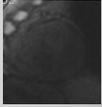
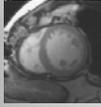


MRI of Myocardial Perfusion



May 11, 2006



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Potential Conflicts of Interest

Consultant / Research Support

- General Electric
- Berlex
- Mallinckrodt
- Guerbet

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Research Foundation

Note

None of the Gadolinium Based MR Contrast Agents are Approved by the FDA for Use in the Imaging the Heart or Vascular System

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Why Perfusion Imaging?

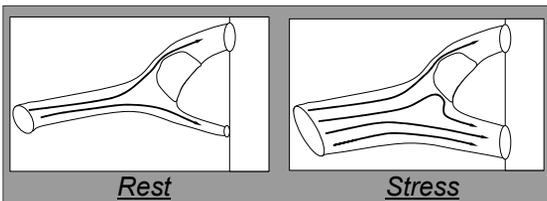
Is there coronary artery disease that can limit the amount of blood that supplies the left ventricle?
And, if so, where is it?

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Stress Perfusion MRI

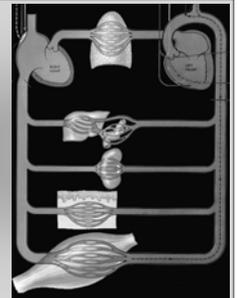
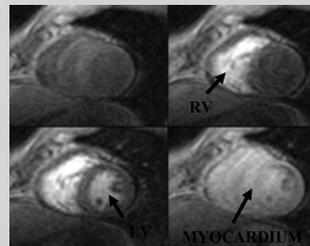
Rationale:

Significant Coronary Artery Disease Limits Myocardial Perfusion During Stress, but Not at Rest.



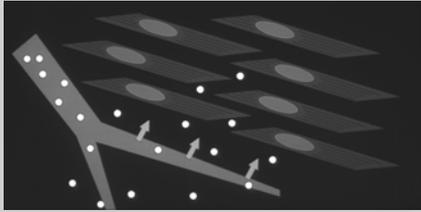
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Stress Perfusion MRI



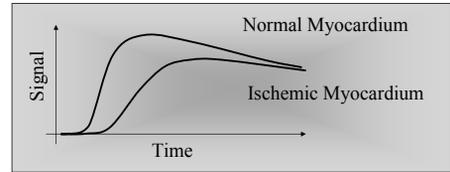
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First Pass: Extravascular Agent



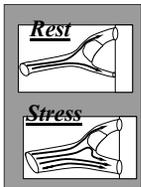
Stress Perfusion MRI

Regions of Decreased Myocardial Perfusion Have *Delayed* and *Diminished* Enhancement



“Dark Spots are Bad”

Methods for Inducing Stress



1. Increase Demand

- Exercise
 - Treadmill
 - Bicycle
 - Pacing
- } *Physiologic*
- Dobutamine

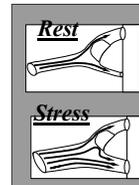
Disadvantages:

- Produces Ischemia (Demand > Supply) – *Monitoring?*
- Time Consuming

Methods for Inducing Stress

2. Increase Blood Flow (up to 3-5x)

- Dipyridamole (*blocks reabsorption of Adenosine*)
- Adenosine (*7 sec half-life*)



Advantages of Adenosine:

- Does not produce ischemia (generally)
- Quick acting
- Do not need to reverse with aminophylline

Adenosine Perfusion MRI

Contraindications:

Adenosine:

- Asthma
- Second or Third Degree AV Block

MRI:

- Pacemaker, AICD, etc..

Adenosine Perfusion MRI

Patient Preparation:

- No Caffeine for prior 24 hours
- 2 Intravenous Lines in Separate Extremities
 - 24 Gauge for Adenosine (*slow infusion*)
 - 22 Gauge for Gadolinium contrast (*bolus*)

Monitoring Adenosine Perfusion MRI

During the Stress:

- Monitor Patient for Symptoms
 - Flushing and Warmth
 - Headache (“Pressure Behind Ears”)
 - Chest Pressure or Increased Respiration
- Monitor EKG & Pulse Oximeter
 - Bradycardia, 2° or 3° Heart Block



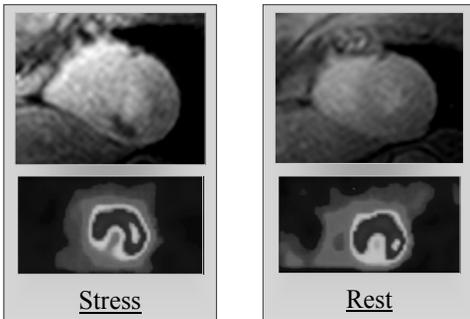
(In Our Outpatient Center: ACLS Certified Radiologist or Cardiologist)

Equipment and Set Up

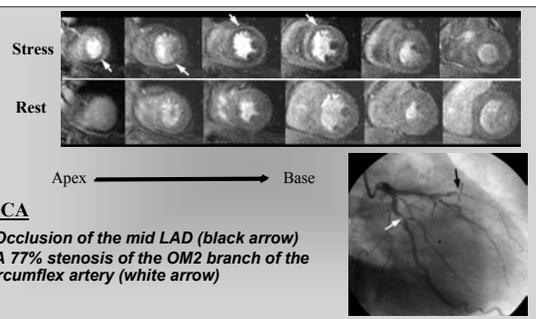
MRI Compatible Drug Infusion Pump



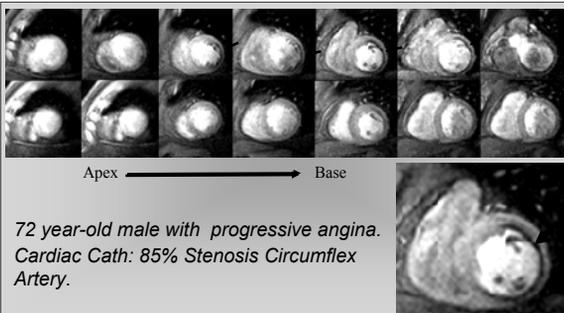
Perfusion MRI vs. Nuclear Medicine



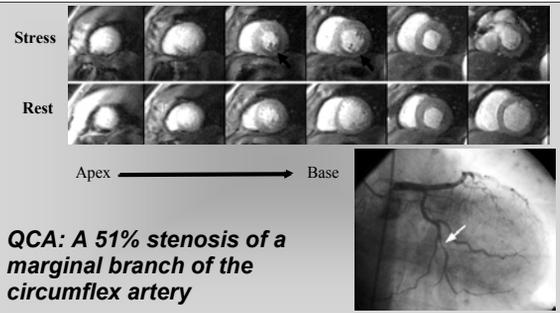
Perfusion MRI: Cath Correlation



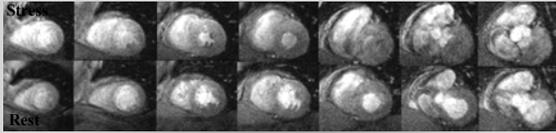
Subendocardial Perfusion Defect



Perfusion MRI: Cath Correlation



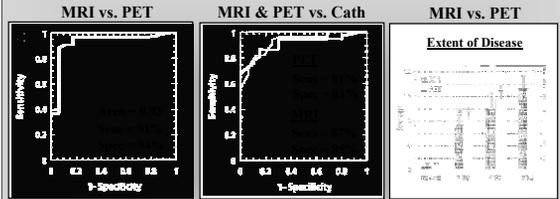
Normal MRI Perfusion Study



64 year old male with multiple risk factors for CAD.
Nuclear perfusion study was abnormal.
Coronary Cath: No significant coronary artery disease.

Perfusion MRI: Comparison to PET and Cath

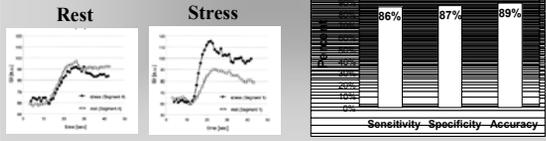
48 patients scheduled for coronary cath for suspected coronary artery disease.



- High correlation between MRI and PET
- MRI stress perfusion reliably identifies CAD
- Provides information on amount of compromised muscle.
- Can define subendocardial perfusion abnormalities

MRI: Adenosine Stress Perfusion

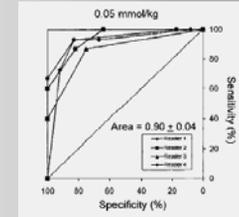
- 84 patients: Scheduled for 1st coronary catheterization
- Prevalence of CAD: 51% (>50% diameter stenosis)
1VD = 19, 2VD = 9, 3VD = 15
- Stress / Rest MRI studies
- Semi quantitative analysis



Myocardial First-Pass Perfusion Magnetic Resonance Imaging

A Multicenter Dose-Ranging Study

S.D. Wolff, MD, PhD; J. Schwitzer, MD; R. Couden, MD; M.G. Friedrich, MD; D.A. Bluemke, MD, PhD; R.W. Biederman, MD; E.T. Martin, MD; A.J. Lansky, MD; F. Kashanian, MD; T.K.F. Foo, PhD; P.F. Ilicato, MS; C.R. Concan, BS, RT



Sensitivity: $90 \pm 3\%$

Specificity: $81 \pm 4\%$

Accuracy: $86\% \pm 3\%$

$n=99$

Conclusions—First-pass perfusion MRI is a safe and accurate test for identifying patients with obstructive coronary artery disease. A low dose of 0.05 mmol/kg gadopentetate dimeglumine is at least as efficacious as higher doses. (Circulation. 2004;110:732-737.)

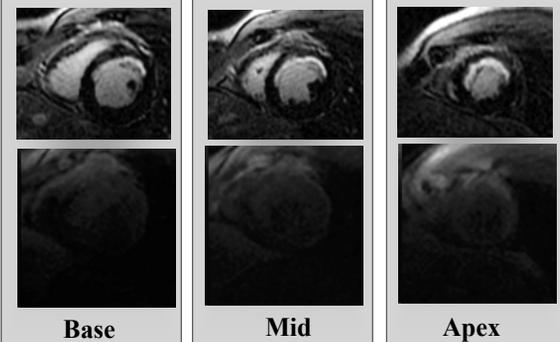
Why Stress Perfusion Alone is Not Enough

A Stress Perfusion Defect Indicates Either a Flow Limiting Stenosis or a Scar

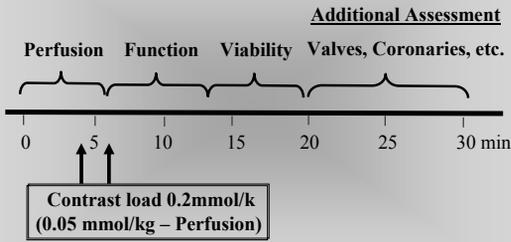
Stress Perfusion Defect	Stenosis or Scar
Rest Perfusion Defect	Scar
Hyperenhancement	Scar

Hyperenhancement is Probably Better Than Rest Perfusion

Stress Perfusion / Viability: Matched



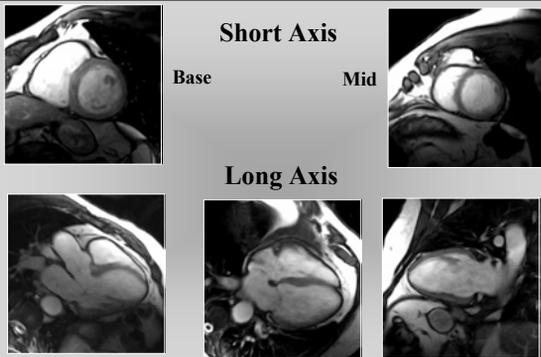
Integrated Cardiac Exam



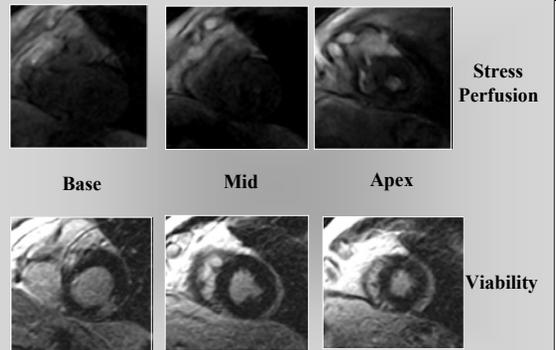
Case Study

- 71 year-old man with a history of previous MI and RCA stent placement
- Few recent episodes of chest pain
- Is there significant coronary artery disease?

Results: Normal Global & Regional Systolic Function



Results: Perfusion and Viability



Cardiac MRI Report

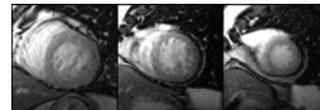
Impression

Post-contrast images show a small, transmural infarct inferolaterally at the base. First-pass imaging with adenosine (1.40mg/kg/min) shows a moderate amount of reversible ischemia inferiorly, septally and apically.

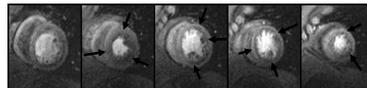
Coronary Catheterization:

- Occlusion of the Cx after the origin of the OM1
- Widely patent RCA with no intrastent restenosis

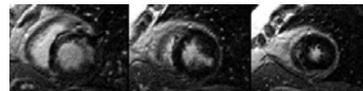
Clinical Case: Chest Pain



Function
Normal (EF = 58%)
Mild LVH



Perfusion
Global Ischemia



Viability
Small Anterobasal Infarct

