Cardiac MRI Essentials

The stress CMR study

Two types of pharmacological stress:

- Adenosine stress
  - Vasodilator
  - CMR is used to assess myocardial perfusion
  - Some use regadenoson stress instead of adenosine
- Dobutamine stress
  - Positive inotrope/chronotrope
  - CMR is used to assess regional wall motion (± myocardial perfusion)

Adenosine stress CMR - patient preparation

- Avoid for 24 hours:
  - Caffeine
  - Aminophylline
  - Dipyridamole
- Precautions checklist
  - Asthma/bronchospasm
  - Unstable symptoms
- Baseline 12-lead ECG to check for any conduction problems

Performing an adenosine stress study

- Monitor ECG, HR, BP, and SaO_2 throughout
- Two IV cannulae (can use one if necessary)
- IV infusion of adenosine: 140 mcg/kg/min, aiming for at least 3 minutes
- Some centers increase infusion rate if poor hemodynamic response
- Looking for:
  - Heart rate ↑ by ≥10 bpm *and/or*
  - Systolic BP ↓ by ≥10 mmHg
- Record any symptoms that occur

Typical imaging workflow for an adenosine stress study

- Obtain cine CMR images in standard four-, three-, two-chamber views
- Assess regional wall motion

- Perform a perfusion test scan to ensure optimal positioning of short-axis slices

- Perform the adenosine stress myocardial perfusion study
- At peak stress, acquire perfusion images in three short-axis slices (basal, mid, apical)

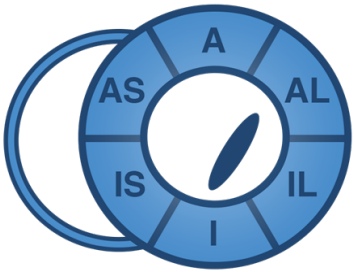
- 10 minutes rest
- During the rest period, acquire the standard left ventricle short-axis stack

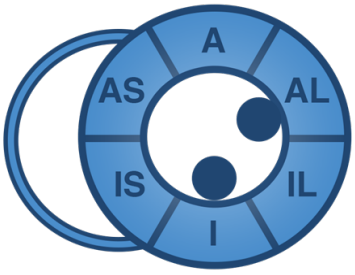
- Perform the rest myocardial perfusion study
- Acquire perfusion images in three short-axis slices (basal, mid, apical)

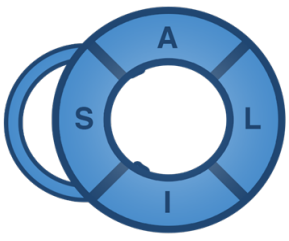
- Perform a late gadolinium enhancement (LGE) study
- Obtain LGE images in the standard four-, three-, two-chamber and short-axis views

Myocardial perfusion imaging

- Bolus of gadolinium contrast at peak stress
- Observe contrast as it perfuses the myocardium
- Look for perfusion defects (red arrow, right)
- Repeat at rest and compare images
- Report according to standard segments (below)







Dobutamine stress CMR - patient preparation

- Avoid for 24 hours:
    - Beta-blockers
    - Nitrates
    - Ivabradine
- Nil by mouth for 4 hours (however, if diabetic, light snack up to 2 hours before)
- Precautions checklist
- Baseline 12-lead ECG

Performing a dobutamine stress study

- Monitor ECG, HR, BP, and SaO_2 throughout
- Two IV cannulae (can use one if necessary)
- IV infusion of dobutamine, incrementally every 3 minutes: 10/20/30/40 mcg/kg/min, until target heart rate achieved
- Can add atropine if target heart rate not achieved
- Cine CMR at each dose level:
    - 3 long-axis views (two-, three-, four-chamber)
    - 3 short-axis views (basal, mid, apical)
    - Assess and report any regional wall motion abnormalities induced by stress
- Record any symptoms that occur

Further reading

Standardized cardiovascular magnetic resonance (CMR) protocols 2013 update. *Journal of cardiovascular magnetic resonance* 2013; **15**: 91 [click here to access online]