, after low-dose intravenous metoprolol tartrate and after high-dose intravenous metoprolol tartrate. They found that the stress defect extent and severity were reduced by 25% to 30% even at the low dose of the B-Blocker, with no change in the rest defect appearance. As such, B-blockers “masked” the ischemic burden.
Diaphragmatic Attenuation

- Commonly seen in obese males or males with large chests
- May appear as black area underneath the heart on cine view
- Defect seen as fixed inferior wall defect
- Upward creep diaphragmatic reversible defects were more commonly seen with thallium imaging
Supine vs. Prone
Breast Attenuation

• Usually seen in large-breasted females
• Fixed anterior or anterolateral defect
• Defect may appear as partially reversible if breast positioning differs for the rest and stress acquisitions
• Defect size and position may vary depending on breast size and positioning
Breast Attenuation

Before

Breast taped
Extra-cardiac Activity

- Liver Activity
  - Excessive liver activity can cause scatter artifacts and an increase in inferior wall activity
Extra-cardiac Activity

- **Bowel Activity**
  - Activity within bowel loops can cause inferior wall defects
  - Liver, gallbladder, or bowel activity may cause normalization problems
Motion Artifact

- Approximately 20% of defects can be attributed to motion
- Motion correction programs can correct only one pixel motion shift or greater, therefore, a repeat scan may be required
- Patient comfort and cooperation is critical
Hurricane Sign
Motion Defect
Exercising a patient on the treadmill with a LBBB will cause a septal defect.

Pt 1 exercised on a Treadmill note defect.
Patient 1 stressed with Adenosine and rescanned

Note lack of defect
Two-day protocol. Ideally, stress and rest imaging with Tc-99m agents should be performed on two separate days to avoid having residual activity from the first study contaminate the second study. In overweight patients (ie, >250 lb or body mass index >30) or in female patients where significant breast attenuation is anticipated, a low dose of Tc-99m radiotracer may result in suboptimal images and a 2-day imaging protocol is preferable.
Patient Satisfaction

What was your scheduling experience like?
- My personal schedule was accommodated
- Insurance questions were answered
- I received a confirmation call

What was your arrival at our clinic like?
- I was able to find the office easily
- I was greeted professionally and courteously
- The technologist greeted me professionally and courteously
- The office was neat and clean

What was your testing experience like?
- Technologist thoroughly explained the test process.
- Temperature of my room was satisfactory to me.
- Technologist was attentive to my needs
- Overall the testing experience was satisfactory to me
Physician Survey
To improve our nuclear program, please complete this brief questionnaire regarding services provided by the Cardiovascular Nuclear Stress Lab. Your responses will assist us in improving quality care to your patients and facilitate our reporting to you. Thank you, in advance, for your time and candor in providing this information.

Please rate the Nuclear Cardiology Laboratory using the following scale:
1 = Excellent 2 = Very Good 3 = Good 4 = Fair 5 = Poor

____ Timeliness of written communications/reports to your office
____ Timeliness of faxed reports on abnormal stress exams
____ Overall satisfaction with ease of scheduling studies
____ Feedback from patients regarding the nuclear exam has been favorable
____ Overall satisfaction with the test results generated by the stress lab
____ Overall satisfaction with the quality of care provided
____ Overall satisfaction with the Nuclear Cardiology process

Comments and Recommendations:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Name (optional) ___________________________________
WAKE UP!!