Why Cardiac MRI?

Presented by:

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Disclosures

• I have no financial disclosures
Objectives

• Review basic principles of Cardiac MRI.
• What patient characteristics do I need to consider before ordering a cardiac MRI?
• Review key MRI findings identified in ischemic and non-ischemic cardiomyopathies.
• Review other cardiac MRI applications.
• Review the appropriate use criteria.
• Cardiac MRI is the non-invasive tool of choice for the evaluation of myocardial tissue characteristics
  
  – Myocardial structure
  
  – Myocardial function

It can also be used for myocardial viability but does not give tissue metabolic activity which can be obtained from PET Myocardial viability studies
Principle: Nuclear magnetic resonance
In the presence of a strong magnetic field
hydrogen ions are stimulated to emit radio waves
Radio waves are detected by a coil put over or
around the body part of interest.
Images of the structure are reconstructed based
on radio waves emitted.
Magnetic gradients (banging sounds) are
introduced to capture data and reconstruct images.
• MRI allows accurate image reconstruction because studies are gated and a small amount of data is collected while the heart is continually moving.

• Data is collected at the same point in several cardiac cycles allowing for image reconstruction limiting distortion from cardiac motion.
Inherent magnetic relaxation times are used to characterize tissue structure

- T1 Longitudinal Relaxation Time
- T2 Transverse Relaxation Time
- Alteration of the time and strength of the gradient fields along with the addition of contrast allows for evaluation of tissue characteristics such as edema, infarct, storage disease or tumors.
Contrast

- Gadolinium contrast – diffuses from the capillary to the extracellular space.
- Initially appears bright as it is perfused into the cardiac chambers and myocardium.
- Different relaxation times than blood or myocardium.
- Delayed images retain gadolinium in scarred, infarcted, injured or infiltrated myocardium.
Gadolinium Contrast

- Normal myocardium
- Acute infarction
- Scar

Intact cell membrane  Ruptured cell membrane  Collagen matrix
What do I need to consider?

- Can the patient lay still and almost flat for an hour?
- Is the patient claustrophobic?
- Is the patient able to follow instructions?
- Is the patient able to perform breath holds?
- Does the patient have an MRI compatible pacer or AICD?
- Can the patient receive gadolinium contrast GFR>30?
Ischemia/Infarct evaluation
Viability
Viability

< 2 Hours

2 - 6 Hours

> 6 Hours

Non - ischemic  Ischemic (viable)  Necrotic

The Chattanooga Heart Institute Memorial
45 F with CP negative cardiac catheterization and prior viral illness
Myocarditis
Hypertrophic cardiomyopathy
Sarcoidosis
patchy to band like
Noncompaction cardiomyopathy
Noncompacted:Compacted 2.3 to 1
Hemochromatosis

T2 weighted imaging Normal = 40ms
Abnormal < 20 ms

Normal liver
Iron deposition in liver
ARVD
Arrhythmogenic Right Ventricular Dysplasia T1 Fat Saturation

LV
RA
RV

The Chattanooga Heart Institute Memorial
Other Infiltrative Diseases

- Amyloidosis
- Metabolic storage diseases
  - Anderson-Fabry
  - Pompe
  - Gaucher
  - Neimann-Pick
a.

Ischemic
- Subendocardial infarct
- Transmural infarct

Nonischemic
- Midwall HE
- DCM, Myocarditis
- HCM, RV pressure overload
- HCM
- Sarcoidosis, Myocarditis, Anderson-Fabry’s disease, Chagas’ disease
- Epicardial HE
- Sarcoïdosis, Myocarditis, Anderson-Fabry’s disease, Chagas’ disease
- Global Endocardial HE
- Amyloidosis, Systemic sclerosis, Post cardiac transplant

b.
Cardiac Masses
Structural Heart disease

Cortriatriatum

VSD
Appropriate

• Evaluation of Chest Pain Syndrome with ECG un-interpretable or unable to exercise (CMR stress)
• Evaluation of Intra-cardiac Structures
• Cardiac Risk assessment with known disease
• Evaluation of complex congenital heart disease
• Evaluation of LV function post MI with technically limited images from echocardiogram
Appropriate

• Evaluation of specific cardiomyopathies
• Characterization of native and prosthetic cardiac valves in patients with limited echo or TEE
• Evaluation of arrhythmogenic right ventricular cardiomyopathy
• Evaluation of myocarditis or MI with normal coronary arteries
Appropriate

• Evaluation of cardiac mass
• Evaluation of pericardial conditions
• Evaluation for aortic dissection
• Evaluation of left atrium and pulmonary venous anatomy prior to ablation
Appropriate

- Location and extent of myocardial necrosis including no-flow regions
- Determine post PCI necrosis
- Determine viability prior to revascularization
References


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