

The background of the slide features the Brown University crest on the left, which includes a sun with a face and two open books. On the right, there is a detailed anatomical illustration of a human heart. The main title is centered in large, bold, white, italicized font.

# ***CARDIAC CT & MRI: USES & LIMITATIONS***

*Michael K. Atalay, MD, PhD, FSCCT*

*Director, Cardiac MRI & CT*

*Rhode Island Hospital/The Miriam Hospital*

*Asst. Professor Diagnostic Imaging & Medicine,*

*Alpert Medical School of Brown University*

The logo features a stylized sun with a face and rays in the upper left, and a shield with a red cross and two open books in the lower left. The background is dark blue with a gradient.

# OVERVIEW

- Cardiac CT → *Virtual angiogram*

- *CPT 75574—CT Angiography, heart, coronary arteries and bypass grafts with contrast*

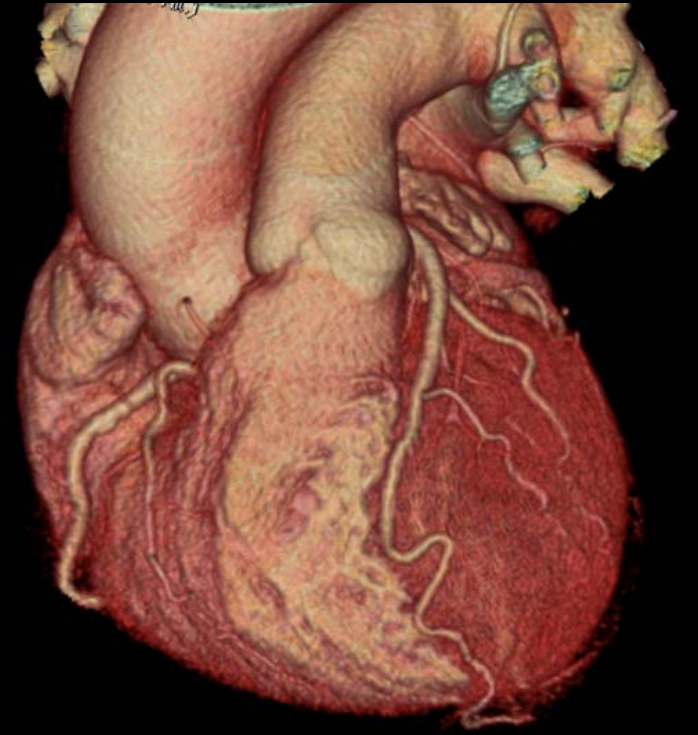
- Cardiac MRI → *Imaging of infarction*  
→ *Assess heart function*

- *CPT 75561—CMR for morphology and function without & with contrast material*

# CARDIAC CT FOR CAD DETECTION

## *Advantages vs. other imaging methods*

- Very fast (<8 sec)
- 3-D technique with very high spatial resolution (~0.4 mm)
- Convenient & non-invasive
- *Very high negative predictive value*





# DETECTION OF SIGNIFICANT BLOCKAGE ( $\geq 50\%$ ) WITH CCT

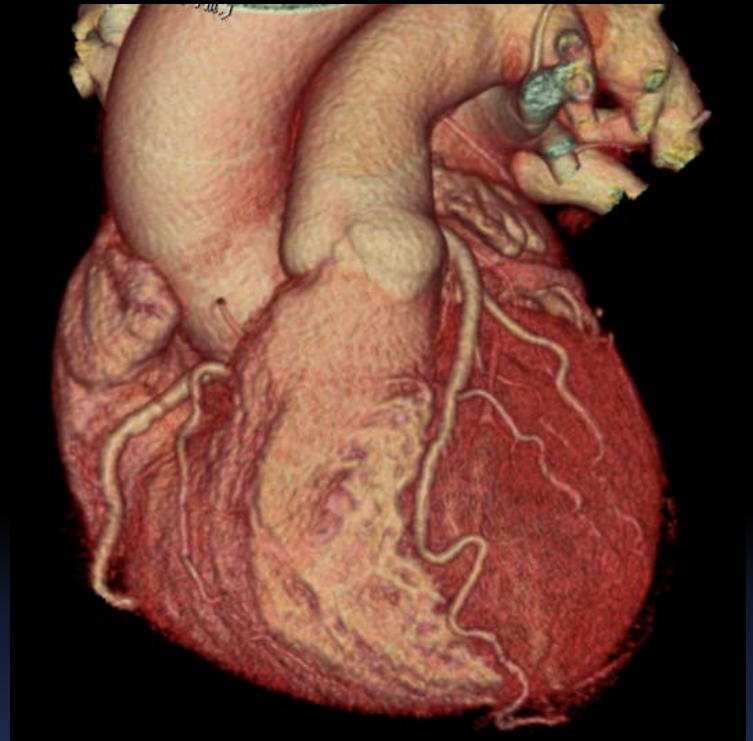
Study Report	PPV	NPV	Sens.	Spec.
Leschka 2005	87	99	94	97
Raff 2005	66	98	86	95
Mollet 2005	76	99	99	95
Ehara 2006	89	95	98	86
Plass 2006	91	98	93	97

*If CCT is normal, then there is no sig CAD!*

# CARDIAC CT

## *Disadvantages*

- Radiation
- Iodinated contrast
  - Risk of allergy
  - Nephrotoxic
- *Can't treat lesions\**



\*62% of elective catheterizations in the US demonstrate no significant obstructive CAD, with no CAD in 39%. *Patel et al, NEJM 2010;362;886-95*



# CCT: PREPARATION

- **No** caffeine for 12<sup>o</sup>
  - Oral &/or IV  $\beta$ -blocker to lower heart rate
  - 18 gauge IV in arm
  - Sublingual NTG pill
  - CCT: 130 cc IV dye
- 
- » 15 min. for entire study,
  - » *CCT in ~8 seconds!*



CCT ANGIOGRAM

# PRETEST PROBABILITY FOR CAD

Age	Sex	Typical/Definite Angina	Atypical/Probable Angina	Non-anginal Chest Pain	Asymptomatic
<39	M	Intermediate	Intermediate	Low	Very low
	F	Intermediate	Very low	Very low	Very low
40-49	M	High	Intermediate	Intermediate	Low
	F	Intermediate	Low	Very low	Very low
50-59	M	High	Intermediate	Intermediate	Low
	F	Intermediate	Intermediate	Low	Very low
>60	M	High	Intermediate	Intermediate	Low
	F	High	Intermediate	Intermediate	Low

**High:** >90% pretest probability

**Low:** 5-10% pretest probability

**Intermediate:** 10-90% pretest probability

**Very low:** <5% pretest probability





# APPROPRIATE USE OF CCT (1)

## Detection of CAD in Symptomatic Patients Without Known Heart Dz **Symptomatic — Non-acute Symptoms**

1	<ul style="list-style-type: none"><li>• ECG Interpretable AND</li><li>• Able to Exercise</li><li>• Intermediate pretest probability of CAD</li></ul>
2	<ul style="list-style-type: none"><li>• ECG Uninterpretable or unable to exercise</li><li>• Low OR Intermediate pretest probability of CAD</li></ul>

## Detection of CAD in Symptomatic Patients Without Known Heart Dz **Symptomatic — Acute Symptoms With Suspicion of ACS**

1	<ul style="list-style-type: none"><li>• Normal ECG and cardiac biomarkers</li><li>• Low OR Intermediate pretest probability of CAD</li></ul>
2	<ul style="list-style-type: none"><li>• ECG Uninterpretable</li><li>• Low OR Intermediate pretest probability of CAD</li></ul>
3	<ul style="list-style-type: none"><li>• Nondiagnostic ECG or equivocal biomarkers</li><li>• Low OR Intermediate pretest probability of CAD</li></ul>

*Taylor et al, JACC 2010;56;1864-94*



# APPROPRIATE USE OF CCT (2)

## Now-Onset or Newly Diagnosed Heart Failure and No Prior CAD

- |   |   |
|---|---|
| 1 | <ul style="list-style-type: none"><li>• Reduced LV ejection fraction</li><li>• Low OR Intermediate pretest probability of CAD</li></ul> |
|---|---|

## Sequential Testing After Stress Imaging Procedures

- |   |   |
|---|---|
| 1 | <ul style="list-style-type: none"><li>• Discordant ECG exercise and imaging results</li></ul>                 |
| 2 | <ul style="list-style-type: none"><li>• Equivocal stress imaging results</li></ul>                            |
| 3 | <ul style="list-style-type: none"><li>• New/worsening symptoms w/ prior normal stress imaging study</li></ul> |

## After Prior ECG Exercise Testing

- |   |  |
|---|--|
| 1 | <ul style="list-style-type: none"><li>• Normal ECG exercise test</li><li>• Continued symptoms</li></ul>                                |
| 2 | <ul style="list-style-type: none"><li>• Prior ECG exercise testing</li><li>• Duke Treadmill score—intermediate risk findings</li></ul> |

*Taylor et al, JACC 2010;56;1864-94*

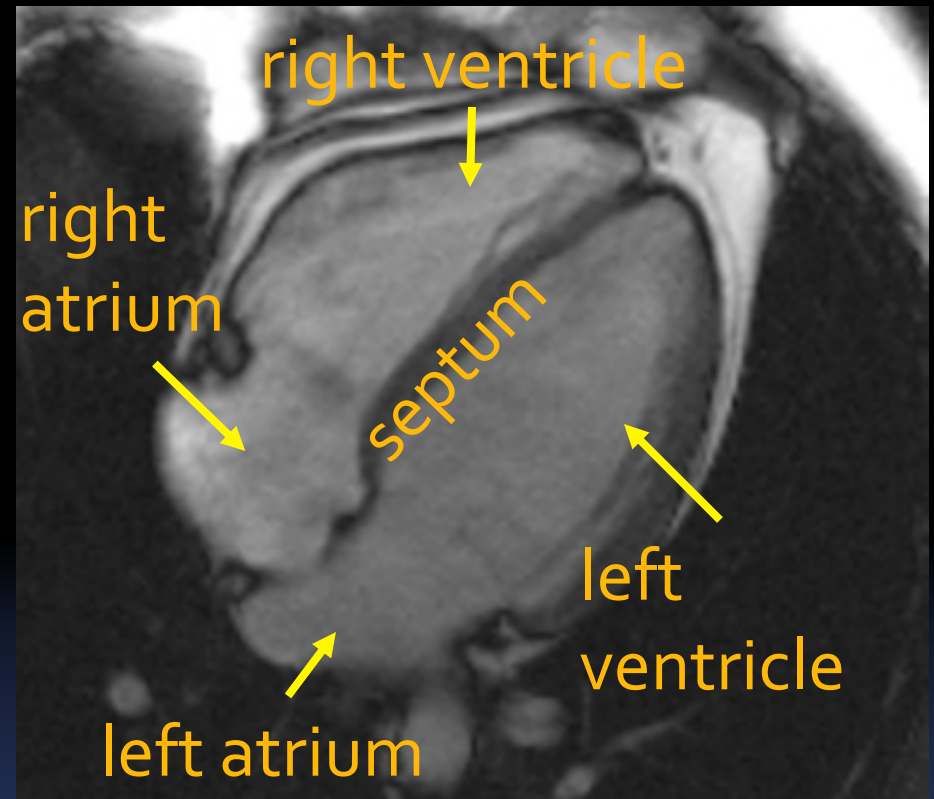
# CARDIAC MRI

- MRI uses strong magnets and radio waves to generate images
- MRI is safe:
  - No radiation
  - Non-allergenic dye



# CARDIAC MRI: ANATOMY & FUNCTION

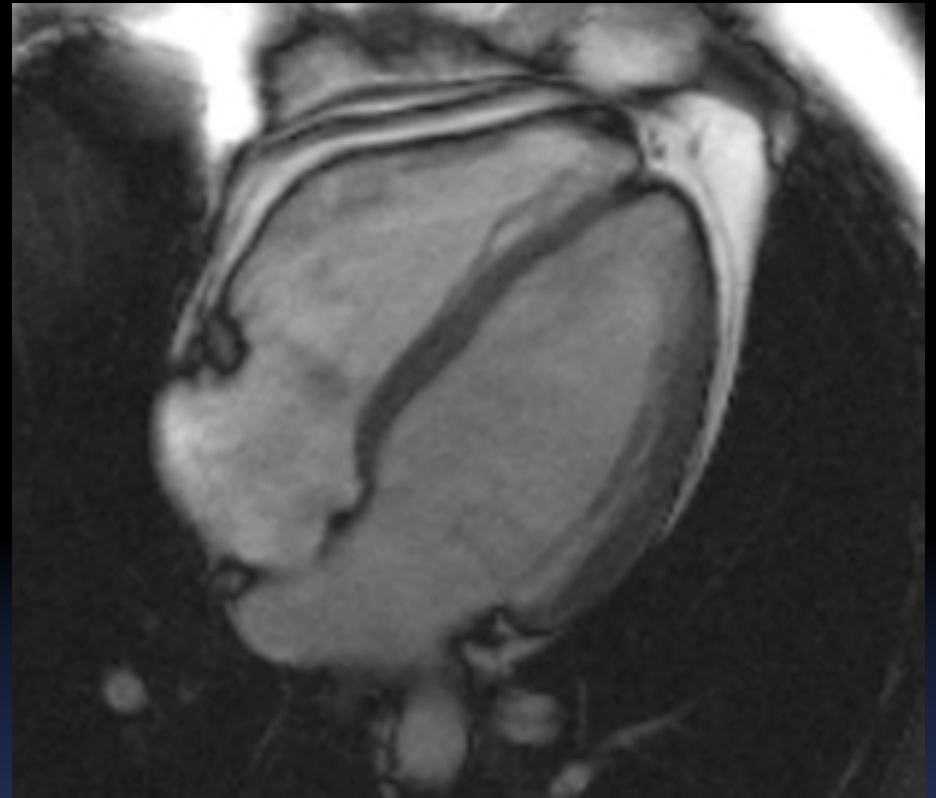
- MRI offers superb assessment of *anatomy*





# CARDIAC MRI: ANATOMY & FUNCTION

- MRI offers superb assessment of *anatomy & function*



# CARDIAC MRI: INFARCT IMAGING

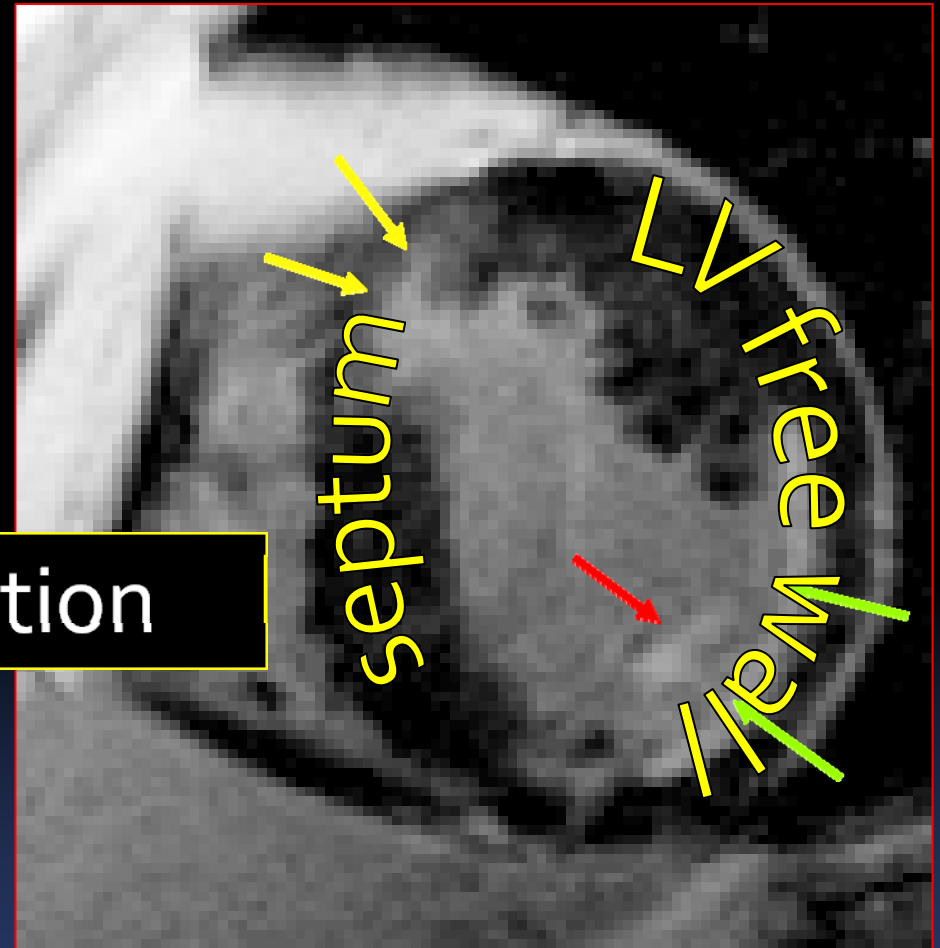
- *MRI with contrast delineates MI*



# CARDIAC MRI: INFARCT IMAGING

- *MRI with contrast delineates MI*

Myocardial infarction





# APPROPRIATE USE OF CMR (1)

## Evaluation of Myocardial Scar for Viability

1	<ul style="list-style-type: none"><li>• To determine viability prior to revascularization</li><li>• Establish likelihood of recovery of function with revascularization (PCI or CBAG) or medical therapy</li></ul>
2	<ul style="list-style-type: none"><li>• To determine viability prior to revascularization</li><li>• Viability assessment by SPECT or dobutamine echo has provided “equivocal or indeterminate” results</li></ul>

*Hendel et al, JACC 2006;48;1475-97*





# APPROPRIATE USE OF CMR (2)

## Evaluation of Ventricular and Valvular Function

1	<ul style="list-style-type: none"><li>• Quantification of valvular disease</li></ul>
2	<ul style="list-style-type: none"><li>• Evaluation of LV function following MI OR in heart failure patients</li><li>• Patients with technically limited images from echocardiogram</li></ul>
3	<ul style="list-style-type: none"><li>• Quantification of LV function</li><li>• Discordant information that is clinically significant from prior tests</li></ul>
4	<ul style="list-style-type: none"><li>• Evaluation of specific cardiomyopathies (e.g. amyloid, sarcoid, HCM) or due to cardiotoxic therapies</li><li>• Used of late gadolinium enhancement</li></ul>

*Hendel et al, JACC 2006;48;1475-97*

The logo features a stylized sun with a face and rays in the upper left, and a shield with a red cross and two open books in the lower left. The background is dark blue with a gradient.

## SUMMARY

- Cardiac CT → *virtual angiogram*
- Cardiac MRI → *Imaging of infarction*  
→ *Assess heart function*
- *3D non-invasive methods for seeing the structure and function of the heart*



# *Thank-you*

matalay@lifespan.org

	RIH	TMH
MRI	444-4881	793-4448
CT	444-4819	793-4437