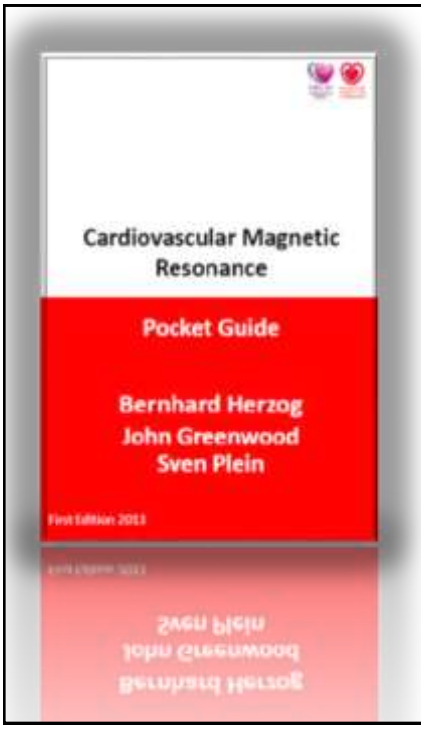


Tips and Tricks

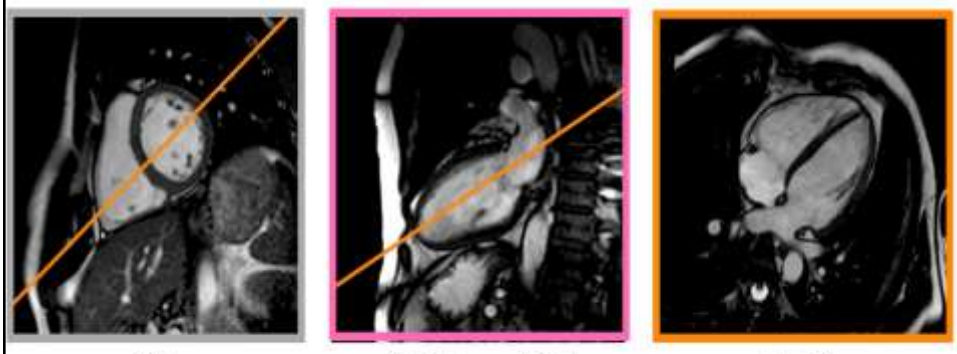
Ahmed Asfour, MD, PhD

Patient preparation

- **eGFR 30-60ml/min/1.73m^2:** choose safest contrast agent*, use only with caution
- **eGFR <30ml/min/1.73m^2:** linear structured contrast agents contraindicated
- **In patients with severe renal failure:** consider haemodialysis within 2 hours after contrast agent administration – not proven to prevent NSF

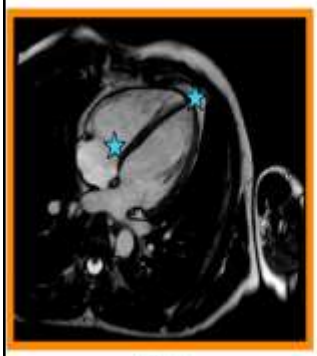
*Safest (cyclical structure): Dotarem, Gadovist

p4CH p2CH **SA Stack**

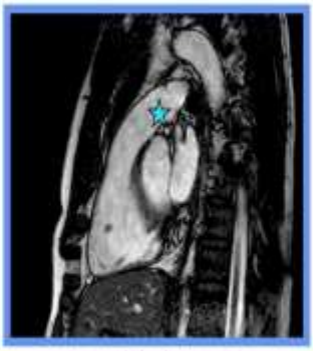


SA p2CH or p4CH **4CH***

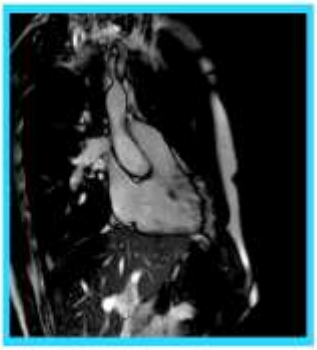
3-point planning



4CH

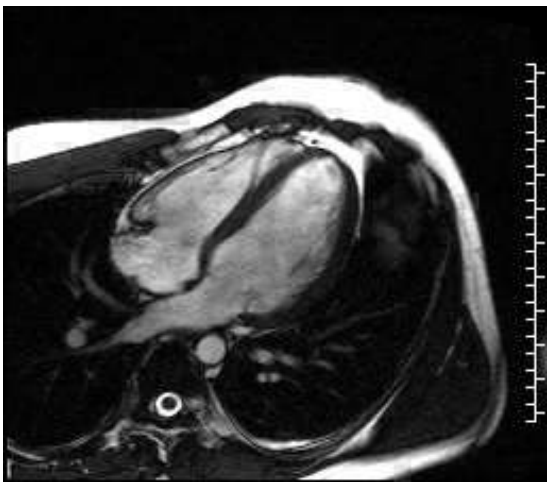


Sagittal RVOT



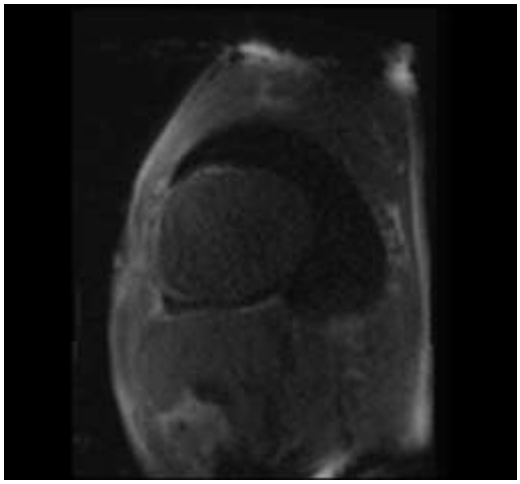
RV in-/outflow

Cine



- To reduce breath-hold times use:
- acceleration techniques
- Increase Segments (K-spae lines) ..turbofactor
- In a healthy heart there is usually one less slice to contour in end- systole at the base of the heart (longitudinal LV shortening). Correlate SA to long axis view if available to identify mitral valve plane.
- RV volmes from axial stack

Perfusion



- Dummy" scan to check:

1. Correct slice positioning
2. Artefacts
3. ECG triggering at every single heartbeat

- Switch to alternate heartbeat acquisition if HR is too high or reduce number of slices

- Field of View

As small as possible
Parallel to the anterior chest wall

LGE

- Scan in mid- or late-diastole
- Use saturation bands across the spinal column and the anterior chest wall to reduce ghosting artefacts
- Use “Phase Swap” (changing the phase encoding direction) to confirm pathology/detect artefact
- Always consider a different plane cross-cutting through the enhanced area
- Increase TI times by 10 – 15ms every couple of minutes,
- Acquiring the images during every second or third heartbeat can help if there are problems with arrhythmia
- Consider infiltrative disease (amyloidosis) if normal myocardium is hard to null despite correct technique

Acute MI

- MVO best seen on EGE images at TI > 400ms
- T2w images must be acquired before contrast administration
- Compare LGE images with cine images if unsure about differentiation between blood pool and endocardial late enhancement

ARVD

- Focus on RV volumes and functional RV abnormalities
- Consider alternative causes (abnormal vascular connections / shunts) in patients with dilated RV

HOCM

1. **LGE at the insertion points** of the RV to the LV are non-specific and often seen even in normal subjects

2. **Suggestive for HCM:**
   1. Localized hypertrophy
   2. Reduced contraction of hypertrophied segments
   3. Presence of LGE
   4. **Tagging** may help identify wall motion abnormalities

3. **Myocardial crypts** may help to define HCM mutation carriers without LV hypertrophy

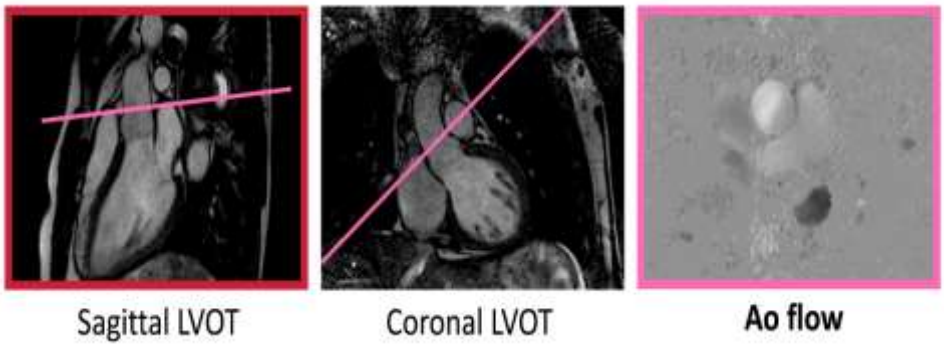
Iron Overload Cardiomyopathy

- Assess T2* values in the septum (fewer artefacts) as there is no different iron deposition among the various LV segments.
- Focal signal loss in native T1- and T2-weighted images
- Abnormally "dark" liver

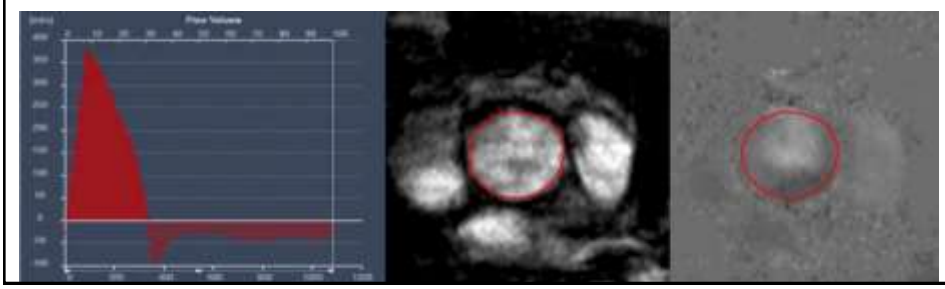
Flow

VENC settings:

Optimal within 25% of the true peak velocity	**Correct direction of flow (R-L, F-H)**
Image plane distal from valve leaflet tips	**Avoid underestimation of velocities. Check:** **Adequate temporal resolution (phases)** **Breath-hold acquisition: 20-25 phases**
Rotate FOV - orthogonal to the direction of flow	**Slice thickness: <7mm**



Sagittal LVOT Coronal LVOT Ao flow



Pericardial Effusion

1. **Pericardial tamponade is a clinical diagnosis**
   1. Even a small and focal effusion can be haemodynamically significant
2. **Signs of tamponade:**
   1. RA / LA collapse, RV / LV collapse
   2. Septal shift towards LV during inspiration
3. **Typical causes of pericardial effusion:**
   1. Global: uremic, infectious, myxedema, neoplastic
   2. Regional: postoperative, trauma, purulent, cyst

Constrictive Pericarditis

1. Pericardial constriction may be present even with a normal pericardial thickness or patchy thickening

2. Real-time dynamic respiratory sequence in several SA views and in a 4-ch view (paradoxical septal motion is often being limited to one part of the septum)

3. CMR cannot conclusively detect calcification

Coronary

1. **Problems identifying coronary rest period:**
   1. Repeat high temporal resolution 4-ch scan at the **correct HR**
   2. **Consider cine scan during free-breathing** if HR changes significantly during breath-hold
   3. **Check during systole** with a tight window (<50 ms)
2. Coronary rest period may differ between LCA and RCA
3. **High HR** (≥ 90bpm): Use shortest scan window possible to minimize blurring
4. Higher spatial resolution equals longer scan times
5. Optimize image quality:
   - Use isotropic voxel sizes

Aortic Disease

- Measure in end-diastole from cine imaging
- Use same slice thickness (<7mm)
- Aortic root (from 2 orthogonal LVOT cines or AV stack)
- Asc / desc Ao (from sagittal oblique aorta cines or alternatively from MRA, if necessary)
- Always perform arterial and venous MRA

- Be aware of following caveats:

1. LVOT / oblique views are not planed through the centre of the aorta
2. MRA is usually ungated and averages pulsating aortic dimensions (i.e. not end-diastole)
3. Different “windowing” of MRA
4. Angled view of aorta, if taken from transaxial stack
5. Inclusion of aortic wall, if taken from BB images

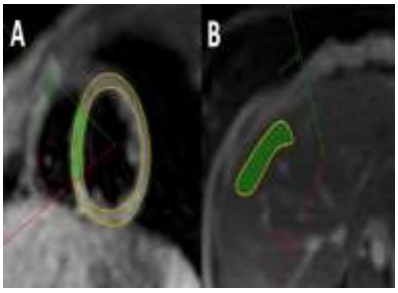
Tagging

1. Reference modality for evaluating multidimensional strain
2. **Temporal resolution about 15-20ms**
3. **Acceleration techniques** used to shorten the breath-hold time are the same as for cine imaging
4. Use a **low flip angle** to reduce tissue saturation and prolong the tagging pattern throughout the cardiac cycle
5. Mid-myocardial circumferential strain from SA is most reproducible

T1 mapping

1. Acquire **one slice per breath hold**
2. Native T1 values are reproducible but **they vary by magnet strength (with 3T resulting in longer native T1 times), vendor platforms and the mapping sequence** employed during acquisition
3. **Check scanner generated native T1 map for breathing artefact.** Consider changing voxel size, fold-over or adding SENSE to reduce breath-hold.
4. **FOV and voxel size should not be changed** between pre/post contrast T1 acquisition to allow various software to generate ECV maps

T2* Mapping



1.Ensure good patient breath-holding for the heart and the liver scans by coaching as the scan duration is long

2.Make sure the septum is of good image quality as this is where quantification is most reproducible

3.Position the transverse liver slice correctly:

1. Avoid large hepatic vessels for correct T2* measurement in the liver tissue

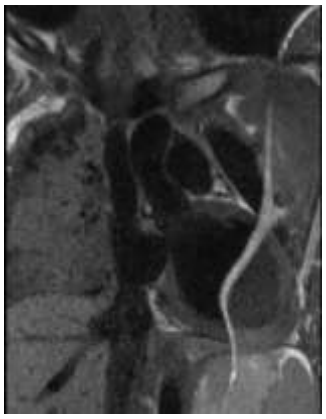
Imaging Poor Breath-Holders

Acceleration Technique	Comment
•Reduce **number of slices** acquired per breath-hold	•Increases overall scan time
•Reduce **number of phases** for each breath-hold:by reducing **acquisition matrix** (scan or phase percentage) •by reducing **FOV**	•Reduces SNR •Increases spatial resolution
•Increase **voxel size**	•Decreases spatial resolution
•Use **parallel imaging**	•Prone to artefacts
•Use **respiratory navigator**	•Increases overall scan time
•Acquire images in **inspiration**	•Varying slice position with each breath-hold
•Consider **general anaesthesia**	

Imaging Patients With Arrhythmia

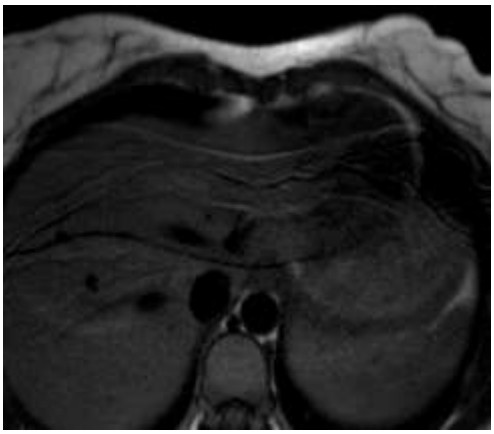
Acceleration Technique	Comment
•**Heart rate** and/or **rhythm control** before scanning	•Use beta-blockers or other antiarrhythmic medication
•Use **Arrhythmia Rejection**	Increases breath-hold time
•Use **Prospective triggering**	•Reduces SNR
•Use **Real-time imaging**	•Reduces temporal and spatial resolution as well as SNR

Artefacts



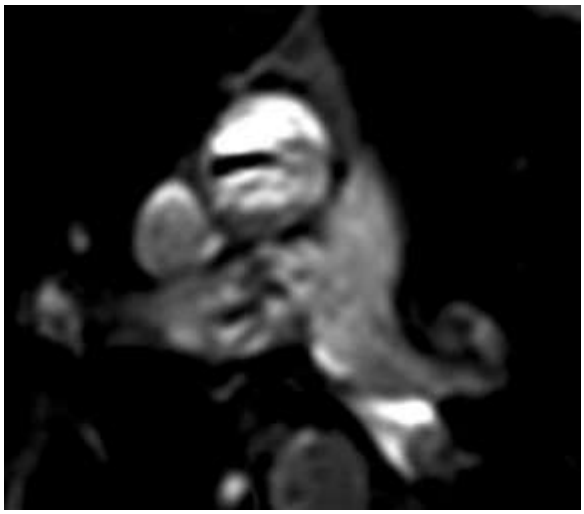
1. Increase FOV
2. Add phase encoding (phase-oversampling, foldover suppression, no phase wrap)
3. Swap phase and frequency direction
4. Use selective tissue saturation bands
5. Use a surface coil

Ghosting artefact (motion)

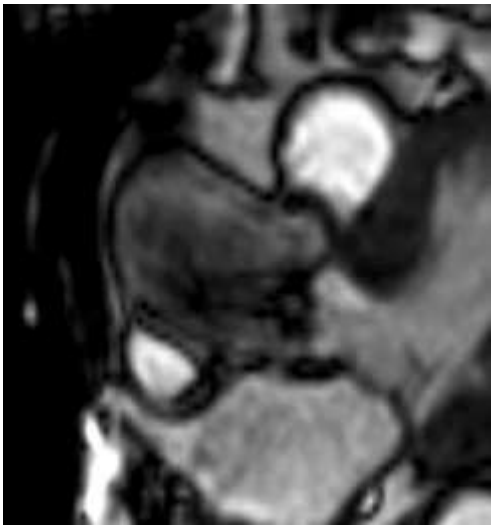


Strict breath-holding acceleration techniques
Respiratory gating or navigator echoes
Swap phase and frequency direction
Use selective tissue saturation bands to suppress the signal from the anterior abdominal wall

Ghosting artefact (Flow)

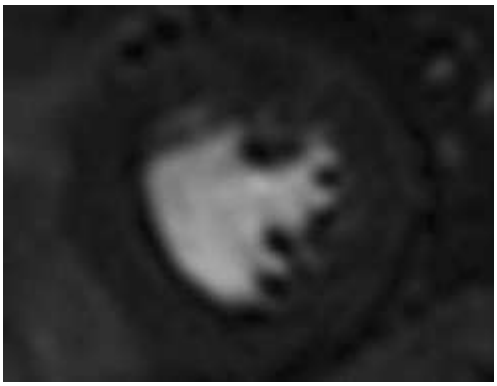


1. Use ECG triggering / gating
2. Use flow compensation (gradient moment nulling, gradient motion rephasing)
3. Use selective tissue saturation bands to suppress the blood signal
4. Swap phase and frequency direction



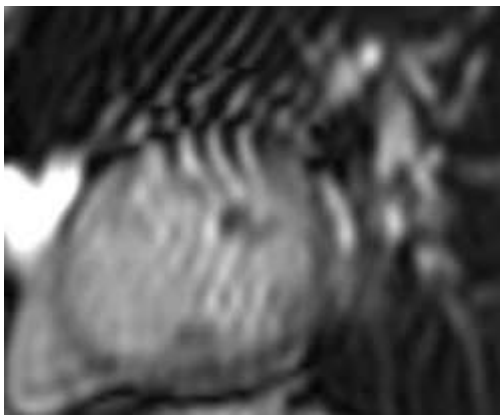
1.Reduce echo time
2.Use flow compensation
3.Use bSSFP acquisition

Dark Rim

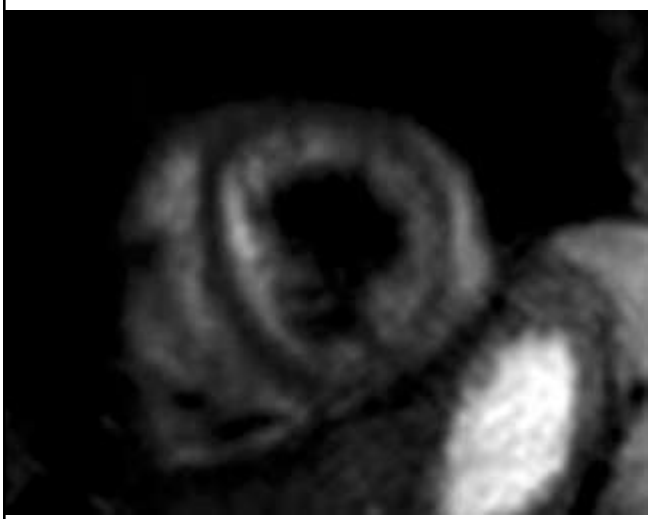


1.Often seen in perfusion imaging
2.Reduce contrast dose/infusion speed
3.Increase in-plane spatial resolution

Interference artifact

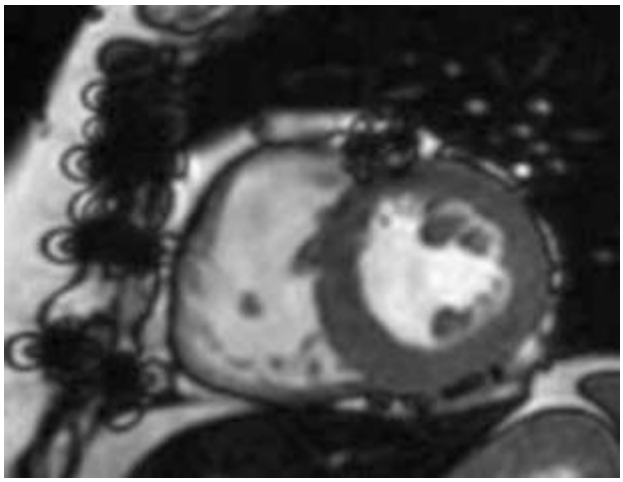


Slow flow artefact



1.Usually in T2w images
2.Increase black blood pre-pulse slice thickness
3.Surface coil

Metallic artefact



Thank You!