Cardiac MRI from a Technologist’s Perspective

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Cardiac Imaging

- Evaluate cardiac morphology, function, & viability.
- Diagnose disorders such as tumors, infections, and inflammatory conditions.
- Detect and evaluate the effects of coronary artery disease & plan treatment.
- Monitor a patient's progress over time.
- Evaluate the anatomy of the heart and blood vessels in children with congenital heart disease.
- Examine the size of the heart chambers and the thickness of the heart wall.
- Determine the extent of myocardial damage.
- Detect the buildup of plaques and thrombi in blood vessels.
- Evaluate the heart's filling pressures (function), heart valve function, and valvular blood flow/lack thereof and after-surgical repair of congenital cardiovascular disease in children and adults.
- Evaluate myocardium for non-can!lead

1.5T vs. 3T

- 3T offers improved diagnostic capabilities for perfusion, viability, and coronary imaging but cannot yield TrueFisp cine scans (bssFP)
- 3T MRS

Pulse Sequences

- Half Fourier Single Shot Turbo (Fast) Spin Echo – (HASTE, SSFPSE)
- Steady State Free Precession – gated bright blood sequence (TrueFISP FESTA, SAGE, Balanced FFE, CE-Fast)
- Spin Echo Black Blood – T1 blood suppressed sequence (dark-blood prepared TSE, HASTE, or FLASH)(double IR SE, FSE-XL with blood suppression)
- Spin Echo Black Blood null fat – double IR with fat saturation (TR/TE)(IR/SE, FSE-XL IR with blood suppression)
- Flow Velocity Encoding – sequence to measure flow (Phase contrast PC, VENC)
- Cardiac Viability – delayed enhancement IR (segmented 2D TurboFLASH)
- Cardiac Perfusion – dynamic assessment of rate and extent of blood perfusing the LV (multislice T1 weighted scans)
- CE-AREA – Time-resolved imaging with Stochastic Trajectories (TWIST)

System Requirements

- At least a 1.5 T unit with high performance gradients
- Accurate system for ECG gating
- Appropriate coil (32-channel/1.5T & 128-channel/3T receive-only array coils)
- Cardiac software providing appropriate parameter selection
- Post-processing software capable of measuring cardiac function

ECG Gating

- Shave chest hairs if necessary.
- Clean and dry skin with adhesive gel.
- Thoroughly dry skin with soft clean cloth.
- Use MRI-compatible pre-gelled electrodes with adhesive pads.
- Attach electrode pads on chest in optimal locations (electrical axis)
- Route cables straight out of magnet with no loops or loops.
- Check ECG waveform integrity both in and out of magnet box.

Magnetic Hydodynamic Effect
ECG Gating (cont)

- P – Atria contract
- QRS – Atria relax
- T – Ventricles relax

Triggering

Prospective Triggering
- Triggers off the R-wave with a lapse of time at end-diastole
- Measures less than entire cardiac cycle
- Very sensitive to arrhythmias and irregular heart rates
- Manually adjusted acquisition window
- Cine frame-rate determined by data segments

Retrospective Triggering
- Continuous acquisition through entire cardiac cycle
- Arrhythmia rejection is available
- Automatically adjusted acquisition
- Cine frame-rate determined by user

Contrast Agents

- **Gadobenate Dimeglumine** (Multihance; Bracco Imaging, USA)
  - High relaxivity gadolinium-based contrast agent
- **Gadofosveset Trisodium** (Ablavair; Lantheus Medical Imaging, USA)
  - High relaxivity gadolinium-based contrast agent
  - Immediate dynamic imaging used for MRA
  - Steady-state imaging ~ 7 min to ~ 60 min

Safety

- Stents, Coils & Filters
- Cardiac pacemaker
- Cardiac valve
- History of metal
- Kidney disease
- SAR
- ECG patches

Patient Cooperation

- Patient comfort
- Clear instructions
- Distraction

Awesome Links

- [http://www.peted.org/?id=list#1](http://www.peted.org/?id=list#1)
- [http://www.youtube.com/watch?v=7XaftdE_h60](http://www.youtube.com/watch?v=7XaftdE_h60)
- [http://www.youtube.com/watch?v=7K2icszdxQc](http://www.youtube.com/watch?v=7K2icszdxQc)
Anatomy

- Closed Loop System
- Pulmonary Circulation/Low Pressure (Right Heart)
- Systemic Circulation/High Pressure (Left Heart)

Conduction System

- Sinoatrial Node (SAN)
- Atrioventricular Node (AVN)
- Bundle of HIS
- Purkinje Fibers

3 Plane Loc

Ax Whole Heart / HASTE
2 Chamber

Short Axis (SA)

4 Chamber

3 Chamber (LVOT1)

Aortic Outflow (LVOT2) & AV

Right Ventricular Outflow Tract (RVOT1)