Modern Cardiac MRI

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Overview

• Introduction to CMR
• Assessment of Myocardial Infarction
• Applications of Viability Imaging
• Conclusions
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• Conclusions
Infarction
**Background**

In the United States

- >1 million myocardial infarctions per year, vast majority of which are caused by CAD
- Atherosclerosis affects > 10 million people

Heart disease is also a problem worldwide
Long and Short Axis Views

Long Axis View

Short Axis View
Aortic outflow Tract

Perpendicular View

From Cedars-Sinai Medical Center
Contrast-enhanced CMR

Pre-Gd  
Post-Gd
Disease and Diagnostic Modality
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Contrast-enhanced CMR

Pre-Gd

Post-Gd
High Resolution Ex Vivo

500 µm

X

500 µm

X

500 µm
Delayed Enhancement
Viability Assessment

TTC
Histopathology Comparison

TTC

MRI
TTC vs. Hyperenhancement

TTC vs MRI

3 days
Reperfused MI
Conclusion

Delayed gadolinium enhancement by CMR represents irreversible myocardial injury (dead regions)
(Bright is dead)
In vivo – Function & Viability

Cine MRI

Gd Enhanced
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Clinical Viability

- 67 yo with h/o 3-vessel CAD s/p PCI 1 yr ago c/o progressive fatigue
  - Stress radionuclide imaging evidence of reversible ischemia at the base and severe left ventricular dysfunction (EF of 26%)
Cine - Pre

\[ EF = 34\% \]

Cine - Post

\[ 4 \text{ months} \]

\[ EF = 55\% \]
Clinical Viability

• 52 yo female present with new onset of typical angina
Clinical Viability

• Are there data that support the utility of CMR viability assessment for directing revascularization?
Clinical Viability

- 50 patients were studied pre versus post revasc
- Reversible myocardial dysfunction was identified by contrast-enhanced MRI before coronary revascularization.

Kim et al, NEJM, 2000;343:1445–53
Clinical Viability

• Are there additional role of CMR viability assessment for directing therapies?
  – Ventricular reconstruction
  – Prediction of functional recovery after revascularization
  – Prediction of sudden cardiac death
Background

• Sudden cardiac death kills 400,000 people in the US each year

• Most sudden cardiac deaths are believed to be due to arrhythmias

• 2-15% of such patients reach the hospital
Background

- Myocardial scar size is related to inducibility of VT

**Hypothesis**

- Infarct characteristics predict inducible ventricular arrhythmias during invasive electrophysiologic study

Bello, Fieno et al, JACC, 2005; 45:1104–8
Study Population

• 48 patients with informed consent to MRI protocol were enrolled from Northwestern Memorial Hospital and Lakeside Veterans Administration

• All patients had coronary artery disease

• All patients were undergoing invasive electrophysiological testing

Bello, Fieno et al, JACC, 2005; 45:1104–8
Image Analysis

Diastole  Systole  Contrast  Contours

Base
Mid
Apex
Electrophysiologic Testing

• Patients were studied with a standard electrophysiologic protocol

• Inducibility was characterized as follows:
  – Non-inducible
  – Sustained Monomorphvic Ventricular Tachycardia
  – Polymorphic Ventricular Tachycardia, Ventricular Fibrillation, or Ventricular Flutter
Patient 1: CAD, LV dysf, EF< 30%  Inducible Mono VT
Patient 2: CAD, LV dysf, EF< 30%  Non - Inducible
Patient 3: CAD, EF > 30%  Inducible Mono VT
Patient 4: CAD, EF > 30%  Non-Inducible
Receiver-Operator Curves

Sensitivity

1 - Specificity

- Infarct Surface Area
- Infarct Mass
- Ejection Fraction
Conclusions

• Infarct size is a better predictor for inducible monomorphic ventricular tachycardia than ejection fraction
Clinical Implications

• Cardiac MRI could be an important test to identify patients at risk for sudden cardiac death
Prevention following MI

• To establish who is at risk:
  – Echo
  – Holter
  – EP testing
  – Heart rate variability
  – SAECG
  – T wave alternans
  – Stress test (nuclear or echo)
  – Coronary angiography

Contrast enhanced MRI
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Conclusions

• Delayed gadolinium enhancement represents irreversible myocardial injury
Conclusions

• Clinical applications of CMR assessment of myocardial viability include:

  – Prediction of recovery after revascularization

  – Planning for ventricular reconstruction

  – Assessment of myocardial scar size
Thank you

Cine MRI  
Gd Hyperenhanced