Disclosure

Neither I nor my immediate family members have a financial relationship with a commercial organization that may have a direct or indirect interest in the content.
Perfusion Options

- ECG stress
- Echocardiography
- Nuclear
  - SPECT
  - PET
- MRI
- CT
<table>
<thead>
<tr>
<th>Modality</th>
<th>SEN</th>
<th>SPEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress ECG</td>
<td>61%</td>
<td>70%</td>
</tr>
<tr>
<td>Stress Echo</td>
<td>79%</td>
<td>87%</td>
</tr>
<tr>
<td>SPECT</td>
<td>88%</td>
<td>73%</td>
</tr>
<tr>
<td>MRI</td>
<td>93%</td>
<td>75%</td>
</tr>
<tr>
<td>CCTA</td>
<td>81%</td>
<td>71%</td>
</tr>
<tr>
<td>CT perfusion/viability</td>
<td>89%</td>
<td>96%</td>
</tr>
</tbody>
</table>

Based on Gold standard of > 50% stenosis on Angiography

*Andrew Bierhals, MD, MPH: “Cardiac Perfusion and Viability Detection with Computed Tomography” July 2011
Perfusion MRI vs. SPECT

There are many possible justifications for choosing MRI. These include:

- Higher spatial resolution
- Shorter exam time
- Absence of soft tissue attenuation artifacts
- No radiation
- More accurate quantitative assessment of myocardial viability and ventricular/valvular function
- Subendocardial vs. transmural
MR Perfusion Stress Agents: Past and Present

- **Dipyridamole (persantine)**
  - **0.142-mg/kg/min IV infusion over 4 minutes**

- **Adenoscan (adenosine)**
  - **140-μg/kg/min IV infusion over 4-6 minutes**

- **Lexiscan (regadenoson)**
  - **0.4-mg/5mL IV bolus injection**
The stress chemical agent mostly used today in the cardiac MRI setting is Lexiscan.

The preferred contrast agent at our site for perfusion MRI’s is Multihance.
Lexiscan Stress Indications in the MRI setting

Alternative to exercise stress testing for:

- Patients with Angina Pectoris
- Risk stratification
- Surgical clearance
- Post MI and coronary revascularization procedures
- Patients with risk factors for CAD or atypical chest pain
What is Lexiscan?

- An A2a adenosine receptor agonist

- Regadenoson has a 2- to 3-minute biological half-life, as compared with adenosine's 30-second half-life.

- Regadenoson stress protocols using a single bolus have been developed, obviating the need for a second intravenous line.
Regadenoson Stress Patient Preparation

- Restriction of Xanthine containing products 24-36 hours before test (Tea, coffee, Uniphyl, Theo-Dur, Slo-Bid, Theophylline etc.) Theophylline is the antidote for Adenosine.
- NPO at least 6, however best if 8 hrs. before test
- No caffeine at least 6, however best if 24 hrs. before test
- No tobacco for 4 hrs. before test
- Any prior studies with results should be available and reviewed by clinician.
- Cardiac enzymes (CK, CK-MB, Troponin) reviewed only in case of angina symptoms
- Prior 12 lead EKG available and reviewed
- Order for perfusion MRI checked and precertification completed.
- Patient ruled out for metal, claustrophobia and prior allergies to gadolinium
Regadenoson Stress Patient Preparation 2

- Stress test explained and Regadenoson consent form completed
- Chest prepared, EKG electrodes placed
- IV access obtained with a large bore catheter no smaller than a #20 gauge. (A smaller catheter will result in having to slow down contrast bolus which may result in a less than optimum study.)
- Creatinine level checked for GFR calculation
- Baseline EKG, BP, HR and pulse oximetry
- Auscultate lung sounds
- Practice breath holds for long and shallow breathing
- Crash cart available
- IV sedation PRN. (Versed 1mg. IVP)
- With IV sedation -O₂ via nasal cannula at 2L/min
Lexiscan Stress Perfusion
CMR Scanning Protocol 1

- Scout images
  - TrueFISP multi-slice 3-plane localizers
  - Transverse stack of TrueFISP breathholds
- Breath held Cine images (steady state free procession (SS_TrueFISP))
  - Single 2-chamber LA
  - Single 4-chamber LA
  - Short axis stack (10mm thick-contiguous)
    - Start with mid-ventricular level (to check FOV)
      - Adjust position to “off-center-shift”
      - Type in desired position of center SA image in SHIFT frame
  - LVOT Cine (Rule out aortic stenosis)
Lexiscan Stress Perfusion CMR Scanning Protocol 2

- Trial dynamic stress
  - Choose 5 stress slices from short axis for dynamic run to match a cine SA image (Hx to slice positions, above)
    - Group 1 is 5 slices extending from base to mid-ventricular level
- RN/MD enters MRI room to begin stress portion
  - Informs pt.
  - Checks baseline HR and BP (repeated every min. for approx. 15 min.)
  - Establishes communication with tech in control room with arm raised prior to injection, the arm going down is the time that Regadenoson 0.4mg is finished being injected
  - The IV line is then flushed with saline and the contrast line is available for infusion of multihance
Stress perfusion begins-dynamic stress option
  • After injection of Regadenoson, check HR and adjust TR to acquisition window
  • If HR >100 (use a TR <70ms or lower)
  • Alternately, acquire every other beat
  • SCAN: Start acquiring dynamic TGRAPPA sequence
  • Start Multihance (0.075 mmol/kg at 5mL/s) wait 3 heartbeats to inject
  • Follow with a 15mL saline flush
  • Start breathhold when contrast seen in RV

Administer remainder of full dose (0.25mmol/kg) Multihance IV>
Lexiscan Stress Perfusion CMR Scanning Protocol 4

- 10-15 minute wait prior to next dose of gadolinium (to wait until regadenoson effects decreased) – DURING THIS WAIT
- TI scout
- Delayed enhancement (PSIR turboFLASH)
  - Use determined T1
  - Stack SA to include SA imaged above
  - Single 4 CH LA
  - Single 2 CH LA
- Start dynamic rest images (used to distinguish stress defects from artifact)
Lexiscan Stress Perfusion
CMR Scanning Protocol 5

- Start dynamic rest images (used to distinguish stress defects from artifact)
  Copy same image position as for dynamic stress
  use same 5 slices used for stress by typing in the position
- SCAN: start acquiring dynamic TGRAPPA sequence
- Start Multihance (0.075 mmol/kg at 5 mL/s) WAIT 3 heartbeats to inject
  • Follow with saline flush (15mL @ 5 mL/s)
- Start breathhold when contrast seen in RV

Study complete!
Food for Thought

- Overall, since the CPT code (75563) was introduced in 2008, relatively few cardiac stress perfusion MRI’s have been performed.

- Why haven’t there been more cardiac perfusion MRI’s ordered since it is now reimbursed?

- Should SPECT and perfusion MRI be considered equivalent imaging modalities?
Special Thanks

- Advanced Cardiac Imaging (Cardiac CT/MRI)
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