Multimodality Cardiac Imaging: Which Test for Which Indication?

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Acknowledgements:
Shuai Leng, PhD
Kiaran McGee, PhD
Jerome Breen, MD
Bhavik Patel, MD
Philip Young, MD
Tom Foley, MD
Disclosures

No relevant financial relationship(s) with industry:

I do intend to discuss off-label / investigative uses(s) of the following commercial product(s)/devices(s):

Gadolinium for Cardiovascular MRI
Multimodality Cardiac Imaging: Objectives

Learning Goals:

• Discuss the relative strengths and weaknesses of various imaging modalities for cardiac imaging

• Use those strengths & weaknesses to guide management decisions regarding the use of appropriate cardiac imaging modality

✓ Head-to-head comparison of CT & MRI
Nucs vs CT vs MRI

Pros:
- Nucs: Highest contrast sensitivity, Most published data, Widely available
- CT: Better spatial resolution, Visualize calcification
- MRI: Tissue characterization, High contrast sensitivity, Flow information

Cons:
- Nucs: Radiation, Less spatial resolution, Less tissue discrimination
- CT: Radiation, Less contrast sensitivity, No flow information
- MRI: Most operator dependent, More expensive, Cardiac devices

All are highly dependent on available technology and local expertise.
Cardiac Nuclear Medicine: Exam Basics

Radionuclide testing
- $^{99m}$Tc-sestamibi & $^{201}$Thallium$^+$ (SPECT)
- $^{18}$F-FDG (PET)

Traditional role
- Acute coronary syndromes
- Chronic coronary disease

Emerging role
- Novel radiotracers – targeted at specific diseases
Cardiac Nuclear Medicine: Exam Basics

✓ Perfusion imaging of CAD

Manabe, J Nucl Cardiol 2018
PET of cardiac sarcoidosis

Manabe, J Nucl Cardiol 2018
Cardiac Nuclear Medicine: Summary

Evolving role in cardiac imaging

- Traditional noninvasive test of choice for diagnosis and prognosis in coronary artery disease

- Increasing role in delineation of causes of heart failure – particularly due to rise of novel radiotracers

- Frequently used in conjunction with cardiac CT and MRI – not a competitor in terms of direct imaging of the heart
Cardiac CT: Exam Basics

**Key Facts**

- Uses radiation
- IV contrast (variable)
Cardiac CT: Exam Basics

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Key Facts

- Uses radiation
- IV contrast (variable)
- ECG-gating
Cardiac CT: Exam Basics

Key Facts

- Uses radiation
- IV contrast (variable)
- ECG-gating
Cardiac CT: Exam Basics

Can’t Gate = Not Great
Cardiac CT: Specific Indications

Spatial Resolution – Coronary Arteries

Submillimeter spatial resolution
...assuming ECG-gating is working
Cardiac CT: Specific Indications

Spatial Resolution – Aortic Root
Cardiac CT: Specific Indications

Calcification – Coronary arteries, valves, pericardium, etc...
Cardiac CT: Modality Strengths

CT = best test for calcium & coronary arteries
Cardiac MRI: Exam Basics

**Key Facts**

- Uses magnet
- Always on
Cardiac MRI: Exam Basics

Key Facts

Uses magnet
Always on
Cardiac MRI: Exam Basics

Key Facts

- Uses magnet
- Tight space
- Claustrophobia
Cardiac MRI: Exam Basics

Key Facts

Uses magnet
IV contrast (variable)
ECG-gating
Cardiac MRI: Exam Basics

No Gate = No Good
Cardiac MRI: Specific Indications

Contrast Enhancement – Pericardium

44 y/o ♂:

• Echo: indeterminate findings for constrictive physiology

Inflammatory pericarditis
Cardiac MRI: Specific Indications

Tissue Characterization – Myocardium

Lupus myopericarditis

T2W

MDE
Cardiac MRI: Specific Indications

Tissue Characterization – Cardiac Masses
Cardiac MRI: Specific Indications

Contrast Enhancement – Cardiac Masses

Hemangioma
Cardiac MRI: Modality Strengths

MRI = best test for tissue characterization & enhancement
Multimodality Imaging Comparison

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The **patient** rather than the **disease** will often dictate the modality.
CT vs MRI: Pericardial Disease

If patient is **young** and/or **female**, consider MRI

If patient is a **poor breath holder**, consider CT
CT vs MRI: Pericardial Disease

If patient is **cooperative**, consider MRI

If patient is **sick** or **can’t hold still**, consider CT
CT vs MRI: Myocardial Infarction

Echo: apical MI ? thrombus
CT vs MRI: Cardiac Masses

What is your access to the technology?
Who is your local expert?
Multimodality Imaging Comparison

MRI >> CT for flow information

CT >> MRI for calcium & PO changes
CT vs MRI: Flow Information

Flow information not available from CT
CT vs MRI: Cardiac Devices

...if patient has a device, you may not care
CT vs MRI: Calcification & PO Changes

Left AV groove mass seen at echocardiography

Calcification not visible on MRI
CT vs MRI: Calcification & PO Changes

Findings on echocardiography suspicious for pericardial constriction

Calcification not visible on MRI
Multimodality Cardiac Imaging: Summary

Cardiac Nucs
• Perfusion imaging for coronary artery disease. Novel radiotracers for specific disease entities.

Cardiac CT
• Best test for visualizing coronary arteries and calcium.

Cardiac MRI
• Best test for tissue characterization & myocardial / pericardial enhancement.

Sometimes the patient will dictate the modality rather than the disease.
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