D-SPECT®
and
Dynamic SPECT (CFR)
Why Do We Need to Assess Coronary Flow?

The problem with SPECT MPI:
- SPECT myocardial perfusion imaging has relatively high sensitivity but low specificity
- SPECT can underestimate disease extent
  - SPECT interpretation can frequently have equivocal findings
  - Balanced reduction in flow can result in a “normal” looking perfusion study
  - Marked variability in quality of study interpretation

Clinical scenarios where quantification is beneficial:
- Patients with:
  > Multi-vessel CAD
  > Microvascular disease (diabetics, often women, etc)
  > Balanced multi-vessel disease
  > Equivocal perfusion findings

What additional clinical information does coronary flow reserve information provide?
- Provides independent quantitative information about all myocardial territories
- Quantification provides information to help interpret subtle perfusion irregularities
Step 1

Dynamic SPECT Acquisition
The spatial and temporal resolution of D-SPECT allows creation of a video of regional myocardial flow in 3D.

Step 2

Rebinning, Reconstruct, Quantitation
Why is Coronary Flow Reserve Measurement Different than Perfusion & FFR?

- Standard SPECT MPI assessment is based purely on relative perfusion distribution.

- Coronary flow reserve quantitation measures *integrated* hemodynamic effects of epicardial CAD, diffuse atherosclerosis, vessel remodeling and microvascular dysfunction on myocardial tissue perfusion.

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

Courtesy of Drs. Taqueti and Di Carli, Brigham and Women’s Hospital.
What Do I Need To Perform Dynamic SPECT Acquisition and Processing?
Components

• Will need an injector to ensure a quality bolus injection every time
  ❑ **Injector basic requirements:**
    ✓ Injection speed: 1 to 2 ml/sec
    ✓ Saline injection: 45cc per injection
    ✓ Single or double syringe (customer decision based on use of Regadenason)
• Dynamic SPECT* acquisition and reconstruction software (requires 9 detector system)
• INVIA CFR software license
Dynamic SPECT Rest-Stress Protocol

Injection method
Radiopharmaceutical: $^{99m}$Tc-Sestamibi
1. Positioning: 37 MBq (1 mCi)
2. Resting Dynamic Scan: 148 MBq (4 mCi)
3. Stress Dynamic Scan: 555 MBq (15 mCi)

Injector
- Automation
- Tight Bolus
- Reproducibility
- Controlled Injected Activity
- Stress Agent Injection

Dynamic Imaging Protocol

- 37 MBq (1 mCi) → Rest dynamic acquisition ~ 8 min → Delay 25 min → Resting perfusion scan ~ 8 min*
- Stress agent
- POS 0.5 min → Pharmacologic stress agent infusion
- Stress dynamic acquisition ~ 8 min → Delay 25 min → Stress perfusion scan ~ 4 min*

*Perfusion imaging times may differ depending on patient BMI.
Why Do We Need an Injector?

- Tight bolus required for time activity curves with clear peak
- Automates the process making it repeatable
- Reproducible
- Reduced exposure
- Double barrel injectors can control stress agent administration
Clinical Case Review
Case 1: Perfusion Scan

71yo male, HT, VSA

It looks normal

Courtesy of Nihon University, Japan
Case 1: Dynamic Scan

Global Results

<table>
<thead>
<tr>
<th>Region</th>
<th>MC Str (%)</th>
<th>MC Rat (%)</th>
<th>Flow (ml/min/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC Str</td>
<td>MC Rat</td>
<td>MC Str</td>
</tr>
<tr>
<td>LAD</td>
<td>79%</td>
<td>79%</td>
<td>2.36</td>
</tr>
<tr>
<td>LCX</td>
<td>79%</td>
<td>81%</td>
<td>2.23</td>
</tr>
<tr>
<td>RCA</td>
<td>68%</td>
<td>68%</td>
<td>1.64</td>
</tr>
<tr>
<td>TOT</td>
<td>76%</td>
<td>77%</td>
<td>2.11</td>
</tr>
</tbody>
</table>

Perfusion

Flow (ml/min/g)

MC Str Time Activity Curves

MC Rat Time Activity Curves

It is normal

Courtesy of Nihon University, Japan
Case 2: Perfusion Scan

74yo male, HT, DM, DLP

It looks normal

Courtesy of Nihon University, Japan
Case 2: Dynamic Scan

It is abnormal
Case 3: Perfusion Scan

65yo female
HT, DM, DLP

Clear infero-lateral defect

Courtesy of CHU Caen, France
Case 3: Dynamic Scan

Global Results

<table>
<thead>
<tr>
<th>Region</th>
<th>MC Str</th>
<th>MC Rst</th>
<th>Flow (mL/min/g)</th>
<th>MC Str</th>
<th>MC Rst</th>
<th>Reserve</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAD</td>
<td>82 %</td>
<td>81 %</td>
<td>2.10</td>
<td>1.41</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>LCX</td>
<td>69 %</td>
<td>74 %</td>
<td>1.28</td>
<td>1.13</td>
<td>1.13</td>
<td></td>
</tr>
<tr>
<td>RCA</td>
<td>76 %</td>
<td>77 %</td>
<td>1.62</td>
<td>1.28</td>
<td>1.27</td>
<td></td>
</tr>
<tr>
<td>TOT</td>
<td>78 %</td>
<td>78 %</td>
<td>1.74</td>
<td>1.30</td>
<td>1.34</td>
<td></td>
</tr>
</tbody>
</table>

All territories are abnormal
Case 3: Cath-Lab

FFR:
- LAD: 0.47
- LCX: 0.74
- RCA: Occlusion

Courtesy of CHU Caen, France