Cardiac MRI: Your Bread and Butter

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Cine maps

T1-T2 maps

LGE maps

T2* maps

MRA

Perfusion maps

Flow maps
Cine maps

LGE

MRA

T1-T2 maps

T2* maps

Perfusion maps

Flow maps
Cardiac Axes
Morphology & Function

- Main ingredient
- LAX, SAX, any anatomy (eg. BAV)
- 1 slice per series
- Postprocess
  - Volumetry
Gold Standard of Ventricular Volumetry

Grothues et al, Am Heart J 2004;147:218–23
T1 maps

- ROI: Toast color

- MAP: Toastability

'Burnt Toast – Nah, coffee will do'
'Ah! Breakfast is ready!'
'Give it another go'
'Huh? Does this thing even work?'

T1 maps

$T_1$ dry $T_1$ fresh

t (ms)
ExtraCellular volume: ECV%

\[
\text{Myocardial interstitial space\%} = \frac{1 - \text{Hct}}{\text{Blood plasma\% (} = 1 - \text{Hct)}\right) \\
\frac{T_{1\text{myo Post}} - T_{1\text{myo Pre}}}{T_{1\text{bld Post}} - T_{1\text{bld Pre}}} = \text{ECV\%}
\]
T2 Maps

Normal values: Radiology 2020; 297:344–351
Early Gadolinium Enhancement

Cine Post injection: early Gad TI=440ms
Late Gadolinium Enhancement (LGE)

- Cine
LGE Map (PSIR)

TI
LGE patterns

Ischemic

A. Subendocardial Infarct

B. Transmural Infarct

LGE patterns

Nonischemic

A. Mid-wall HE
- Idiopathic Dilated Cardiomyopathy
- Hypertrophic Cardiomyopathy
- Right ventricular pressure overload (e.g., congenital heart disease, Chagas Disease pulmonary HTN)
- Sarcoidosis
- Myocarditis

B. Epicardial HE
- Sarcoidosis, Myocarditis, Anderson-Fabry, Chagas Disease

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

Amyloid

TI scout

Early Gad

LGE

LGE

PSIR
Keyhole MRA
CMR recipes

Cine long axes

Cine short axis stack

Cine transv

T1-T2 maps

LGE: Early Gad & Late Gad
  TI: 440ms
  TI: 280→360ms

T1 maps

MRA

Cine AO valve
ACM vs normal RV
‘ARVC’, Male 32y

Normal RV, Male 42y
Genetic defect

Male 17y

Male 16y
Genetic defect

Male 17y

Male 16y
Left ventricular fibrosis
Male 32y
Iron Deposition Cardiomyopathy

- Myocardial assessment
  - D/ Iron deposit
  - Load: T2* (ms) or mg/g dw
- Liver iron quantification
  - D/ and Iron load (mg/g dw)
- Serial follow up

57, myelodysplasia, transfusion dependent
22♀, hemoglobinopathy, transfusion & chelation. FU.
Improved survival of thalassaemia major in the UK and relation to T2* CMR. JCMR, 2008;10:42

EF 37%  Feb 2010

EF 71%  Okt 2010
Echo Doppler

MRI Phase Contrast

Velocity ENCoded Maps

Flow maps
Phase Contrast Image

- Flow  $+V_{ENC}$ →
- Flow  $\leftarrow -V_{ENC}$
- No flow
- No signal
4D Flow

- Turner patient
- Bicuspid aortic valve
- Dilated ascending aorta
- Dysmorphic aortic arch
- Coarctation
- Dilated left subclavian artery
- Lusoric right subclavian artery
CMR uniform recipes

- Cine bFFE
  - Cardiac axes
  - Anatomy
- One slice per series
  - Follow up or second opinion read
- Report interpretation of numbers

Cine

T1-T2 maps

LGE

MRA

Flow maps

T2* maps
Take Away Message

- Cine bFFE
  - Anatomy and function
- LGE and ECV% are unique
- 30min scans are feasible
  - Myocarditis
  - Viability
- Cardiomyopathy
  - combined patterns
- Talk to your cardiologist