Cardiac MRI in Clinical Practice
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Disclosures

No financial disclosures
✓ What is a cardiac MRI?
✓ Indications and Contraindications
✓ Comparative Cost
✓ Case Examples

“ ’I’m stumped. We’ll have to wait for the autopsy.’”
What is a Cardiac MRI?

- Non-invasive evaluation of cardiac function, cardiac structures, and cardiac pathology
- No ionizing radiation
- No iodinated contrast material (gadolinium based contrast)
What is a Cardiac MRI? – Patient Experience

- Inpatients and outpatients
- Peripheral IV insertion
- ECG lead attachment for gating
- Breath holding instructions
- Injection of gadolinium contrast material
- Anxiolytic medications can be provided for claustrophobia
- Exam time 30-45 minutes
What is a Cardiac MRI? – Basic Exam

Cardiac Structure and Function
What is a Cardiac MRI? – Basic Exam

Velocity Flow Mapping
What is a Cardiac MRI? – Basic Exam

Magnetic Resonance Angiography
What is a Cardiac MRI? – Basic Exam

Myocardial Perfusion Imaging

Stress

Rest
What is a Cardiac MRI? – Basic Exam

Delayed Myocardial Enhancement Imaging
What is a Cardiac MRI? – Basic Exam

HYPERENHANCEMENT PATTERNS

<table>
<thead>
<tr>
<th>Ischemic</th>
<th>Nonischemic</th>
</tr>
</thead>
</table>
| A. Subendocardial Infarct | A. Mid-wall HE
* Idiopathic Dilated Cardiomyopathy
* Myocarditis

| B. Transmural Infarct | B. Epicardial HE
* Sarcoidosis, Myocarditis, Anderson-Fabry, Chagas Disease

| C. Global Endocardial HE | • Amyloidosis, Systemic Sclerosis, Post cardiac transplantation |

Cardiac MRI - Indications

- Coronary atherosclerosis
  - Myocardial viability assessment
  - Pharmacologic stress perfusion imaging (stress test)

- Cardiomyopathy
  - Differentiate causes of unexplained cardiomyopathy (ischemic vs non-ischemic)
  - Evaluation for restrictive cardiomyopathy (i.e. hemochromatosis, amyloidosis, Anderson-Fabry’s disease, glycogen storage disease, ect)

- Valve disease - Quantification and severity of valve stenosis or regurgitation

- Ventricular arrhythmias
  - Evaluation for fibrosis, hypertrophic cardiomyopathy, arrhythmogenic right venricular dysplasia

- Congenital Heart Disease
  - Complete assessment - structure, function, associated abnormalities and shunt quantification

- Thoracic Aortic Disease
  - Aneurysm, dissection, intramural hematoma, large-vessel vasculitis, coarctation

- Cardiac Mass
  - Differentiate common benign and malignant cardiac masses

- Pre-procedure Planning
Cardiac MRI - Contraindications

- MRI Contraindications
  - Central Nervous Aneurysm Clips
  - Implanted Neural Stimulator
  - Cochlear Implant
  - Ocular foreign body
  - Implanted metallic devices (gastric pacemaker, ect)
  - Insulin pump
  - Metal shrapnel or retained bullet

- Cardiac MRI Specific
  - Implanted pacemaker or defibrillator
Cardiac MRI - Benefits

- Non-invasive imaging technique, no radiation exposure
- Superior imaging quality compared to echocardiogram
- Easily image cardiac structures that may be obscured by bone, air, fat, etc.
- More accurate assessment in patients with technically limited echocardiograms
- Gold-standard for assessment of left ventricular ejection fraction
- Assessment of the pericardium
- Proven usefulness for both diagnosis and management for a wide range of cardiac disease states
- Superior sensitivity and specificity for stress testing compared to other stress imaging modalities
- Gadolinium-based contrast material has a very low incidence of allergic reaction
- Most cases of Nephrogenic Systemic Fibrosis can be eliminated with use of a safe renal protocol
<table>
<thead>
<tr>
<th>Imaging Study</th>
<th>RVU</th>
<th>Medicare Reimbursement (2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-planar SPECT Myocardial Perfusion Stress Test (Physician Supervision + ECG and Image Interpretation)</td>
<td>15.87</td>
<td>$568.59</td>
</tr>
<tr>
<td>Complete Transthoracic Echocardiogram</td>
<td>6.42</td>
<td>$230.02</td>
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<tr>
<td>Stress Echocardiogram (Physician Supervision + ECG and Image Interpretation)</td>
<td>7.63</td>
<td>$273.37</td>
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<tr>
<td>Cardiac MRI with and without contrast</td>
<td>11.86</td>
<td>$424.92</td>
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<tr>
<td>Cardiac MRI with and without contrast + velocity flow mapping</td>
<td>13.4</td>
<td>$480.09</td>
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<tr>
<td>Stress Cardiac MRI</td>
<td>14.14</td>
<td>$506.61</td>
</tr>
</tbody>
</table>

“Final RVUs and Allowables 4Q 2015 Compared to CY 2016 Final Medicare Physician Fee Schedule (MPFS)”. American Society of Nuclear Cardiology. Information obtained from “CMS Website MPFS CY 2016 Final Rule”
58 year old female present with acute onset of chest pain
- History of prior myocardial infarction
- Left heart catheterization: Mid LAD – 98% complex lesion. Proximal RCA – 90% stenosis. Proximal LCx – 60%
- LVEF 30-35%

CABG versus PCI?
25 year old female 1 week of worsening chest pain, viral illness ~ 2 weeks prior

- Troponin 3.8. ECG with non-specific T wave changes

Cause of the elevated troponin?
19 year old Butler college student presented with syncope during exercise

- Initially unresponsive in field, AED applied and shock delivered x 2 with return of spontaneous circulation

Cause of her cardiac arrest?
65 year old African American male presented with 3 months of dyspnea, orthopnea, and PND

- Previous history of atrial fibrillation, ROS + for unexplained peripheral neuropathy

Evaluation of unexplained cardiomyopathy
38 year old Hispanic female presented with 6 months of dyspnea with exertion and edema

- Exam with persistently split S2 and loud P2 component
57 year old male presented with dyspnea and acute delerium

- Chronic sinus issues, fevers, chills, malaise for 6 months

MRI brain demonstrated small bilateral emboli
Evaluate for left ventricular mural thrombus
52 year old African American male presented with pre-syncope

- CXR with hilar adenopathy, Telemetry demonstrated multiple runs of NSVT
- LHC showed angiographically normal coronaries
- Evaluation for Nonsustained Ventricular Tachycardia
Cardiac MRI - Cases

61 year old Caucasian male evaluated for dyspnea
  • Echo concerning for a possible LA mass
Cardiac MRI ordered to characterize mass
32 year old female with a history of SLE and anti-phospholipid syndrome presented with acute onset of chest pain and peripheral edema

- Troponin elevated > 50
24 year old male with an aborted cardiac arrest
Questions?

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