Myocardial Perfusion PET with Myocardial Blood Flow & Flow Reserve in Clinical Practice

Shana Elman, MD
Assistant Professor, Department of Radiology
University of New Mexico Health Sciences
SNMMI – SWC Annual Meeting, 3/22/2019
Disclosures

- I have no financial disclosures.
Objectives

■ Understand benefits of PET over SPECT for myocardial perfusion imaging

■ Discuss how to add value to myocardial perfusion imaging with myocardial blood flow (MBF) and myocardial flow reserve (MFR)

■ Identify patient populations that will benefit from myocardial perfusion PET

■ Discuss challenges of incorporating cardiac PET into clinical practice
Changing epidemiology of CV disease

CV disease remains the number one cause of death and disability, but clinical presentations are changing

- ↓ incidence of atherothrombotic plaque rupture causing ST-segment elevation MI
- ↑ rates of hospitalizations with a secondary MI diagnosis and heart failure with preserved ejection fraction (HFpEF)

These observations follow the epidemiologic shifts in the prevalence of CVD risk factors in the population, including the growth of obesity, glucose intolerance and older age

Factors affecting the pathophysiology of myocardial ischemia and injury in stable IHD

**Epicardial Arteries** (> 400 μm)
- Focal stenosis
- Diffuse atherosclerosis
- Microvascular disease

**Small Arteries** (< 400 μm)

Coronary blood flow

Pressure difference

\[
\text{CFR} = \frac{\text{MBF peak hyperemia}}{\text{MBF rest}}
\]

**FFR/IFR**

**IMR**

Courtesy of M. Di Carli 2018

ASNC

UNM Health Sciences Center
Physiology

Normal Artery
- Rest
  - Normal microvascular tone
- Exercise
  - Complete microvascular dilatation

Atherosclerotic Artery
- Rest
  - Partial microvascular dilatation
  - ΔP = 30 mm Hg
  - 100 mm Hg, 70 mm Hg
- Exercise
  - Complete microvascular dilatation
  - ΔP = 60 mm Hg
  - 100 mm Hg, 40 mm Hg
  - Epicardial arterial constriction

Coronary Blood Flow (Multiple of Resting Value)
- Duration of Exercise

Benefits of PET over SPECT

- Low radiation exposure (1-5 mSv)
- Short acquisition protocols (< 1 hr w/ Rb-82)
- High-quality images (particularly helpful to minimize artifacts from tissue attenuation and scatter)
- High diagnostic accuracy
- Ability to identify non-response to stress
- Strong prognostic power
## Radiopharmaceuticals

<table>
<thead>
<tr>
<th></th>
<th>Rb-82</th>
<th>$^{13}$N-Ammonia</th>
<th>$^{18}$F-Flurpiridaz</th>
<th>$^{15}$O-Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Half-Life</strong></td>
<td>75 sec</td>
<td>~10 min</td>
<td>~2 hours</td>
<td>~2 min</td>
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<tr>
<td><strong>Positron Range (mm)</strong></td>
<td>5.9</td>
<td>1.5</td>
<td>0.6</td>
<td>2.5</td>
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<tr>
<td><strong>Myocardial Extraction</strong></td>
<td>Good</td>
<td>Very Good</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>FDA Status</strong></td>
<td>Approved</td>
<td>Approved</td>
<td>Soon?????</td>
<td>Not Approved</td>
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<td><strong>Stress Type</strong></td>
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<td>Pharm or Exercise</td>
<td>Pharm</td>
</tr>
<tr>
<td><strong>Per Dose Cost</strong></td>
<td>$$$</td>
<td>$ (if you do enough)</td>
<td>$$</td>
<td>Unknown</td>
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</table>
Benefits of PET over SPECT

- Low radiation exposure (1-5 mSv)
- Short acquisition protocols (< 1 hr w/ Rb-82)
- High-quality images (particularly helpful to minimize artifacts from tissue attenuation and scatter)
- High diagnostic accuracy
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Bateman et al. J Nucl Cardiol 2016
Image Quality of PET over SPECT

- Improved spatial resolution
- Improved attenuation correction
- Improved temporal resolution
- Improved myocardial extraction
- Leads to fewer false negatives and fewer false positives with increased diagnostic accuracy independent of gender or body habitus and improved identification of multivessel disease
SPECT from 65-year-old man with anginal symptoms
PET from the same 65-year-old man with anginal symptoms.
Benefits of PET over SPECT

- Low radiation exposure (1-5 mSv)
- Short acquisition protocols (< 1 hr w/ Rb-82)
- High-quality images (particularly helpful to minimize artifacts from tissue attenuation and scatter)
- High diagnostic accuracy
- Ability to identify non-response to stress
- Strong prognostic power

Bateman et al. J Nucl Cardiol 2016
Table 4. Summary of published literature on diagnostic accuracy of PET

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Number</th>
<th>Tracer</th>
<th>Sensitivity (%)</th>
<th>Specificity</th>
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<tr>
<td>Schelbert et al(^7)</td>
<td>1982</td>
<td>45</td>
<td>(^{13})NH(_3)</td>
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<tr>
<td>Tamaki et al(^8)</td>
<td>1985</td>
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<td>95</td>
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<tr>
<td>Yonekura et al(^9)</td>
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<td>Tamaki et al(^10)</td>
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<td>100</td>
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<tr>
<td>Gould et al(^11)</td>
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<td>-</td>
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<td>95</td>
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<td>Go et al(^13)</td>
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<td>Stewart et al(^14)</td>
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<td>Marwick et al(^15)</td>
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<td>Grover-Mckay et al(^16)</td>
<td>1992</td>
<td>31</td>
<td>(^{82})Rb</td>
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<td>73</td>
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<tr>
<td>Laubenbacher et al(^17)</td>
<td>1993</td>
<td>34</td>
<td>(^{13})NH(_3)</td>
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<td>83</td>
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<tr>
<td>Wallhaus et al(^18)</td>
<td>2001</td>
<td>45</td>
<td>(^{64})Cu-PTSM</td>
<td>84</td>
<td>100</td>
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<tr>
<td>Bateman et al(^19)</td>
<td>2006</td>
<td>112</td>
<td>(^{82})Rb</td>
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<tr>
<td>Walsh et al(^20)</td>
<td>1988</td>
<td>33</td>
<td>(^{15})O-H(_2)O</td>
<td>92</td>
<td>-</td>
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<tr>
<td>Williams et al(^21)</td>
<td>1994</td>
<td>287</td>
<td>(^{82})Rb</td>
<td>87</td>
<td>88</td>
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<tr>
<td>Simone et al(^22)</td>
<td>1992</td>
<td>225</td>
<td>(^{82})Rb</td>
<td>83</td>
<td>91</td>
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<tr>
<td>Sampson et al(^23)</td>
<td>2007</td>
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<td>(^{82})Rb</td>
<td>93</td>
<td>83</td>
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<tr>
<td>Husmann et al(^24)</td>
<td>2007</td>
<td>70</td>
<td>(^{13})NH(_3)</td>
<td>96</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total weighted mean</strong></td>
<td></td>
<td>1660</td>
<td></td>
<td>90</td>
<td>89</td>
</tr>
</tbody>
</table>


**Diagnostic Accuracy by Gender**

- Men: SPECT 69%, PET 84%, P = 0.55
- Women: SPECT 67%, PET 88%, P = 0.009

**Diagnostic Accuracy by BMI**

- BMI < 30: SPECT 70%, PET 87%, P = 0.05
- BMI > 30: SPECT 67%, PET 85%, P = 0.02

**MVD Sensitivity**

- P = 0.03
- SPECT 48%, PET 71%
Diagnostic Uncertainty
Interpretive Certainty

$^{82}$Rb PET Global MFR in 3-vessel disease detection

MFR < 1.5: Sn/Sp = 80%/74%

C-statistics
MFR = 0.817
SSS = 0.679
p = 0.018
Benefits of PET over SPECT

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- Strong prognostic power
Non-responsiveness to pharmacological stress

- Patient does not demonstrate features expected with severe multivessel CAD.
- Global and regional flows are at or near 1.0, with homogeneous rather than heterogeneous MFR
- Uptake similar to rest and no new defects
- Little or no hemodynamic changes
- No high-risk response features (e.g., ECG changes, stress-induced perfusion defects, wall motion abnormalities, TID, RV uptake)
### High Risk Scan Features on PET MPI

<table>
<thead>
<tr>
<th>Feature</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ECG</strong></td>
<td>&gt;1 mm ST elevation</td>
</tr>
<tr>
<td></td>
<td>&gt;2 mm ST depression</td>
</tr>
<tr>
<td>Heart rate reserve</td>
<td>&lt; 4 beats</td>
</tr>
<tr>
<td><strong>Imaging variables</strong></td>
<td></td>
</tr>
<tr>
<td>Stress defect size and severity</td>
<td>≥ 10%</td>
</tr>
<tr>
<td>Rest defect size and severity</td>
<td>≥ 10%</td>
</tr>
<tr>
<td>Reversibility size and severity</td>
<td>≥ 10%</td>
</tr>
<tr>
<td>Transient cavity dilation</td>
<td>&gt; 1.13</td>
</tr>
<tr>
<td>Increased lung uptake</td>
<td>Visual estimate</td>
</tr>
<tr>
<td>Rest LVEF</td>
<td>&lt; 40%</td>
</tr>
<tr>
<td>Stress LVEF</td>
<td>&lt; 40%</td>
</tr>
<tr>
<td>LVEF reserve</td>
<td>≤ ±5%</td>
</tr>
<tr>
<td>Increased RV tracer uptake</td>
<td>Visual estimate</td>
</tr>
<tr>
<td>Transient increase in RV tracer uptake</td>
<td>≥ 10% increase in RV/LV uptake ratio with stress or</td>
</tr>
<tr>
<td></td>
<td>≥ 10% increase in the RV/LV ratio at stress compared to rest</td>
</tr>
<tr>
<td>Calcium score</td>
<td>&gt; 400</td>
</tr>
<tr>
<td>CT coronary angiography</td>
<td>Severe CAD</td>
</tr>
<tr>
<td>Quantitative blood flow assessment (CFR)</td>
<td>&lt; 1.5</td>
</tr>
</tbody>
</table>

Benefits of PET over SPECT

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Bateman et al. J Nucl Cardiol 2016
Myocardial Flow Reserve and Prognosis
Myocardial Flow Reserve and Prognosis

Lower vs. Upper  P<0.0001
Middle vs. Upper P<0.0001

Cardiac Mortality

Lower Tertile  Middle Tertile  Upper Tertile

Murthy et al. Circulation 2011
Myocardial Flow Reserve and Prognosis

Heart Failure Admissions Cumulative Incidence

Groups
- 1: Nor Qual & Nor Quant
- 2: Abn Qual & Abn Quant
- 3: Abn Qual & Nor Quant
- 4: Nor Qual & Abn Quant

Days

Elman et al. ASNC 2018
A Total Scan Abnormality

B Ischemia

<table>
<thead>
<tr>
<th>Total Scan Abnormality</th>
<th>LVEF</th>
<th>CFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥10% (n)</td>
<td>2.4% (119)</td>
<td>4.4% (217)</td>
</tr>
<tr>
<td>1-9% (n)</td>
<td>0.3% (195)</td>
<td>4.0% (202)</td>
</tr>
<tr>
<td>0% (n)</td>
<td>0.1% (614)</td>
<td>1.1% (509)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Ischemia</th>
<th>CFR</th>
<th>LVEF</th>
</tr>
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<tbody>
<tr>
<td>≥10% (n)</td>
<td>2.2% (50)</td>
<td>2.2% (119)</td>
</tr>
<tr>
<td>1-9% (n)</td>
<td>1.1% (197)</td>
<td>3.3% (234)</td>
</tr>
<tr>
<td>0% (n)</td>
<td>0.1% (681)</td>
<td>1.8% (575)</td>
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<table>
<thead>
<tr>
<th>LVEF</th>
<th>CFR</th>
</tr>
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<tbody>
<tr>
<td>LVEF &lt;40% (n)</td>
<td>2.0% (65)</td>
</tr>
<tr>
<td>LVEF 40-50% (n)</td>
<td>1.4% (89)</td>
</tr>
<tr>
<td>LVEF ≥50% (n)</td>
<td>0.2% (774)</td>
</tr>
</tbody>
</table>

EDITORIAL

Reporting myocardial flow reserve with PET. Ready or not, here it is! But walk before you fly!

Daniel Juneau, MD,a Robert A. deKemp, PhD,b and Rob S. B. Beanlands, MDb

aNuclear Medicine, Centre Hospitalier de l’Université de Montréal (CHUM), Montreal, Canada
bDivision of Cardiology, Department of Medicine, National Cardiac PET Centre, University of Ottawa Heart Institute, Ottawa, ON, Canada

Received Sep 25, 2017; accepted Sep 26, 2017
doi:10.1007/s12350-017-1087-5
Challenges of Incorporating PET into Practice

- **Cost**
  - *Rb-82 generator is expensive (cost per patient decreases the more patients you do)*
    - How do you get a lot of pts referred for a test you aren’t even offering yet?
  - *PET scanner*
    - Need a new scanner?
    - Use the scanner you already have
      - How incorporate cardiac PET into your oncologic PET schedule
    - Avoiding detector saturation
      - Dose must be adjusted to avoid detector saturation during the blood pool phase (particularly challenging with $^{82}$Rb).
    - Reimbursement
      - Patient selection

- Understanding how to integrate additional info into report
- Educating referring clinicians
Decision Analysis

Occasional Imaging  and  On-site cyclotron  N-13 ammonia

Daily Imaging  and  PET/CT capacity  Rb-82 chloride
Myocardial Perfusion PET/CT Protocol

Cine CT Acquisition (120 kVp, 20mA, 2.5mm slice, 0.8 sec rot, ~4.8 sec cine duration)

Courtesy of Laurie Soine, ARNP
Dynamic Acquisition

<table>
<thead>
<tr>
<th>Number of Frames</th>
<th>Frame Duration</th>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>5 seconds</td>
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<td>6</td>
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<td>3</td>
<td>20 seconds</td>
</tr>
<tr>
<td>3</td>
<td>30 seconds</td>
</tr>
<tr>
<td>1</td>
<td>150 seconds</td>
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</tbody>
</table>
Clinical Appropriateness Guidelines: Advanced Imaging

Appropriate Use Criteria: Imaging of the Heart
Effective Date: January 1, 2018

Proprietary

Date of Origin: 03/30/2005
Last revised: 11/14/2017
Last reviewed: 11/14/2017

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Patient Selection

- When non-invasive imaging is required in morbidly obese patients (BMI ≥ 40 kg/m²), with suspected or established CAD, perfusion PET imaging may be considered as the initial test (because of a higher likelihood of technically suboptimal image quality on nuclear stress testing and stress echocardiography in this patient subgroup).

- PET perfusion imaging may also be a preferable initial noninvasive test for other patients in whom conventional nuclear perfusion imaging is likely to be suboptimal including those with breast implants, previous mastectomy, pleural or pericardial effusion, chest wall deformity and those with suboptimal prior nuclear imaging due to attenuation artifact.

- Perfusion PET myocardial imaging is not appropriate for screening for coronary artery disease in asymptomatic low-risk patients regardless of age or body habitus. Whenever possible and clinically appropriate, exercise stress testing should be used in preference to pharmacological testing. However, for patients who are unable to exercise or who have baseline EKG abnormalities which make pharmacological testing preferable, PET imaging is preferable to conventional nuclear perfusion imaging or stress echocardiography.
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

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.
Clinical Indications

- 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.

- Body characteristics that commonly affect image quality [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].
Clinical Indications

- High-risk patients in whom diagnostic errors carry even greater clinical implications.
  - *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
  - *Known extensive coronary disease* following CABG or PCI
  - *Suspected transplant coronary vasculopathy*
  - *When ischemia is suspected in patients with LV dysfunction*
  - *Patients for whom revascularization carries increased morbidity and mortality risk.*
Clinical Indications

- 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.

- 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.

- 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.
CATEGORII III CODES

New

- +0482T Absolute quantitation of myocardial blood flow, positron emission tomography (PET), rest and stress (List separately in addition to code for primary procedure)
  
  (Use 0482T in conjunction with 78491, 78492)

  (For myocardial imaging metabolic evaluation, use 78459)

  (For positron emission tomography [PET] myocardial perfusion study, see 78491, 78492)

AMA Announces New CPT Category III Code for PET Absolute Quantification of Myocardial Blood Flow

By: admin On: 07/31/2017 13:43:30 In: Advocacy


This is an important early step in accurate billing and reimbursement for this service. Much advocacy work remains to be done, however.

Unlike permanent category I CPT codes, category III CPT codes (also called “temporary” codes or “tracking” codes) are used for emerging technologies and procedures to allow tracking as these new services become better established. In fact, it is not proper to use a different code, such as an unlisted code, if the category III code applies.

The new CPT code language is provided below:

This is an add-on code, which means that it must be reported in conjunction with the codes for PET myocardial perfusion, 78491 or 78492. Code +0482T would be expected to be reported on the same day as codes 78491 / 78492. The establishment of this category III code is an important step. The requirement for a category I CPT code with subsequent relative values in the Medicare physician fee schedules will require widespread use of the service and more advocacy by the ASNC community.

Effective Jan. 1, 2018

+0482T Absolute quantitation of myocardial blood flow, positron emission tomography (PET), rest and stress (list separately in addition to code for primary procedure)

Use 0482T in conjunction with 78491, 78492.

For myocardial imaging metabolic evaluation, use 78459.

For positron emission tomography (PET) myocardial perfusion study, see 78491, 78492.
eviCore Adds Coverage for Thyroid Imaging, Cites SNMMI Guideline

April 25, 2018

eviCore, one of the leading medical benefits management companies in the U.S., has updated its coverage guidelines for whole-body thyroid imaging. eviCore cites SNMMI’s practice guideline as the reasoning/evidence to support the change to add thyroid imaging coverage. Specifically, eviCore added "whole-body thyroid nuclear scan post-thyroidectomy" and "whole-body thyroid nuclear scan within two weeks of RAI therapy."

evCore also added the new CPT Category III Code for cardiac PET, CPT +0482T absolute quantitation of myocardial blood flow, positron emission tomography (PET), rest and stress.

View the full list of eviCore Cardiology & Radiology Imaging Guideline Revisions, effective May 1, 2018 »
CPT Codes

- 78459: Myocardial imaging, (PET), metabolic evaluation
- 78491: Myocardial imaging, positron emission tomography, (PET), perfusion; single study at rest or stress
- 78492: Myocardial imaging, positron emission tomography, (PET), perfusion; multiple studies at rest and/or stress
- 0482T: Absolute quantitation of myocardial blood flow, positron emission tomography (PET), rest and stress (List separately in addition to code for primary procedure) (effective 1/1/2018)
- Eligibility for reimbursement is based upon the benefits set forth in the member’s subscriber contract.
- CODES MAY NOT BE COVERED UNDER ALL CIRCUMSTANCES. PLEASE READ THE POLICY AND GUIDELINES STATEMENTS CAREFULLY.
Normal

LV Volume Graph

<table>
<thead>
<tr>
<th></th>
<th>STRESS (G)</th>
<th>REST (G)</th>
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<tbody>
<tr>
<td>ESV</td>
<td>18 ml</td>
<td>19 ml</td>
</tr>
<tr>
<td>EDV</td>
<td>56 ml</td>
<td>45 ml</td>
</tr>
<tr>
<td>EF</td>
<td>68 %</td>
<td>57 %</td>
</tr>
<tr>
<td>SV</td>
<td>38 ml</td>
<td>26 ml</td>
</tr>
<tr>
<td>Mass</td>
<td>44 g</td>
<td>44 g</td>
</tr>
<tr>
<td>TID</td>
<td>1.01 (S1 / R1)</td>
<td></td>
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</tbody>
</table>
### Interaction between Resting MBF, Stress MBF, and CFR

**Myocardial Blood Flow (mL/min/g) & CFR (Stress/Rest) from Base to Apex**

<table>
<thead>
<tr>
<th></th>
<th>LAD</th>
<th>RCA</th>
<th>Circumflex</th>
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<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Mid</td>
<td>Apex</td>
</tr>
<tr>
<td><strong>Rest</strong></td>
<td>1.28</td>
<td>1.24</td>
<td>1.02</td>
</tr>
<tr>
<td><strong>Stress</strong></td>
<td>3.43</td>
<td>3.59</td>
<td>2.69</td>
</tr>
<tr>
<td><strong>CFR</strong></td>
<td>2.68</td>
<td>2.89</td>
<td>2.63</td>
</tr>
<tr>
<td><strong>Interpret</strong></td>
<td>*7</td>
<td>*7</td>
<td>*7</td>
</tr>
</tbody>
</table>

**Table 1:** Interpretation based on [3]: *6: No ischemia, minimally reduced flow capacity; *7: Normal flow;
History

- 69 year-old female admitted to hospital after a cerebrovascular accident; found to be in atrial fibrillation; small increase in troponin i.
- PMH: Hypertension; Type II diabetes

Rest/dipyridamole stress Rubidium-82 myocardial perfusion PET study

Case courtesy of Tim Bateman, MD, Cardiovascular Consultants, Kansas City, MO
$^{82}$Rb PET Images

Near Balanced Flow Reduction

Case courtesy of Tim Bateman, MD, Cardiovascular Consultants, Kansas City, MO
\( ^{82}\text{Rb} \) PET Functional Images

PEAK STRESS
LVEF 50%

REST
LVEF 61%

Case courtesy of Tim Bateman, MD, Cardiovascular Consultants, Kansas City, MO
The combined test findings indicate the following:

1. Virtually diagnostic for the presence of CAD.
2. Apical ischemia probably in the distribution of the left anterior descending coronary artery.
3. Severe transient ventricular dilation, suggesting possible near-balanced flow reduction in multiple coronary territories.
4. Normal left ventricular function at rest (LVEF 61%).
5. Significant drop in LVEF in response to pharmacologic stress.
6. Prognostically concerning scan, with numerous markers of high-risk for major adverse coronary events.

Case courtesy of Tim Bateman, MD, Cardiovascular Consultants, Kansas City, MO
Cath Correlation

• Coronary angiography showed a 75% left main stenosis, a 90% stenosis of the mid LAD, and a 70% right coronary artery stenosis.

• CABG surgery was performed after recovery from the CVA.
Quantitative Coronary Flow Capacity for Risk Stratification and Clinical Decision Making: Is It Ready for Prime Time?

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See the associated article on page 410.

Semiquantitative evaluation of regional myocardial perfusion has been standard practice in nuclear cardiology for more than 3 decades. This approach has proven to be accurate and reproducible. Most importantly, semiquantitative measures of total perfusion deficit and myocardial ischemia are powerful markers of clinical risk and have served as clinically relevant guides to patient the underestimation of the extent of ischemia and obstructive atherosclerosis in the setting of multivessel CAD and the inability to identify patients with clinically important nonobstructive atherosclerosis. Indeed, a growing body of data have demonstrated that quantitative MBF and MFR are unique phenotyping tools to assess vascular health and preclinical atherosclerosis, which, in higher risk patients, can reveal flow-limiting coronary artery stenoses, thereby improving the accuracy of myocardial perfusion imaging in the diagnostic evaluation of known or suspected CAD (7–10). More recent data support the notion that coronary vascular dysfunction, as quantified by reduced MFR, is highly prevalent among patients with known or suspected CAD (11,12), increases the se-
Take Home Points – Myocardial Perfusion PET

- Low radiation exposure (1-5 mSv)
- Short acquisition protocols (< 1 hr w/ Rb-82)
- High-quality images (particularly helpful to minimize artifacts from tissue attenuation and scatter)
- High diagnostic accuracy
- Ability to calculate LVEF Reserve
- Ability to identify non-response to stress
- Strong prognostic power
Questions?
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Thank you!
Which of the following is an advantage of SPECT over PET for myocardial perfusion imaging?

A. Ability to obtain LVEF reserve
B. Shorter acquisition times
C. Lower radiation dose
D. Ability to perform treadmill stress
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A. Ability to obtain LVEF reserve  
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D. Ability to perform treadmill stress
D is correct, exercise stress remains the preferred stress modality for optimal risk assessment. However, patients referred for PET MPI all undergo pharmacologic stress since the currently FDA-approved positron-emitting tracers (Rb-82 & N-13 Ammonia) have very short half-lives, thereby precluding upright exercise testing with its inherent delay in moving patients post-exercise for imaging in the PET camera. If/when F-18 Flupiridaz is approved, the longer half-life associated with this tracer will allow for treadmill stress.

Ability to obtain LVEF reserve, shorter acquisition times, and lower radiation dose are all benefits of PET myocardial perfusion imaging over SPECT.

References:


Myocardial flow reserve (MFR) is:

A. The ratio of resting MBF to MBF during maximal coronary vasodilation

B. The ratio of MBF during maximal coronary vasodilation to resting MBF

C. Resting MBF + MBF during maximal coronary vasodilation/resting MBF

D. Resting MBF + MBF during maximal coronary vasodilation/ MBF during maximal coronary vasodilation
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