

In collaboration with



The information presented on this supplement to MAGNETOM Flash is for illustration only and is not intended to be relied upon by the reader for instruction as to the practice of medicine. Any health care practitioner reading this information is reminded that they must use their own learning, training and expertise in dealing with their individual patients.

This material does not substitute for that duty and is not intended by Siemens Healthcare to be used for any purpose in that regard. The drugs and doses mentioned in this supplement to MAGNETOM Flash are consistent with the approval labeling for uses and/or indications of the drug.

The treating physician bears the sole responsibility for the diagnosis and treatment of patients, including drugs and doses prescribed in connection with such use. The Operating Instructions must always be strictly followed when operating the MR System. The source for the technical data is the corresponding data sheets.

Not for distribution in the US.

SCMR Recommended Cardiac MRI Protocols

1.5T and 3T MAGNETOM Systems with Tim and
software version *syngo* MR B17

www.siemens.com/healthcare

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Introduction

This users guide describes the SCMR Recommended Cardiac MRI Protocols that have been clinically optimized for the Siemens MAGNETOM family of MRI scanners with *syngo* MR B17 software. For ease of use, the protocols are organized by common cardiac diseases and sub-organized by the patient's cooperative abilities.

For example:

Acute Myocardial Infarct

- Recommended – Breathhold & Triggered
- Free Breathing & Triggered
- Extreme Arrhythmia –
Free Breathing & Non Triggered

If the patient has a **good quality ECG signal** with only a few minor arrhythmias (or none) **and is able** to hold the breath, then use the Recommended protocols. Most of these are segmented k-space techniques with a single signal average.

If the patient has a **good quality ECG signal** with only a few minor arrhythmias (or none) **but is not able** to hold the breath, then use the Free Breathing protocols. Most of these are either segmented k-space techniques with multiple signal averages or single-shot k-space techniques.

If the patient has a **poor quality ECG signal** (or none), or if the patient has such extreme arrhythmias that gating is impossible, then use the Extreme Arrhythmia protocols. Such extreme conditions require exclusively single shot k-space techniques which are also compatible with free breathing. Real-time cine techniques can be used without triggering in very extreme cases (default), or with triggering in less extreme cases.

The user may easily switch from one sub-group to another as the conditions of the patient change even during an exam because all three sub-groups contain essentially the same protocols in the same sequence, simply optimized to a different set of conditions (breathing and triggering).

System Requirements

Hardware:

Any Siemens MAGNETOM MRI system with Tim technology:

- MAGNETOM Avanto 1.5T
- MAGNETOM Espree 1.5T
- MAGNETOM Symphony Tim 1.5T
- MAGNETOM Trio Tim 3.0T
- MAGNETOM Verio 3.0T

Software:

syngo MR B17 software level with cardiac and flow options:

- Advanced Cardiac – sequence package
- Advanced Angio – sequence package
- Flow Quantification – sequence package
- *syngo* TWIST – sequence package
- Argus Viewer – analysis package
- Argus Function – analysis package
- Argus Flow – analysis package

Installation Procedure

Obtain the appropriate installation file that corresponds to your MAGNETOM equipment configuration from a Siemens Application Specialist or from the Siemens MAGNETOM World website:

- Go to website: www.siemens.com/magnetom-world
- Select the following links: Clinical Methods > SCMR Recommended Protocols
- Download the appropriate protocol file for your system configuration
- Burn the protocol file onto a CD-ROM disk or thumb-drive memory stick, and insert it into your *syngo* host computer
- Use the Object > Import function on the *syngo* Exam Explorer to install the protocol file into your User Protocols list
- If your system is missing some of the software options listed above, the corresponding protocols will not import

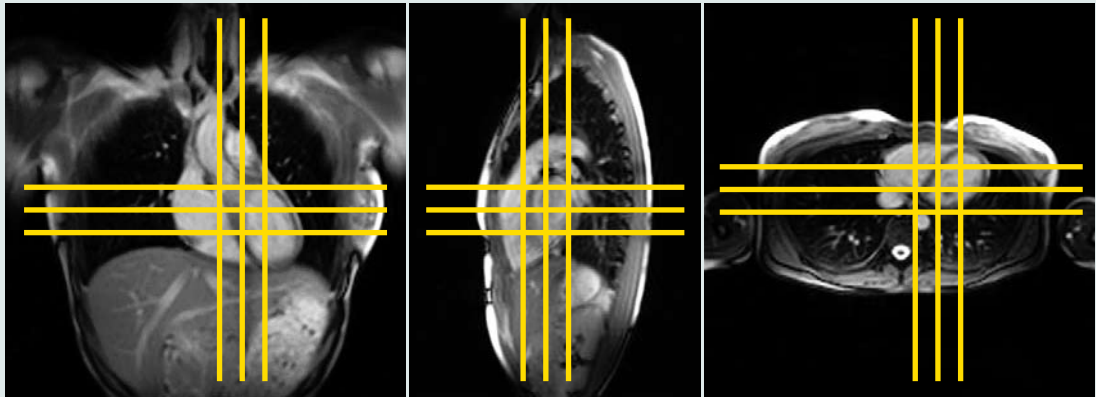
SCMR Recommended Cardiac MRI Protocols

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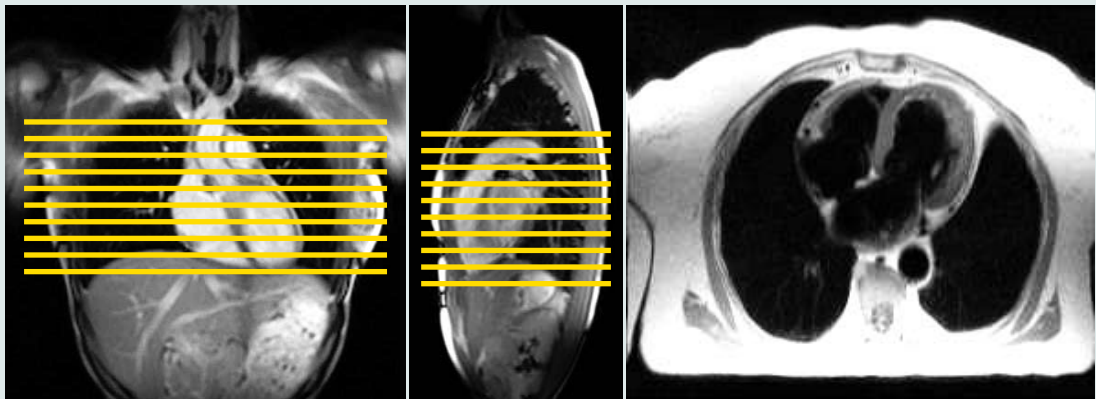
Localizers Module

1. Auto Detect Table Position: runs automatically, untriggered free breathing.

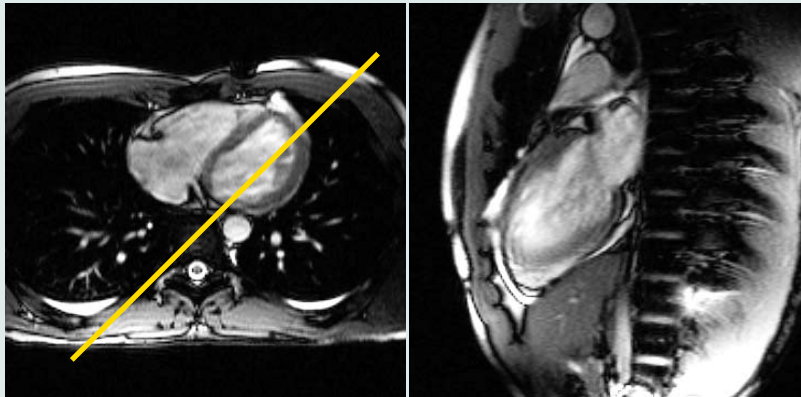
2. Multi Plane Isocenter Localizer: adjusts heart to isocenter of bore (ISO table mode), prescribe 3 axial, 3 coronal, 3 sagittal slices, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



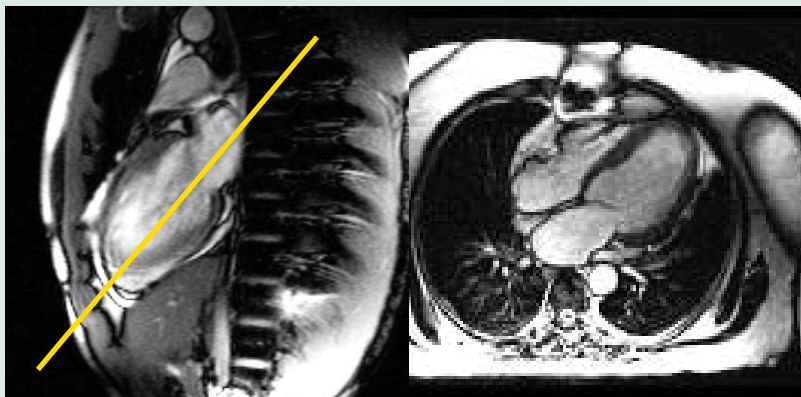
3. Axial Dark Blood Haste Localizer: prescribe 20 slices from sagittal and coronal views, cover from above aortic arch to below apex, multiple breathholds, trigger on every second heartbeat, capture cycle for diastolic gating.



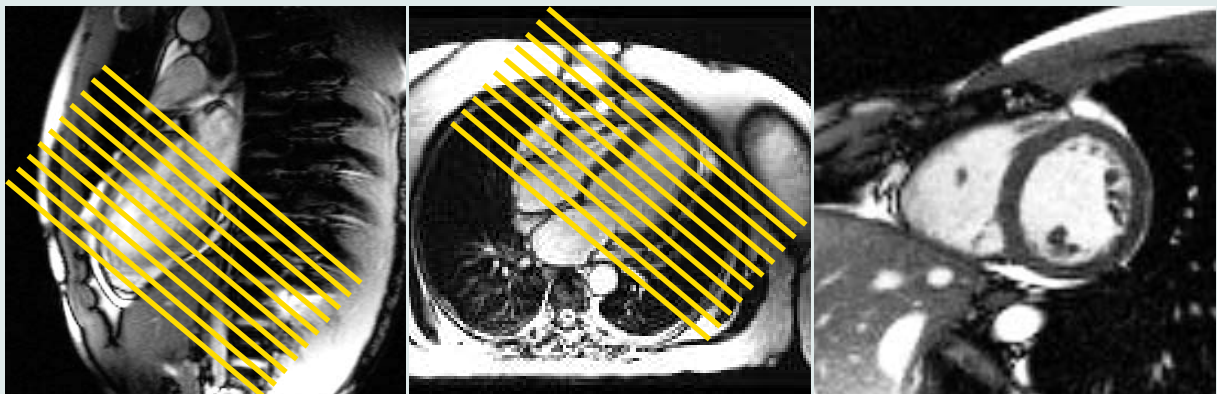
4. **Two Chamber Localizer:** prescribe 1 slice from axial view parallel to ventricular septum, bisect left ventricle through mitral valve and apex, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



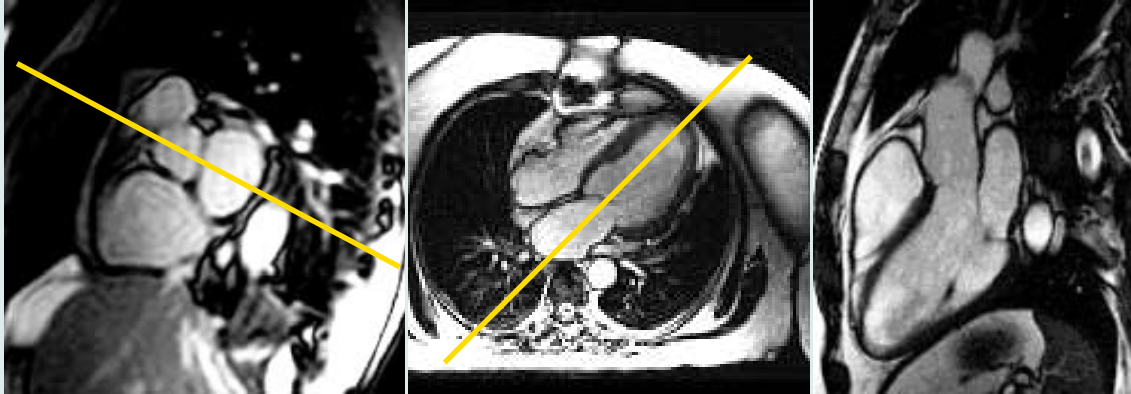
5. **Four Chamber Localizer:** prescribe 1 slice from two chamber view, bisect left ventricle through mitral valve and apex, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



6. **Short Axis Localizer:** prescribe 10 slices from two chamber and four chamber views, perpendicular to long axis of left ventricle, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.

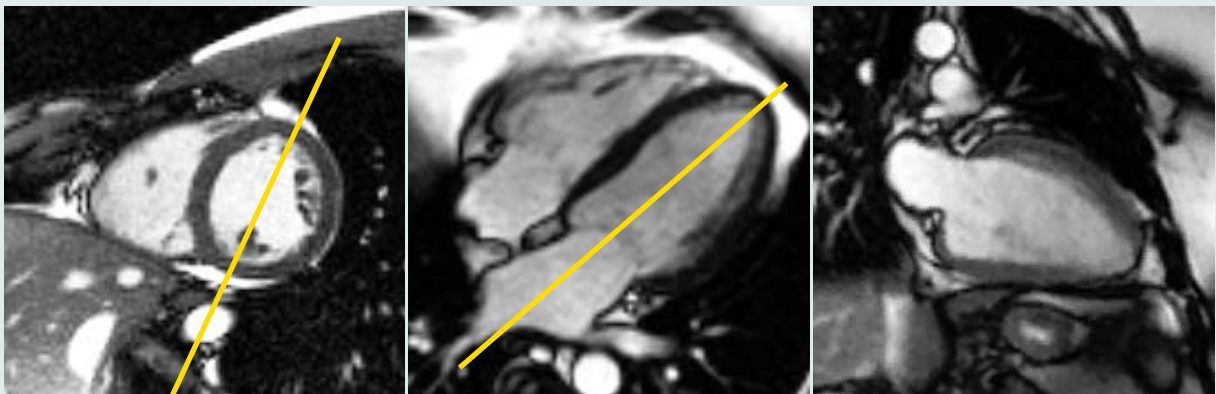


- 7. Three Chamber Localizer:** prescribe 1 slice, bisect the LVOT and posterolateral LV wall on the most basal short axis view, and bisect the LV through the mitral valve and apex on a four chamber view, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.

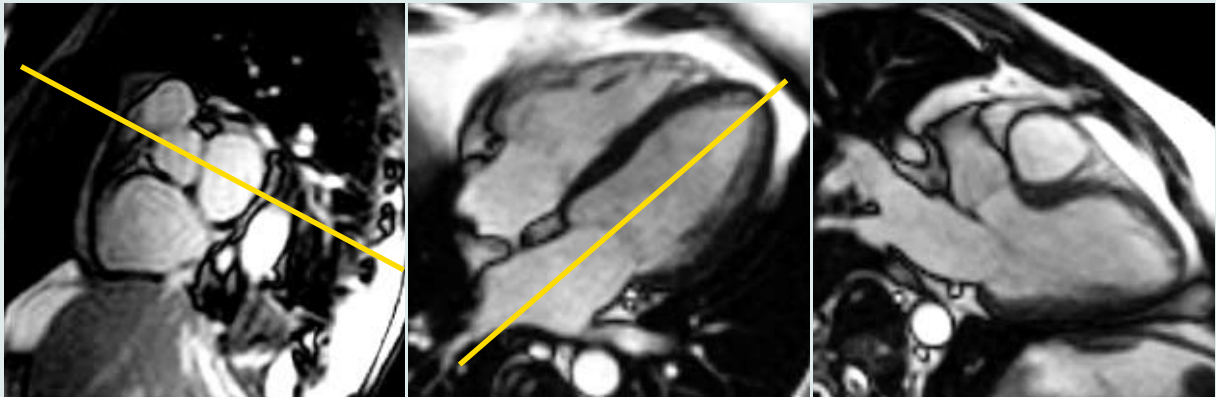


LV Function Module

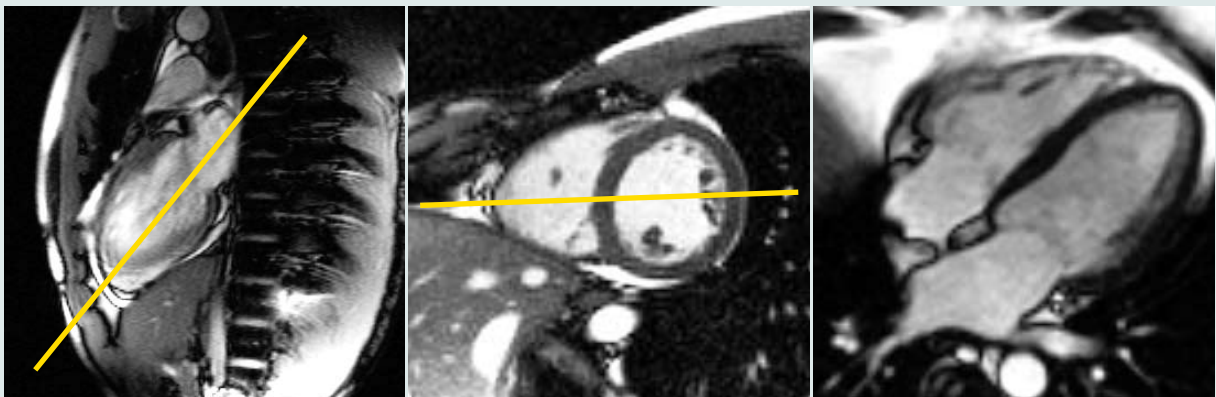
- 1. Two Chamber Cine:** prescribe 1 slice, parallel to ventricular septum on a short axis view, bisect left ventricle through mitral valve and apex on a four chamber view, rotate FoV to avoid wrap, single breathhold, retrospective gating.



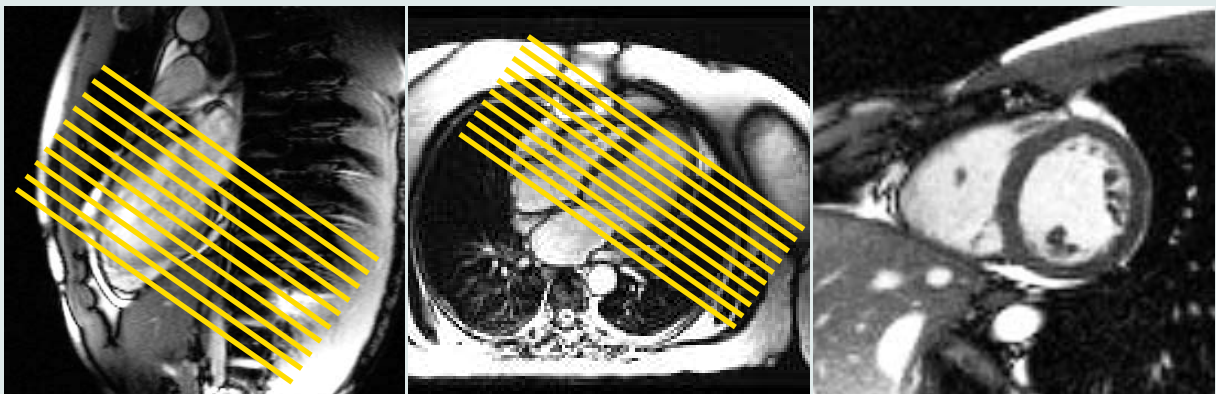
- 2. Three Chamber Cine:** prescribe 1 slice, bisect the LVOT and posterolateral LV wall on the most basal short axis view, and bisect the LV through the mitral valve and apex on a four chamber view, rotate FoV to avoid wrap, single breathhold, retrospective gating.



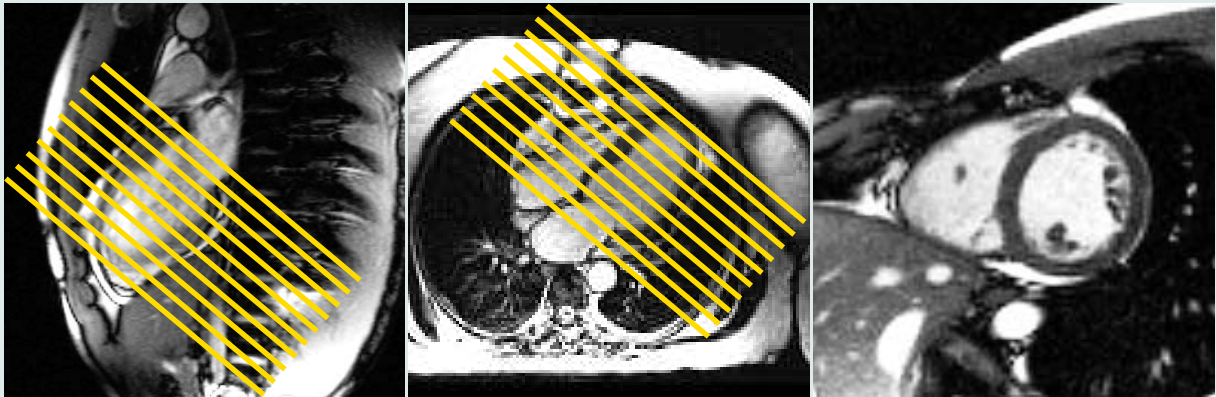
- 3. Four Chamber Cine:** prescribe 1 slice, bisect left ventricle through mitral valve and apex on a two chamber view, bisect left and right ventricles on a short axis view, rotate FoV to avoid wrap, single breathhold, retrospective gating.



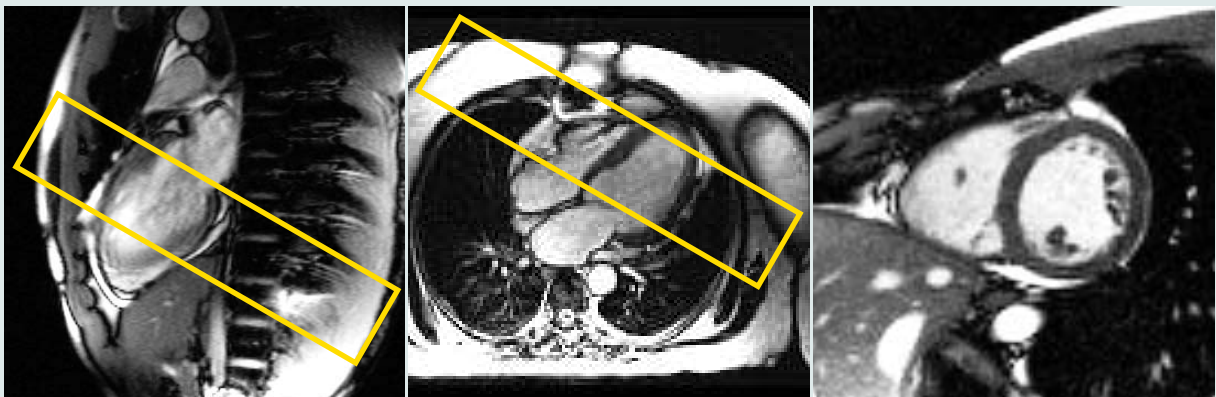
- 4. Short Axis Cine:** prescribe 10 slices from two chamber and four chamber views, perpendicular to long axis of left ventricle, adjust gap to cover from mitral valve to apex, rotate FoV to avoid wrap, multiple breathholds, retrospective gating.



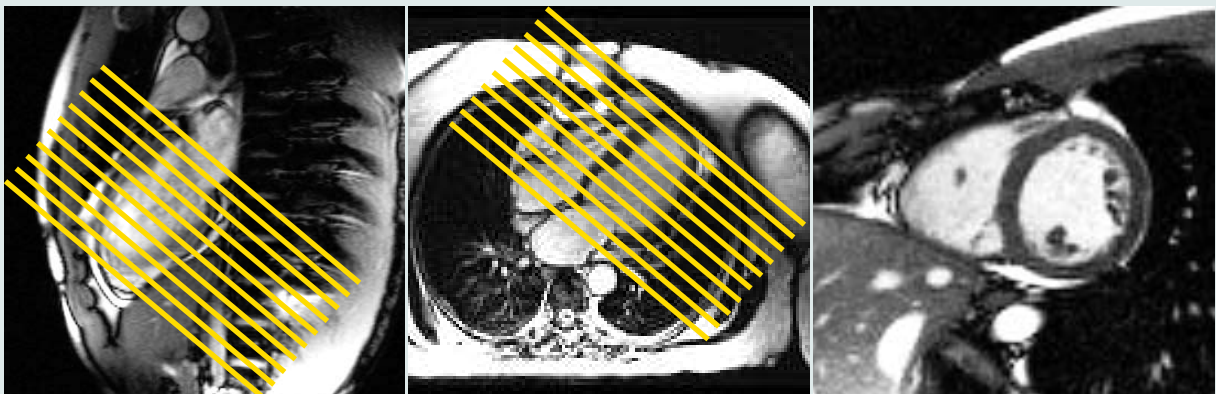
- 5. Optional Short Axis Cine Radial:** high resolution radial k-space truefisp cine, multi slices, multi breathhold, retrospective gating.



- 6. Optional Short Axis Cine 3D Slab:** 3D slab truefisp cine, multi slices, single breath-hold, prospective gating, rotate FoV to avoid wrap.

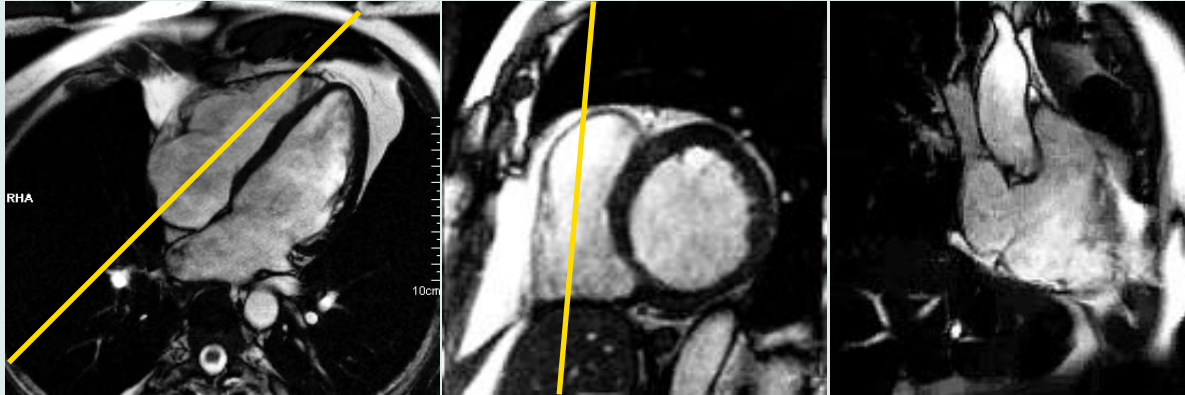


- 7. Optional Short Axis Cine Realtime:** realtime truefisp cine, multi slices, single breathhold, prospective gating, rotate FoV to avoid wrap.

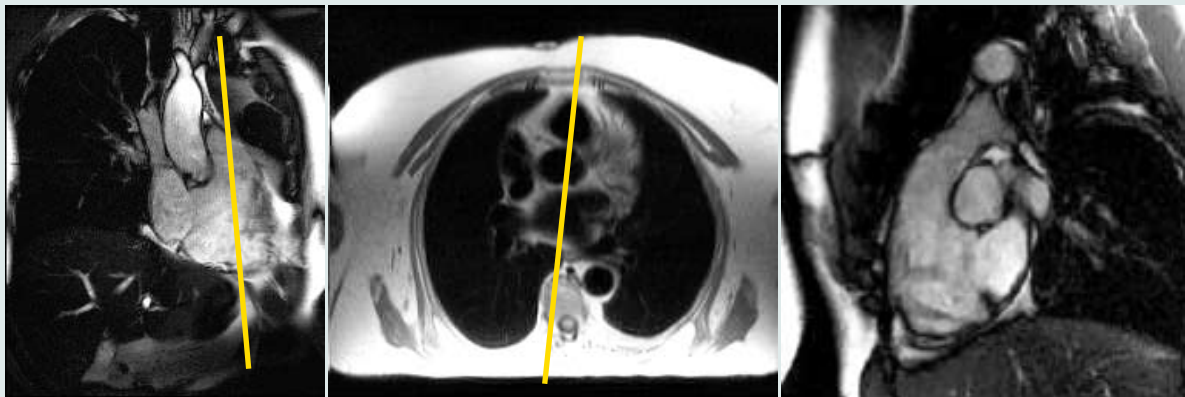


RV Function Module

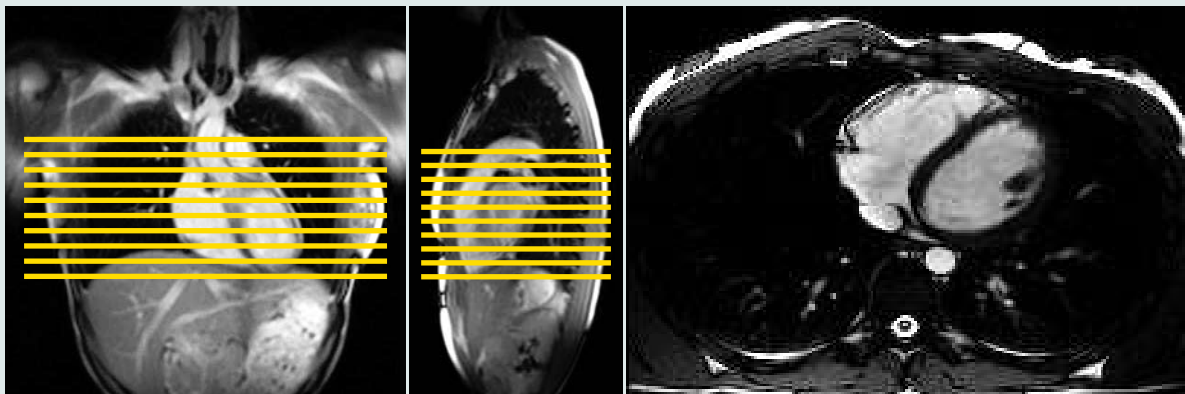
1. **Right Ventricular Vertical Long Axis Cine:** prescribe 1 slice from four chamber and basal short axis views, parallel to ventricular septum bisecting tricuspid valve, right atrium, and right ventricle, single breathhold, retrospective gating.



2. **Right Ventricular Outflow Tract Cine:** prescribe 1 slice from right ventricular vertical long axis and axial views, bisect pulmonary outflow tract, pulmonic valve, and main pulmonary artery, single breathhold, retrospective gating.

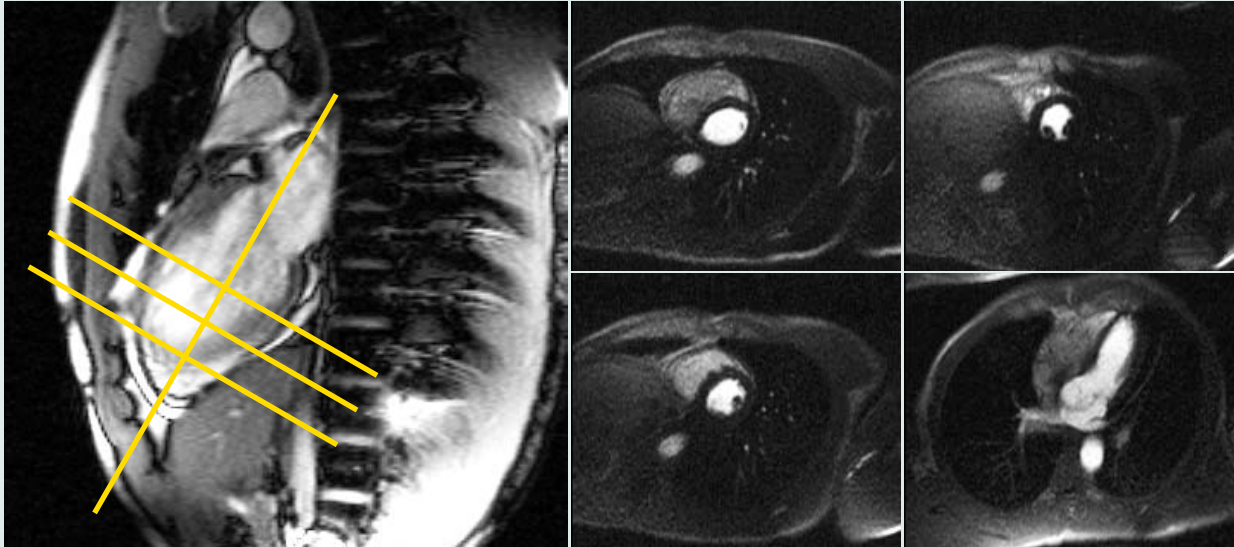


3. **Axial Cine:** prescribe from coronal and sagittal views, adjust gap to cover entire right ventricle and outflow tract, multiple slices, multiple breathholds, retrospective gating.



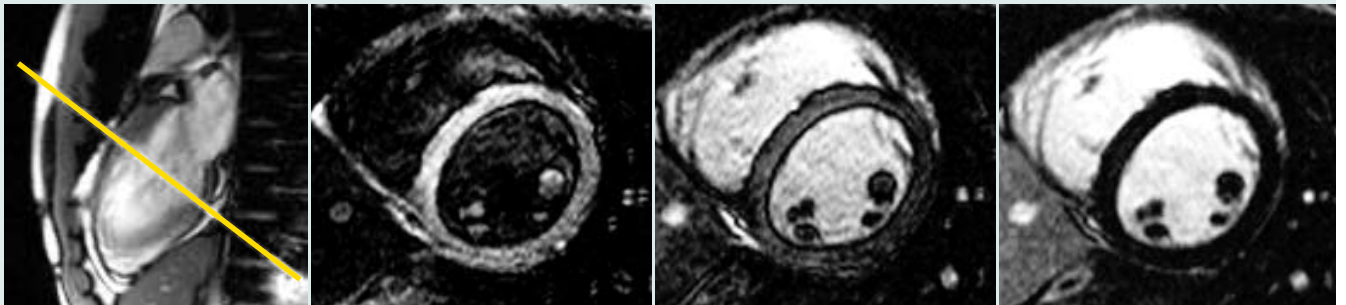
Dynamic Module

1. **Dynamic Test:** saturation recovery segmented turboflash, requires 3 short axis slices at base, mid, and apex levels, optional 1 long axis slice if R-R interval is long enough, rotate FoV to avoid wrap, trigger on every heartbeat, start breathhold during early phase of scan, only 5 measurements for test.
2. **Dynamic:** same as above except with 50 measurements.

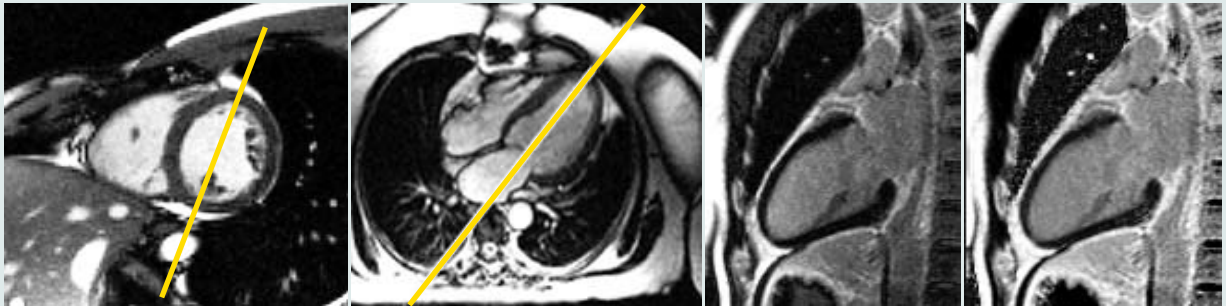


Delayed Module

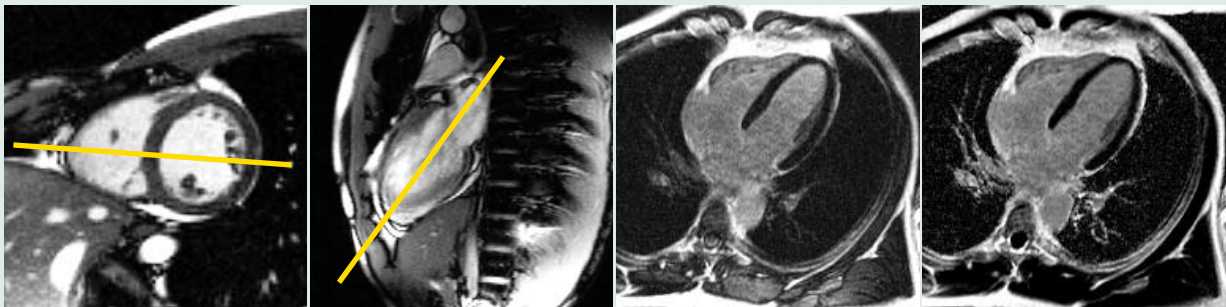
1. **TI Scout:** determine optimal TI for nulling of normal myocardium, prescribe as a mid ventricular short axis slice, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for optimal acquisition window.



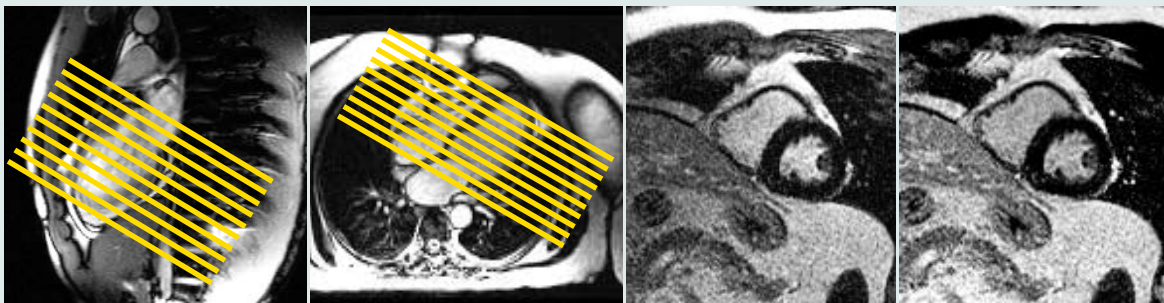
- 2. Two Chamber Delayed:** prescribe 1 slice, phase sensitive inversion recovery turbo-flash technique, provides both magnitude and real images, adjust TI for nulling of normal myocardium, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



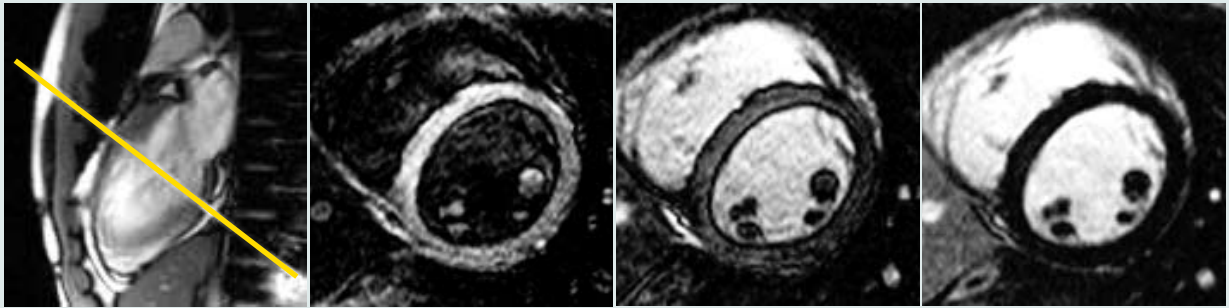
- 3. Four Chamber Delayed:** prescribe 1 slice, phase sensitive inversion recovery turbo-flash technique, provides both magnitude and real images, adjust TI for nulling of normal myocardium, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



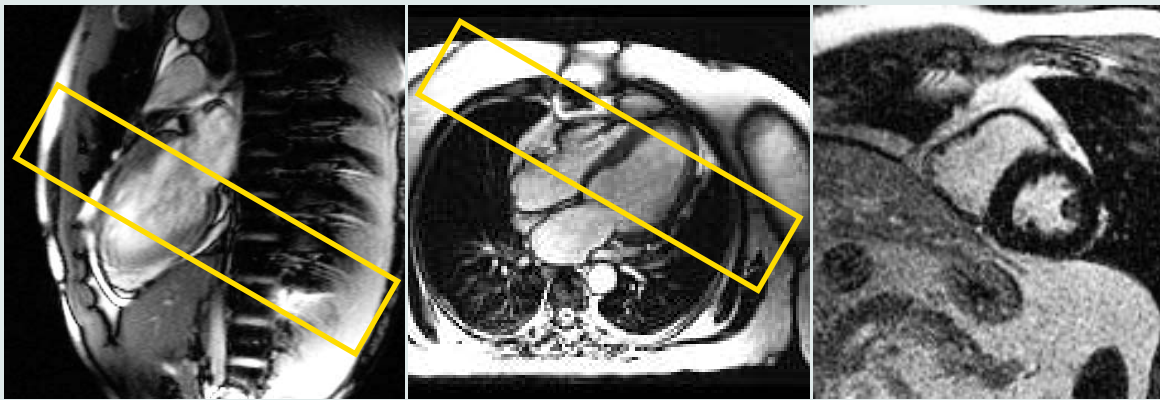
- 4. Short Axis Delayed:** prescribe 12 slices, phase sensitive inversion recovery turbo-flash technique, provides both magnitude and real images, adjust TI for nulling of normal myocardium, rotate FoV to avoid wrap, multiple breathholds, trigger on every second heartbeat, capture cycle for diastolic gating.



- 5. OPTIONAL TI Scout:** determine optimal TI for nulling of normal myocardium, prescribe as a mid ventricular short axis slice, rotate FoV to avoid wrap, single breathhold, trigger on every heartbeat, capture cycle for optimal acquisition window.

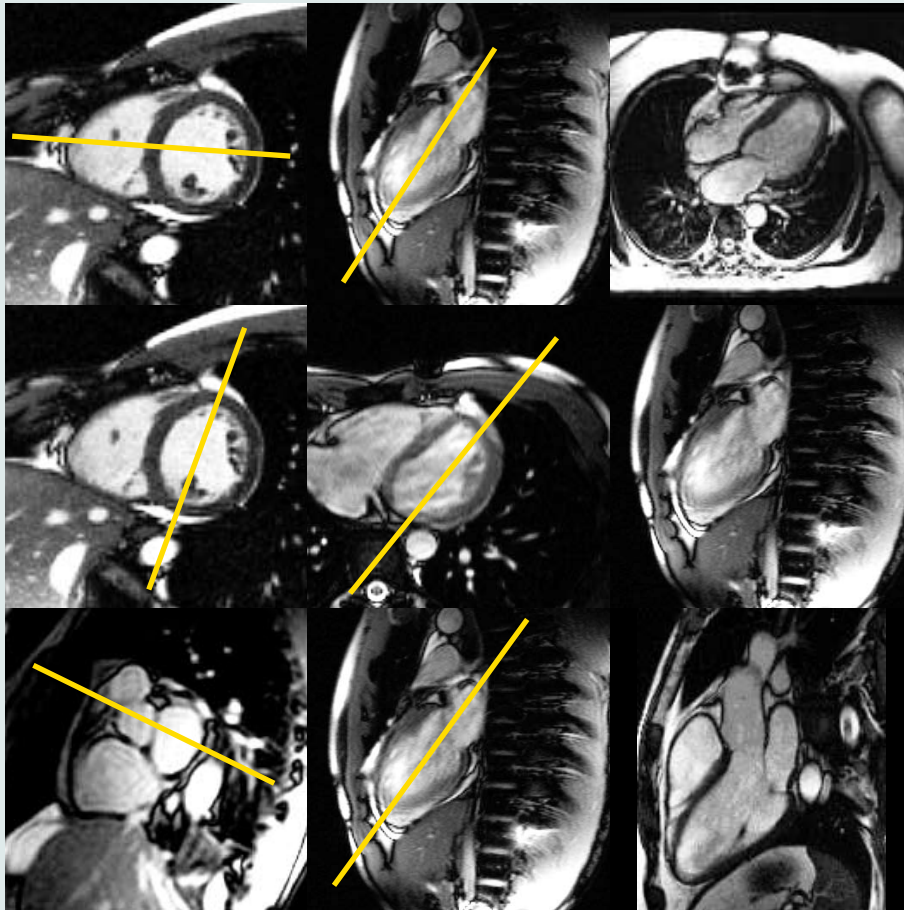


- 6. OPTIONAL Short Axis Delayed 3D:** inversion recovery turboflash 3D technique, adjust TI for nulling of normal myocardium, rotate FoV to avoid wrap, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.

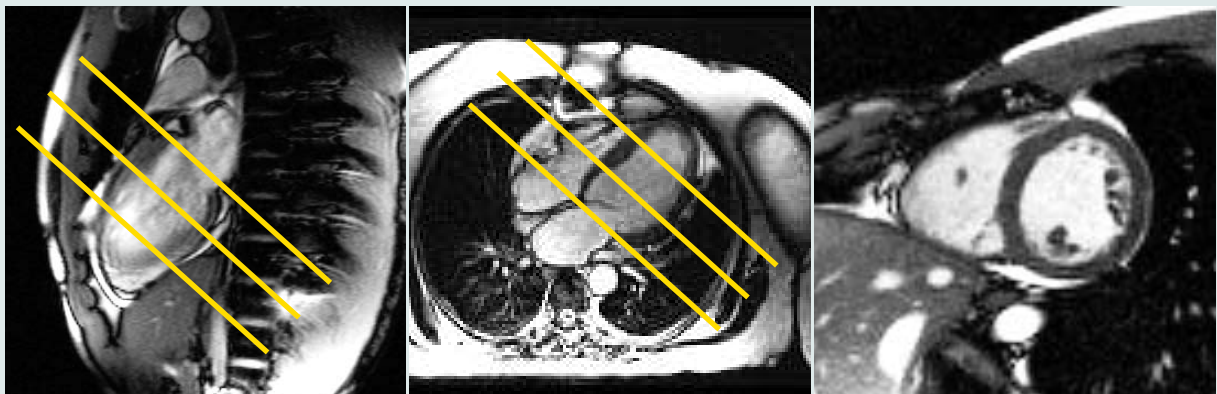


Dobutamine Stress Module

- 1. Long Axis Rest/Stress:** prescribe 2-, 3-, and 4-chamber long axis slices as 3 separate slice groups, rotate FoV to avoid wrap, single breathhold, retrospective gating. Reduce temporal resolution as heart rate increases.



- 2. Short Axis Rest/Stress:** prescribe 3 short axis slices in a single slice group, adjust gap to cover base, mid, apex levels of left ventricle, rotate FoV to avoid wrap, single breathhold, retrospective gating. Reduce temporal resolution as heart rate increases.

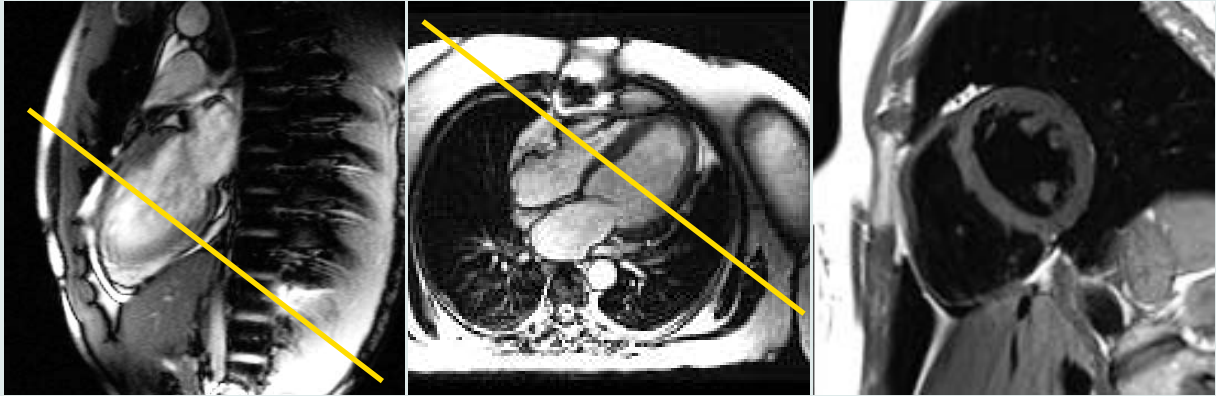


Acute Myocardial Infarct

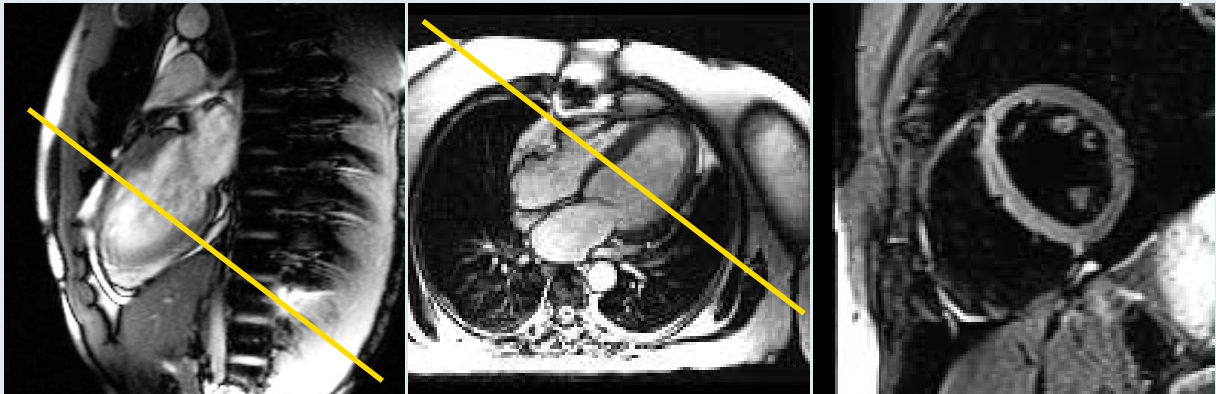
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

3. **Optional TSE Dark Blood T2:** prescribe 1 slice, segmented TSE dark blood T2, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



4. **Optional TSE Dark Blood T2 Fatsat:** prescribe 1 slice, segmented TSE dark blood T2 with fatsat, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



5. **Dynamic Module** without Adenosine to assess myocardial ischemia.

6. **Optional Delayed Module** early after injection to assess microvascular obstruction.

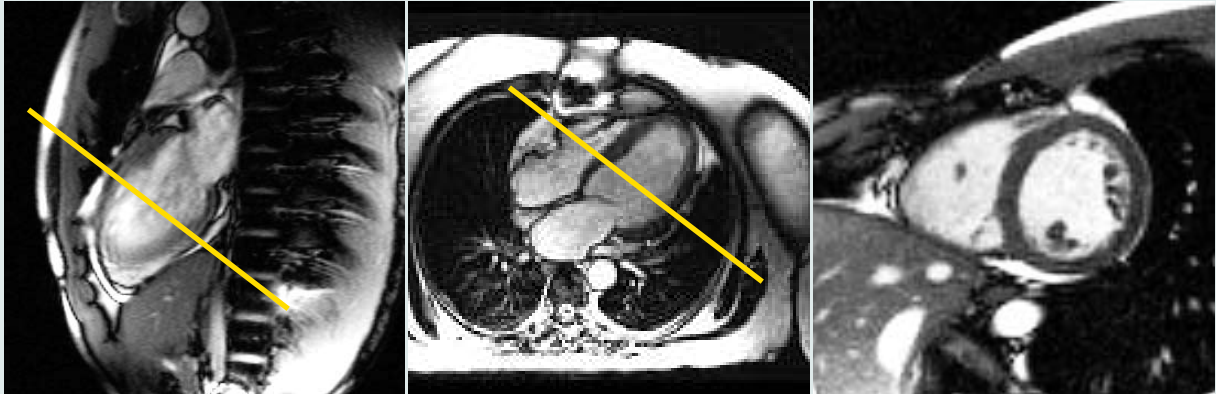
7. **Delayed Module** late after injection to assess myocardial infarct.

Chronic Ischemic Disease

1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

3. **Optional Low Dose Dobutamine Cine:** to assess contractile reserve as improvements in wall thickening, prescribe 1 slice through area of interest, adjust gap to cover base, mid, apex levels of left ventricle, single breathhold, retrospective gating.



4. **Optional Stress/Rest Dynamic Module** with/without Adenosine to assess myocardial ischemia.

5. **Delayed Module** late after injection to assess myocardial infarct.

Adenosine Stress

1. **Localizer Module** for localization.

2. **Stress Dynamic Module** with Adenosine to assess myocardial ischemia.

3. **LV Function Module** to assess ventricular function.

4. **Rest Dynamic Module** without Adenosine to assess myocardial ischemia.

5. **Delayed Module** late after injection to assess myocardial infarct.

Peripheral Arteries

1. **Localize:** feet-first 230 mm above feet.

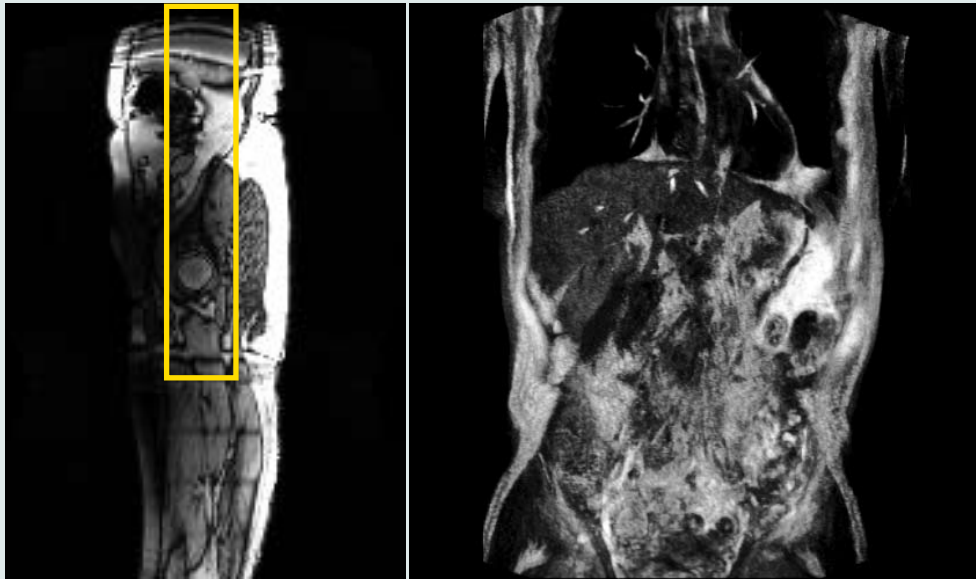
2. **Leg Multiple Localizers:** runs automatically with Body Coil, fixed table position zero, automatic composing.

3. **Thigh Multiple Localizers:** runs automatically with Body Coil, fixed table position Head 450 mm, automatic composing.

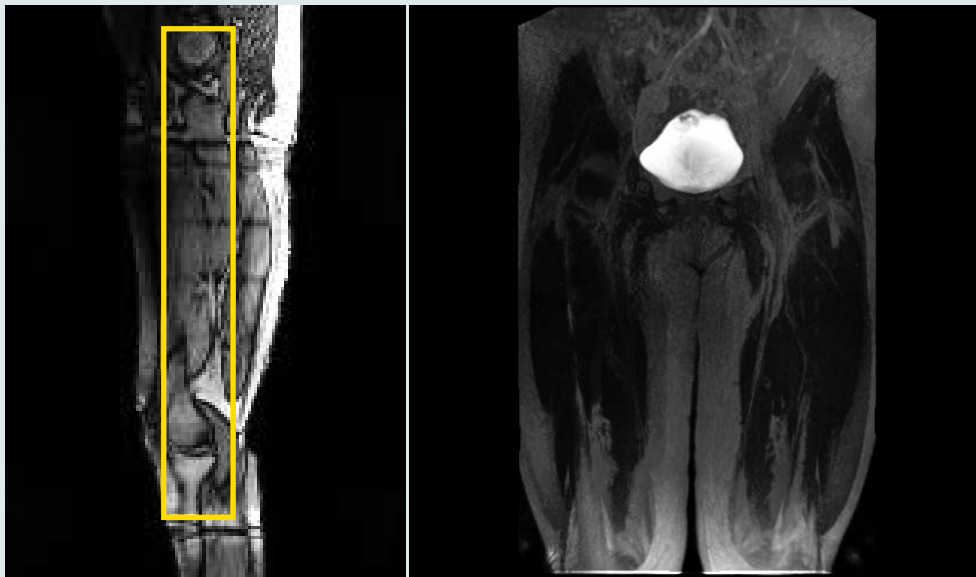
4. **Abdomen Multiple Localizers:** runs automatically with Body Coil, fixed table position Head 900 mm, automatic composing.



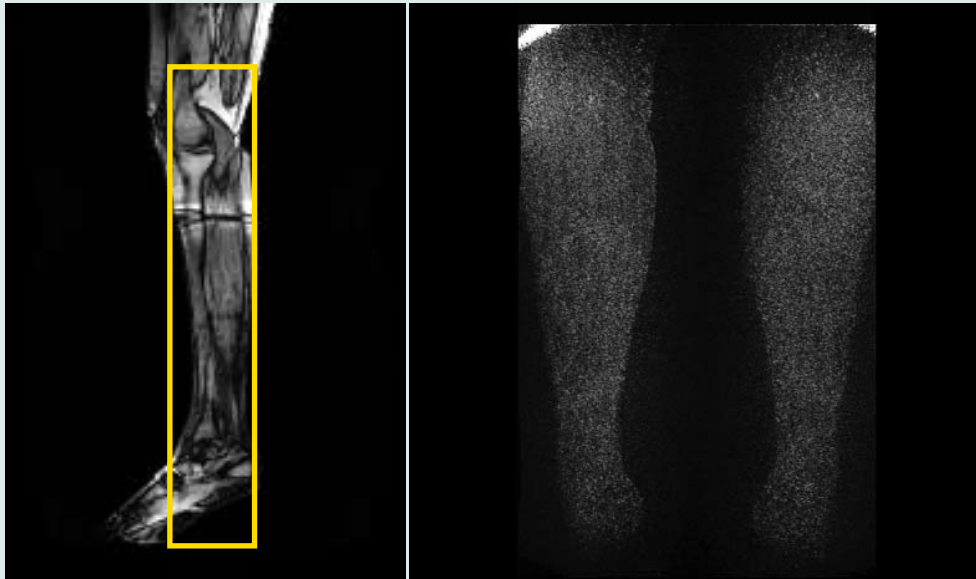
- 5. Abdomen Coronal Mask:** adjusts abdomen to isocenter of bore (ISO table mode), prescribe coronal slab from abdomen localizer images, subtraction mask for angio scans, automatic subtraction and mip and composing.



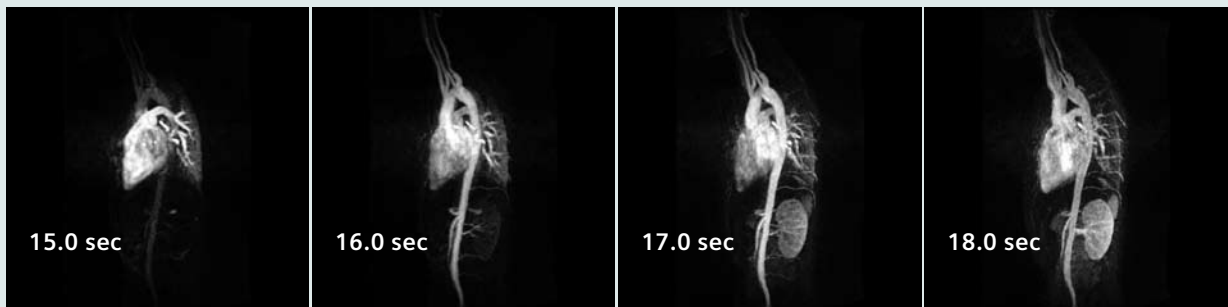
- 6. Thigh Coronal Mask:** adjusts thighs to isocenter of bore (ISO table mode), prescribe coronal slab from thigh localizer images, subtraction mask for angio scans, automatic subtraction and mip and composing.



- 7. Leg Coronal Mask:** adjusts lower legs to isocenter of bore (ISO table mode), prescribe coronal slab from leg localizer images, subtraction mask for angio scans, automatic subtraction and mip and composing.



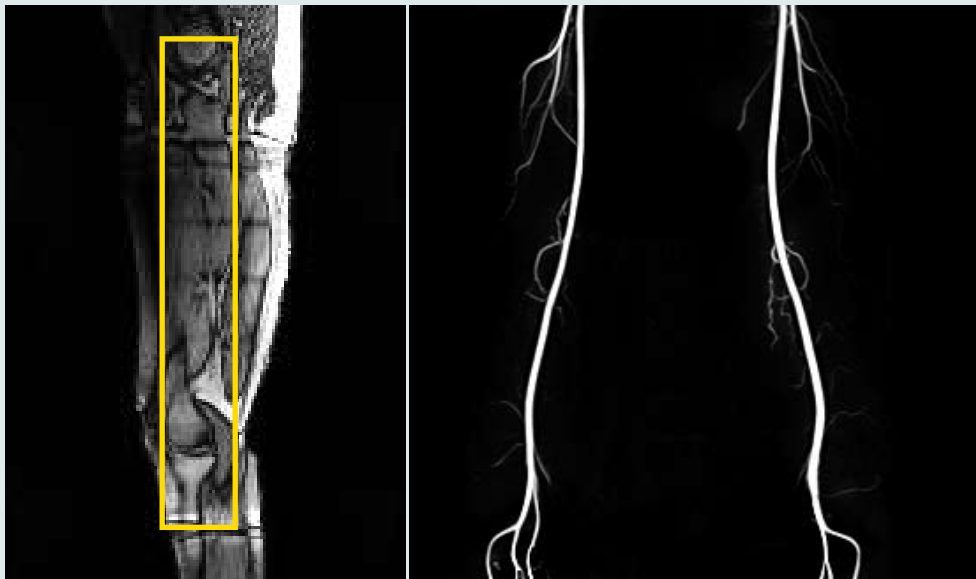
- 8. Aorta Sagittal Care-Bolus:** uses the care-bolus technique for dynamic imaging of the aorta, adjusts abdomen to isocenter of bore (ISO table mode), prescribe sagittal oblique candy cane slice from abdomen scout images, acquires 1 image per second.



9. Abdomen Coronal Angio: adjusts abdomen to isocenter of bore (ISO table mode), automatically repeats mask scan parameters and position, automatic subtraction and mip and composing, 1 measurement with linear reordering.



10. Thigh Coronal Angio: adjusts thighs to isocenter of bore (ISO table mode), automatically repeats mask scan parameters and position, automatic subtraction and mip and composing, 1 measurement with linear reordering.



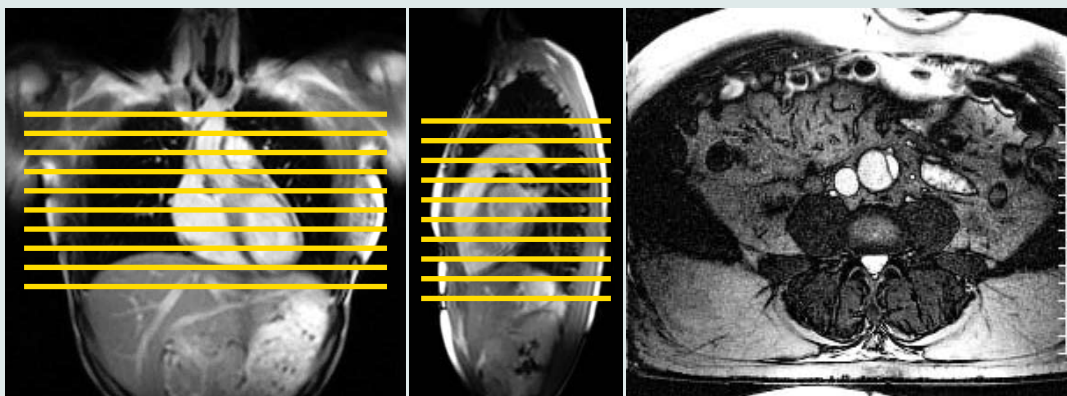
11. **Leg Coronal Angio:** adjusts lower legs to isocenter of bore (ISO table mode), automatically repeats mask scan parameters and position, automatic subtraction and mip and composing, 2 measurements with centric reordering.



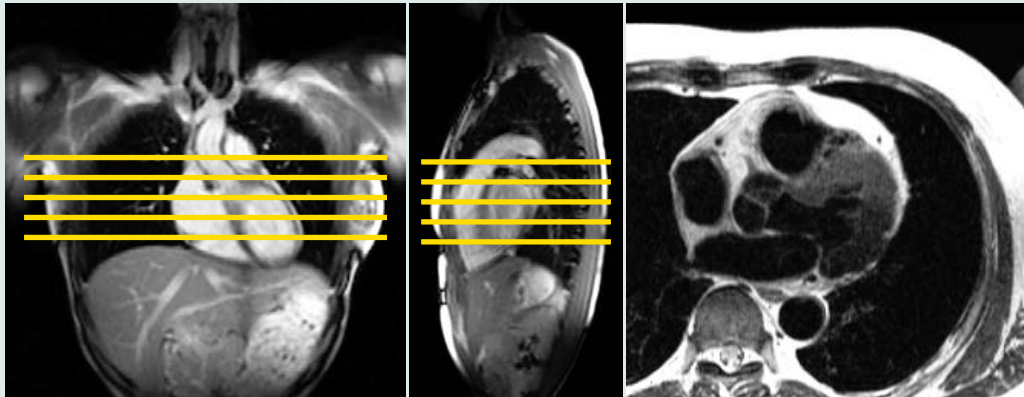
Thoracic Aorta

1. **Localizer Module** for localization.

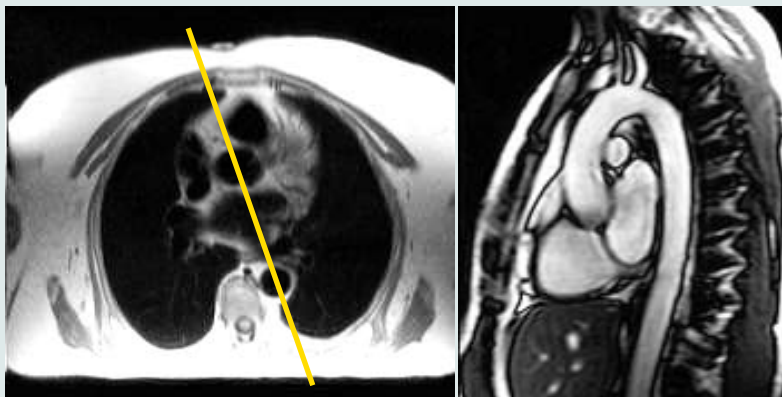
2. **Axial Bright Blood:** prescribe 30 axial slices to cover entire chest, multiple breathholds, trigger on every heartbeat, capture cycle for diastolic gating.



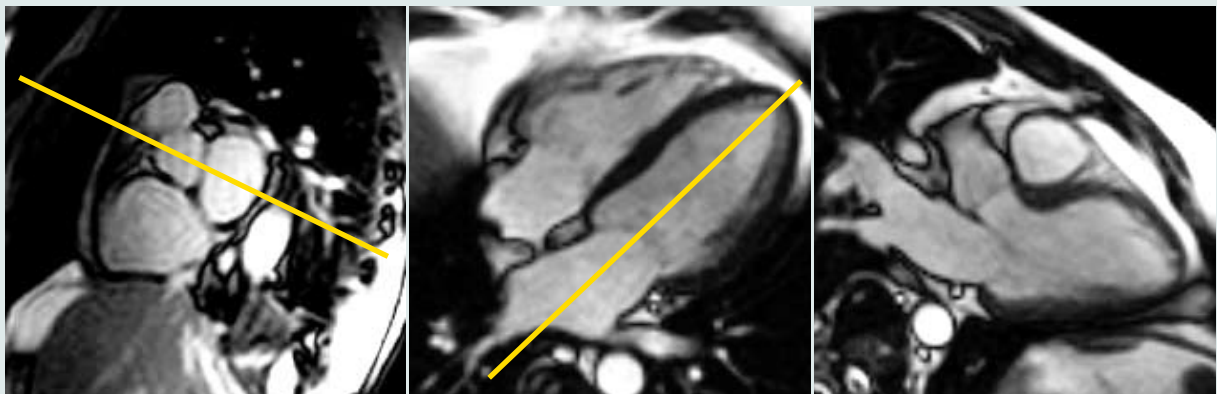
- 3. Axial TSE Dark Blood T1:** for selected slice levels through aortic dissection or intramural hematoma, segmented dark blood tse t1, single slice, single breathhold, repeat as needed, trigger on every heartbeat, capture cycle for diastolic gating.



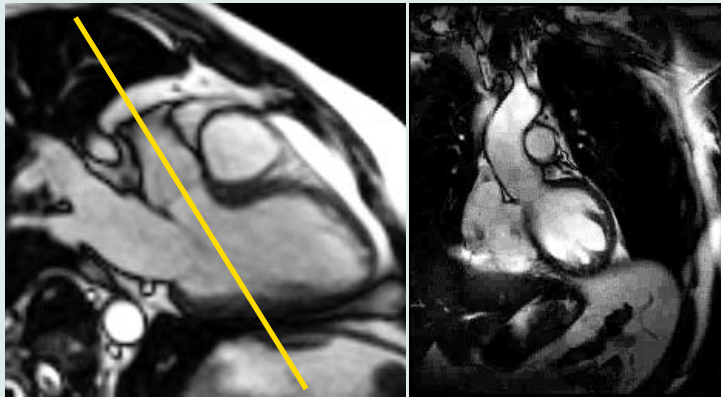
- 4. Sagittal Aorta Cine:** prescribe 1 slice in sagittal oblique (candy cane) view, rotate FoV to avoid wrap, single breathhold, retrospective gating.



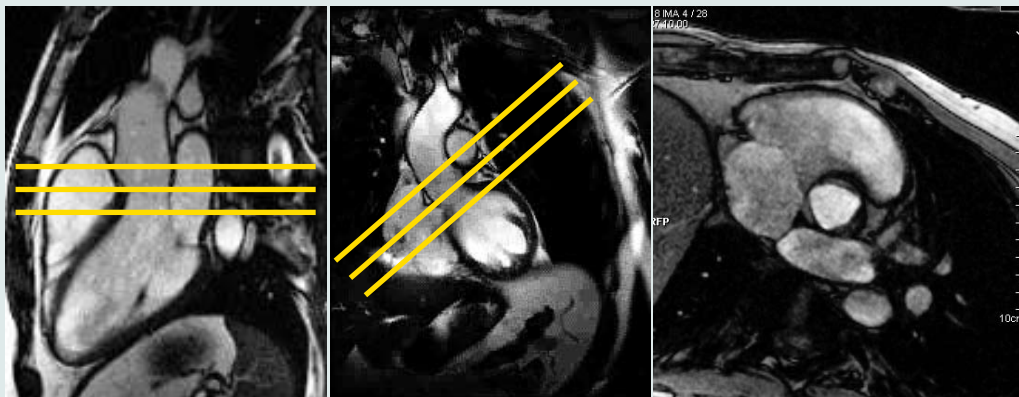
- 5. Three Chamber Cine:** prescribe 1 slice, bisect the LVOT and posterolateral LV wall on the most basal short axis view, and bisect the LV through the mitral valve and apex on a four chamber view, rotate FoV to avoid wrap, single breathhold, retrospective gating.



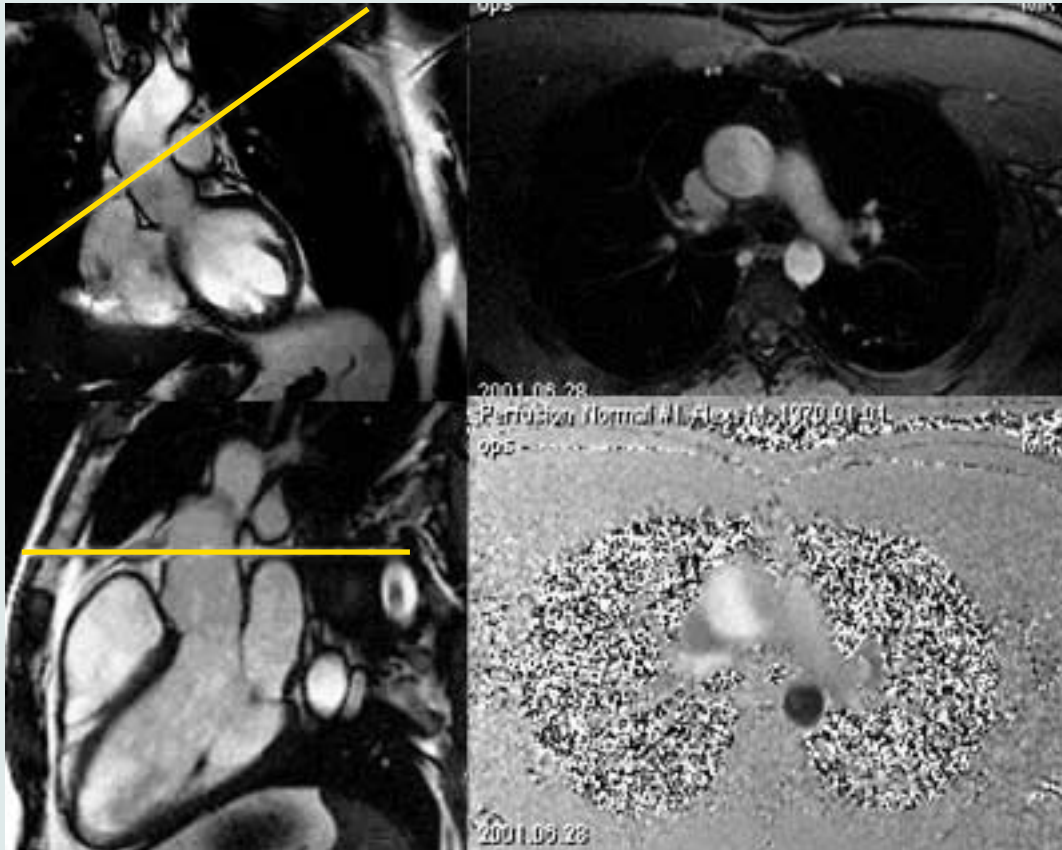
- 6. Coronal Aortic Outflow Cine:** prescribe 1 slice from three chamber view, bisect the LVOT, aortic valve, and ascending aorta, rotate FoV to avoid wrap, single breath-hold, retrospective gating.



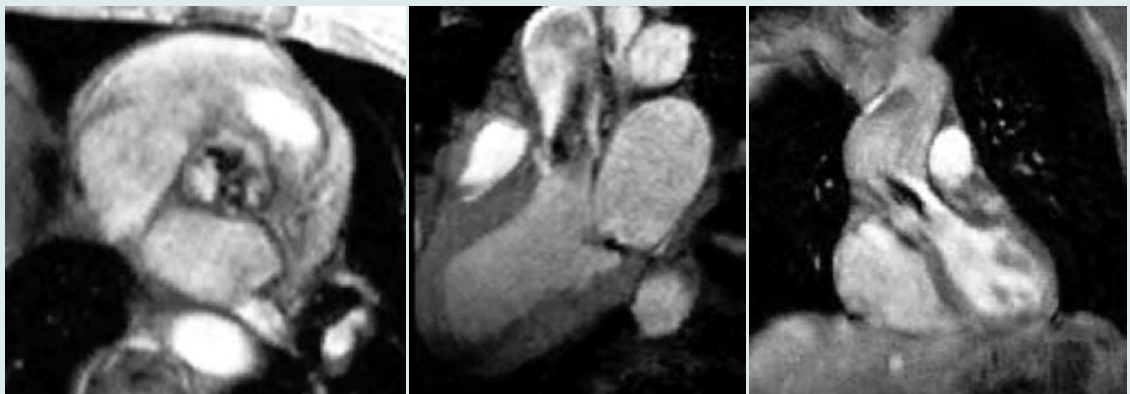
- 7. Cross-Sectional Aortic Valve Cine:** 3 contiguous cross-sectional slices across aortic valve plane, high resolution truefisp radial eliminates wrap with small FoV, multiple breathholds, retrospective gating.



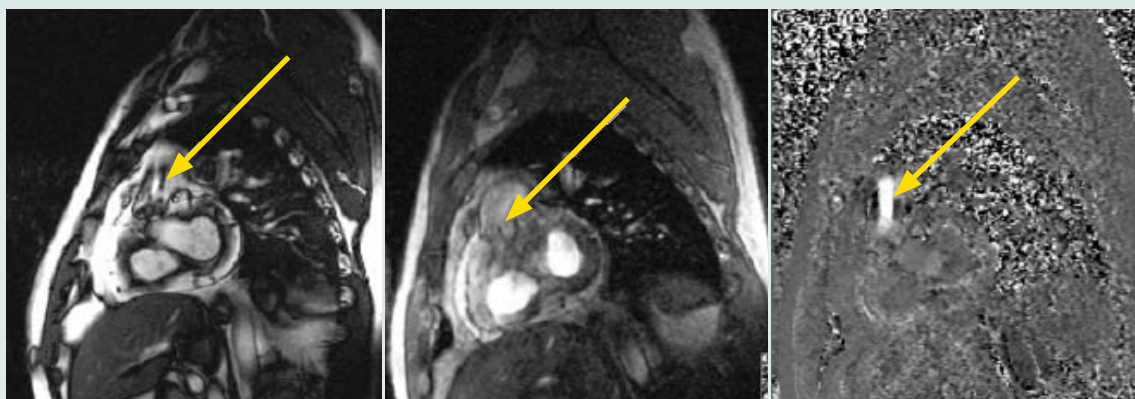
8. Optional Aorta Through-Plane Flow Qs: prescribe from three chamber view and coronal aorta view, 1 cross-sectional slice perpendicular to ascending aorta distal to valve leaflet tips, through-plane VENC 150 cm/sec for normal flow (or greater for stenosis), single breathhold, retrospective gating, short TE for optimal flow sensitivity.



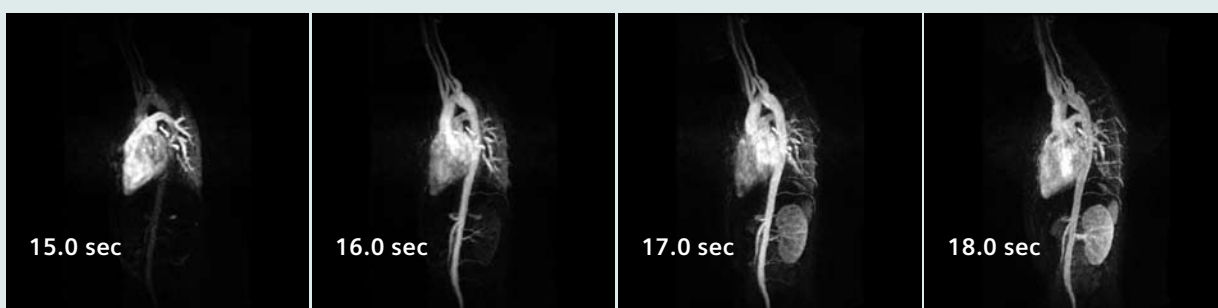
9. Optional GRE Stenotic Jet Cine: 1 slice in the best long-axis view to see the stenotic flow jet, single breathhold, long TE for dark turbulent flow void, retrospective gating.



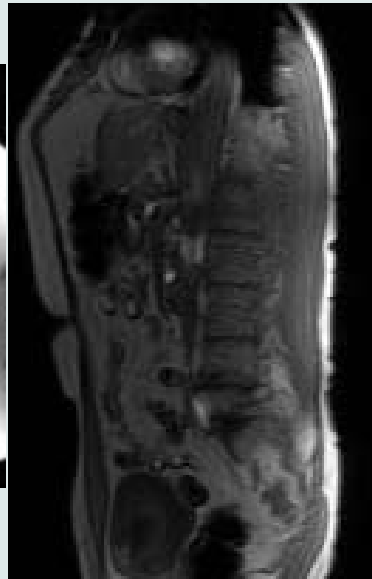
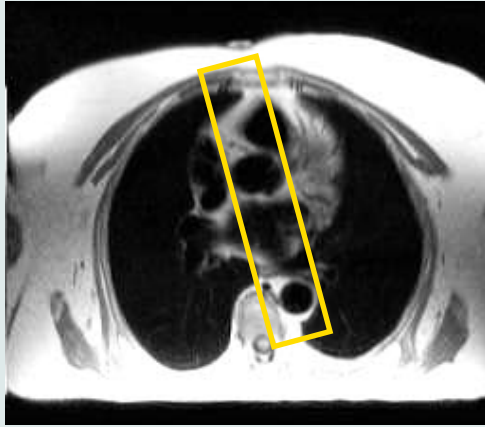
- 10. Optional Stenotic Jet In-Plane Flow:** 1 slice in the best long-axis view to see the stenotic flow jet, single breathhold, in-plane VENC 250 cm/sec or greater, retrospective gating, short TE for optimal flow sensitivity.



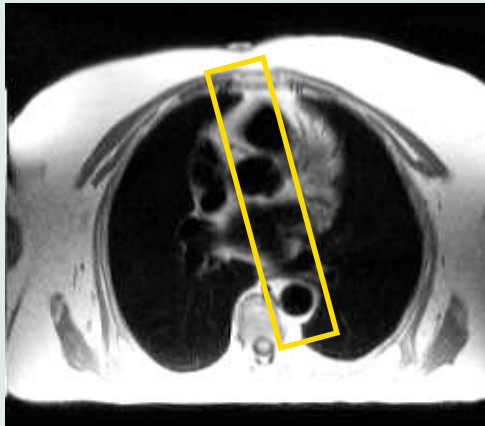
- 11. Aorta Test-Bolus:** uses the test-bolus technique for dynamic imaging of the aorta, prescribe sagittal oblique (candy cane) slice from axial localizer, acquires 1 image per second.



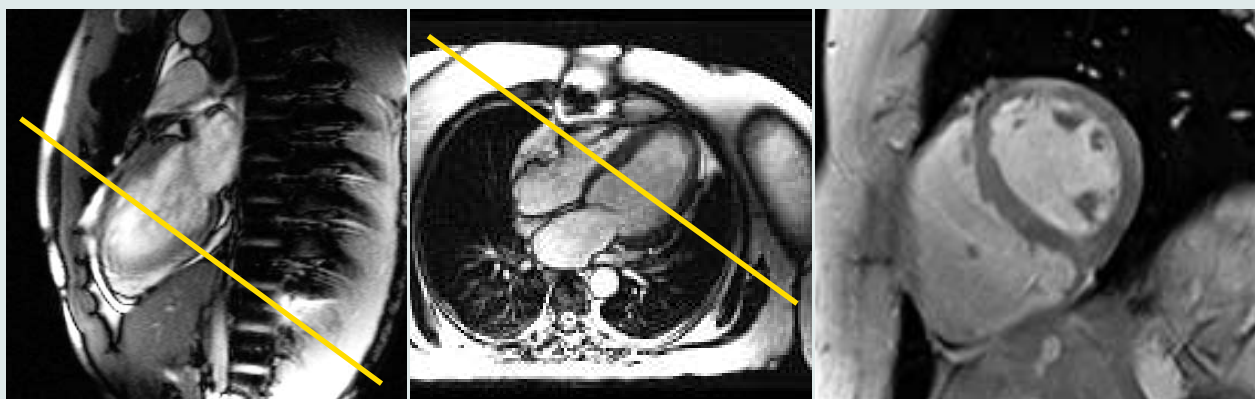
- 12. Sagittal Aorta Mask:** used as the subtraction mask for post scan, prescribe 1 slab in sagittal oblique (candy cane) view, 1 measurement in 1 breathhold, untriggered, automatic subtraction and mip.



- 13. Sagittal Aorta Angio 2 Measurements:** use appropriate scan delay as determined from test-bolus scan, automatically repeats scan parameters and position from mask scan, 2 measurements in 2 breathholds with 10 second pause in between, untriggered, automatic subtraction and mip.



- 14. Optional Axial GRE T1:** for selected slice levels through aorta to visualize aortitis post bolus injection, segmented gre sequence without dark blood pulse, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.

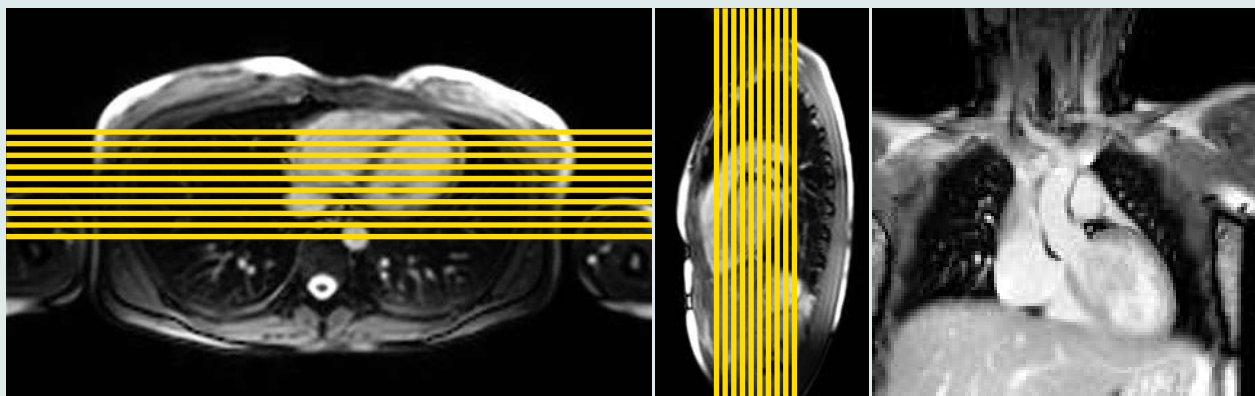


Anomalous Coronary Artery

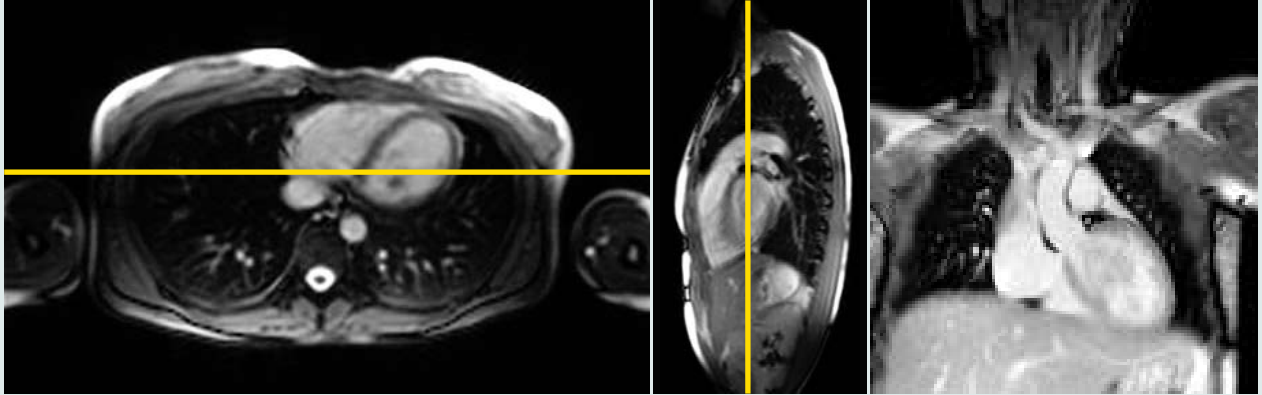
- 1. Localizer Module** for localization.

- 2. LV Function Module** to assess ventricular function.

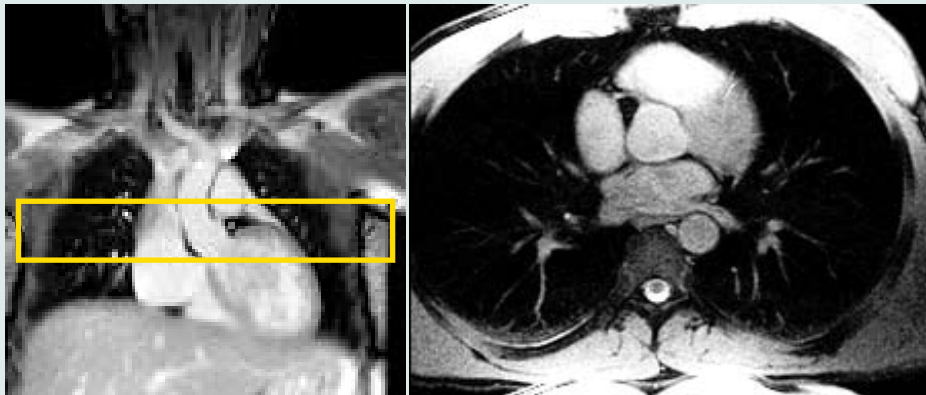
- 3. Coronal Coronary Scout:** prescribe 10 slices from axial and sagittal views, cover entire ascending aorta, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



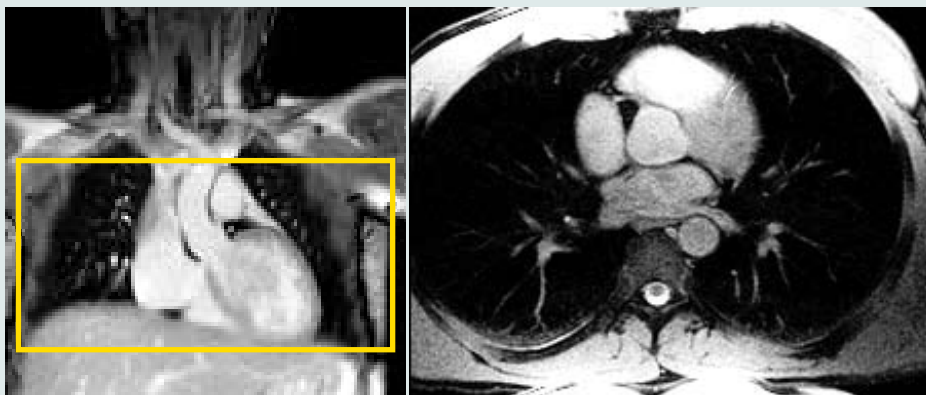
- 4. Dynamic Coronary Scout:** single coronal slice acquired dynamically during free-breathing to determine end-inspiratory and end-expiratory diaphragm positions, copy slice position from previous coronal coronary scout to see coronary origins.



- 5. Axial 3D Coronary Origins:** prescribe 1 axial slab from coronal aortic scout, cover just the coronary origins in a single breathhold, adjust trigger delay to acquire data in mid-diastolic stationary phase as determined from viewing a four chamber cine, no respiratory navigator required.



- 6. Optional Axial Whole Heart:** prescribe 1 axial slab at end-expiratory diaphragm position from dynamic coronary scout, cover entire heart including great vessels, free breathing navigator technique, adjust trigger delay to acquire data in mid-diastolic stationary phase as determined from viewing a four chamber cine, test with respiratory scout mode ON to adjust acceptance position, repeat with respiratory scout mode OFF to acquire images.

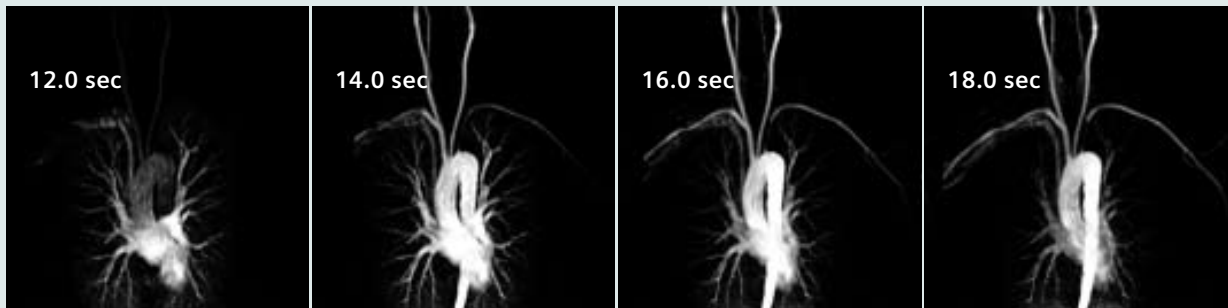


Pulmonary Vein

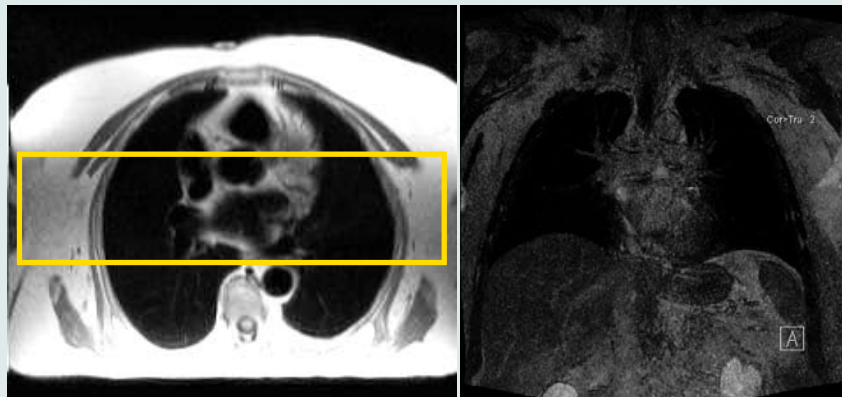
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

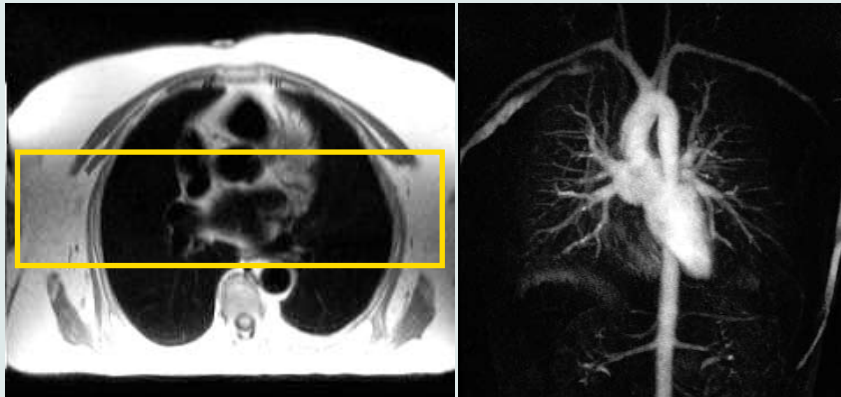
3. **Coronal Pulmonary Test-Bolus:** uses the test-bolus technique for dynamic imaging of the pulmonary veins, prescribe coronal slice through pulmonary veins and left atrium.



4. **Coronal Pulmonary Mask:** used as the subtraction mask for angio scan, prescribe coronal slab through pulmonary veins and left atrium, 1 measurement in 1 breath-hold, untriggered, automatic subtraction and mip.



- 5. Coronal Pulmonary Angio 2 Measurements:** use appropriate scan delay as determined from test-bolus scan, automatically repeats scan parameters and position from pre bolus mask, 2 measurements in 2 breathholds with 10 second pause between, untriggered, automatic subtraction and mip.



- 6. Optional Pulmonary Vein Flow:** prescribe 1 slice from coronal and sagittal views, cross-sectional to the origins of either left or right pulmonary veins, through-plane VENC 30 cm/sec for normal flow or 60 cm/sec for mild stenosis, single breathhold, retrospective gating.

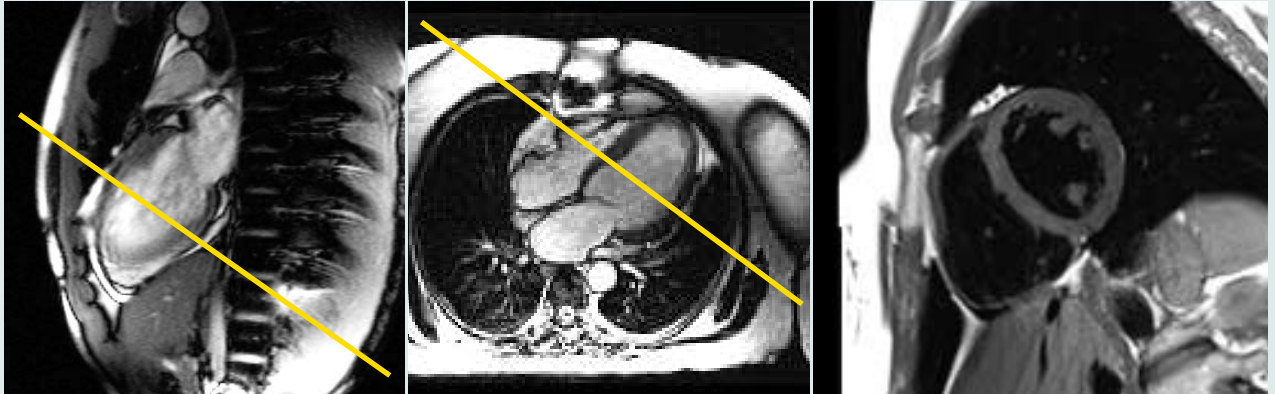


Nonischemic Cardiomyopathy

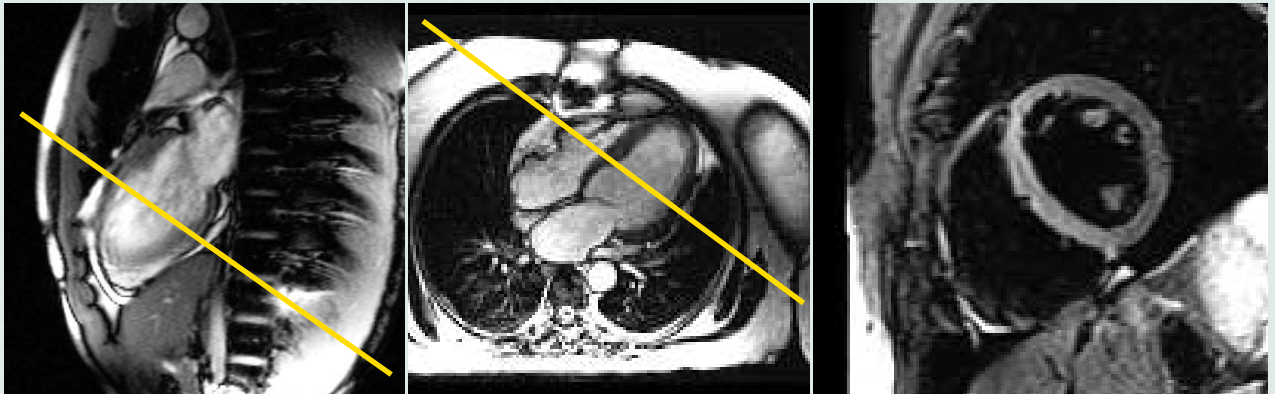
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

3. **Optional TSE Dark Blood T2:** segmented tse dark blood t2, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



4. **Optional TSE Dark Blood T2 Fatsat:** segmented tse dark blood t2 fatsat, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



5. Optional Stress/Rest Dynamic Module with/without Adenosine to assess myocardial ischemia.

6. Delayed Module late after injection to assess myocardial infarct.

7. Optional In-Plane Flow: three chamber view for hypertrophic cardiomyopathy, adjust in-plane VENC to best visualize flow disturbances in LV outflow tract, single breathhold, retrospective gating.



8. Optional Through-Plane Flow: cross-sectional view of LV outflow tract for hypertrophic cardiomyopathy, adjust thru-plane VENC to best visualize flow disturbances in LV outflow tract, single breathhold, retrospective gating.

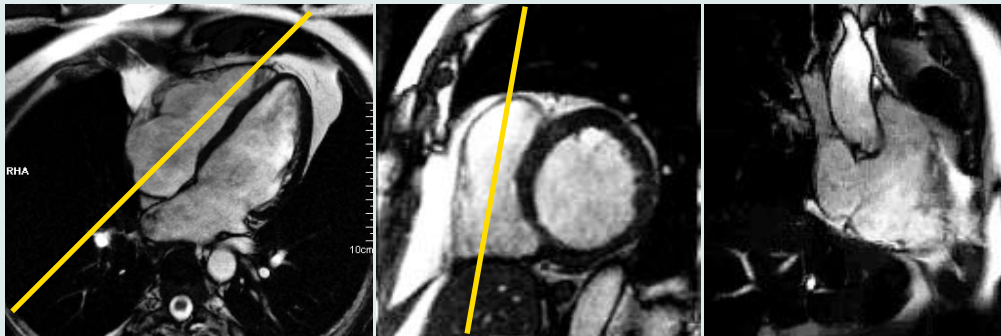


Arrhythmogenic Right Ventricular Cardiomyopathy

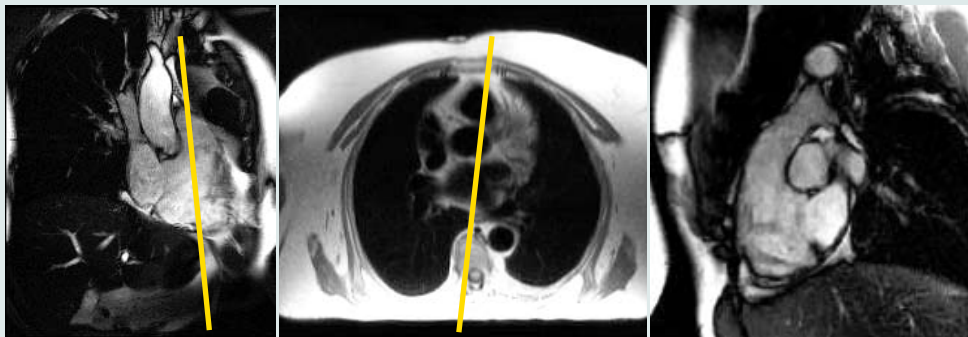
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

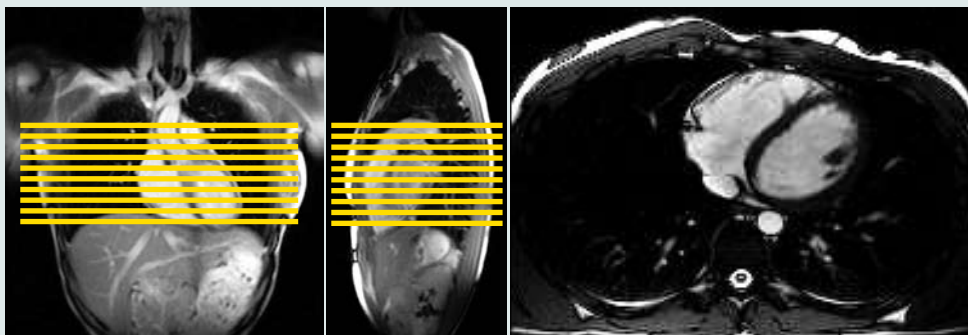
3. **Right Ventricular Vertical Long Axis Cine:** prescribe 1 right ventricular long axis slice from four chamber and basal short axis views, parallel to ventricular septum bisecting tricuspid valve, right atrium, and right ventricle, single breathhold, retrospective gating.



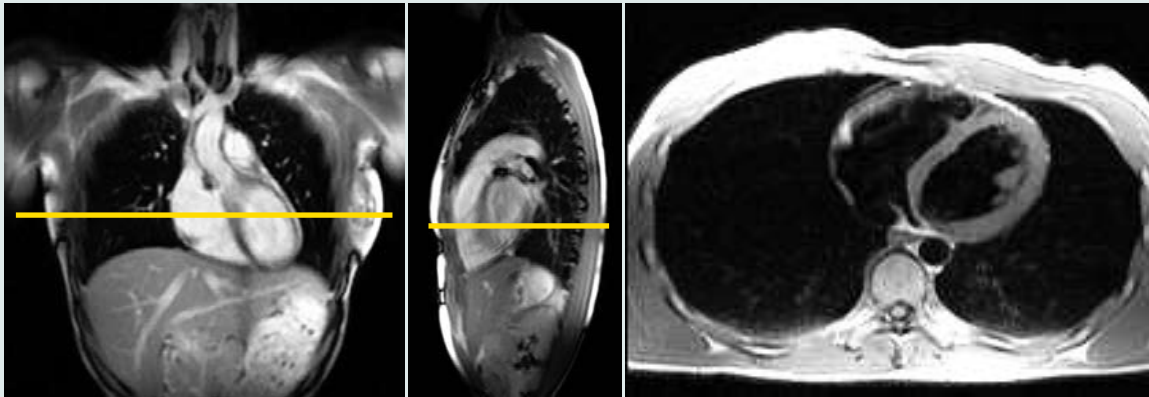
4. **Right Ventricular Outflow Tract Cine:** prescribe 1 slice from right ventricular vertical long axis and axial views, bisect pulmonary outflow tract, pulmonic valve, and main pulmonary artery, single breathhold, retrospective gating.



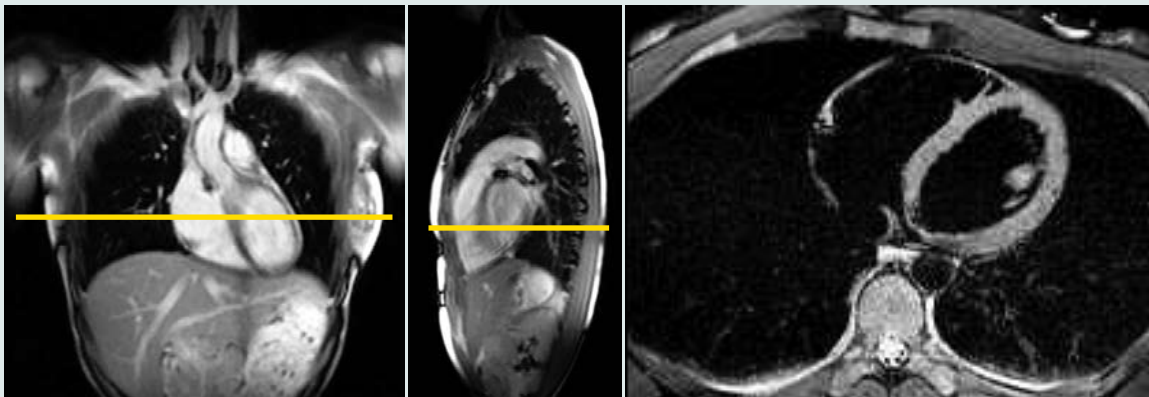
5. **Axial Cine:** prescribe 12 slices, adjust gap to cover entire right ventricle from base to apex, multiple breathholds, retrospective gating.



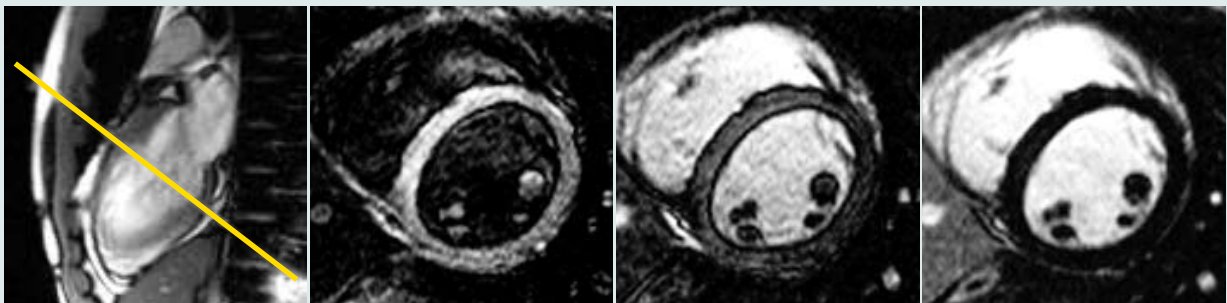
- 6. Optional Axial TSE Dark Blood T1:** for selected slice levels of right ventricle, segmented dark blood tse, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



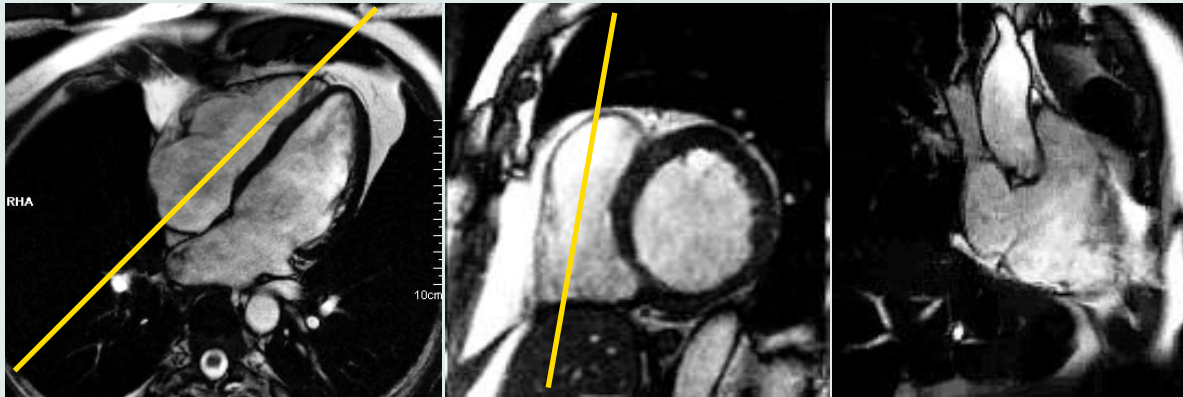
- 7. Optional Axial TSE Dark Blood T1 Fatsat:** for selected slice levels of right ventricle, segmented dark blood tse with fatsat, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.



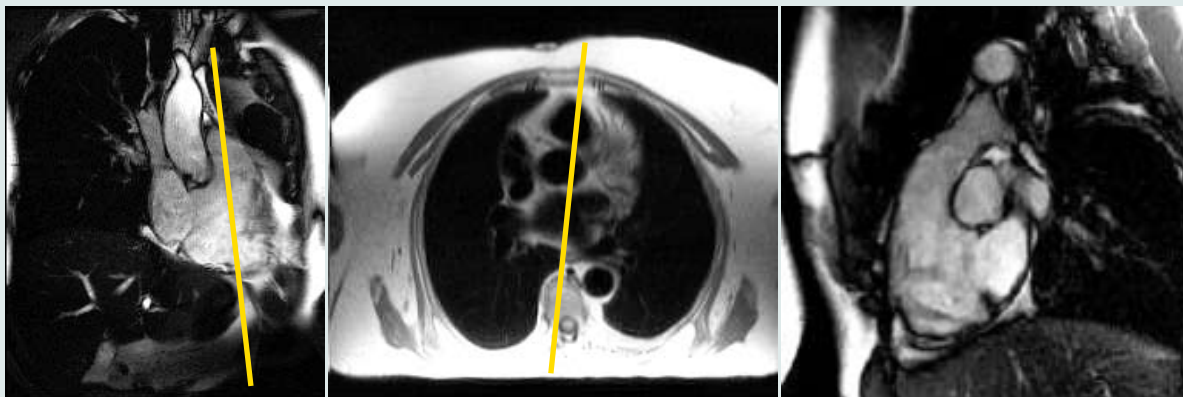
- 8. Optional T1 Scout:** determine optimal TI for nulling of normal RV myocardium, prescribe as a mid ventricular short axis slice, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for optimal acquisition window.



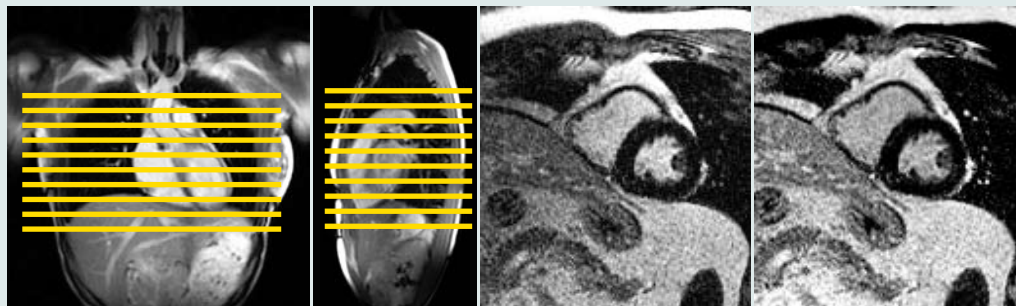
- 9. Optional Right Ventricular Vertical Long Axis Delayed:** 1 slice in 1 breathhold, phase sensitive inversion recovery turboflash technique, provides both magnitude and real images, adjust TI for nulling of normal RV myocardium, trigger on every second heartbeat, capture cycle for diastolic gating.



- 10. Optional Right Ventricular Outflow Tract Delayed:** 1 slice in 1 breathhold, phase sensitive inversion recovery turboflash technique, provides both magnitude and real images, adjust TI for nulling of normal RV myocardium, trigger on every second heartbeat, capture cycle for diastolic gating.



- 11. Optional Axial Delayed:** 12 slices in 12 breathholds, phase sensitive inversion recovery turboflash technique, provides both magnitude and real images, adjust TI for nulling of normal RV myocardium, trigger on every second heartbeat, capture cycle for diastolic gating.

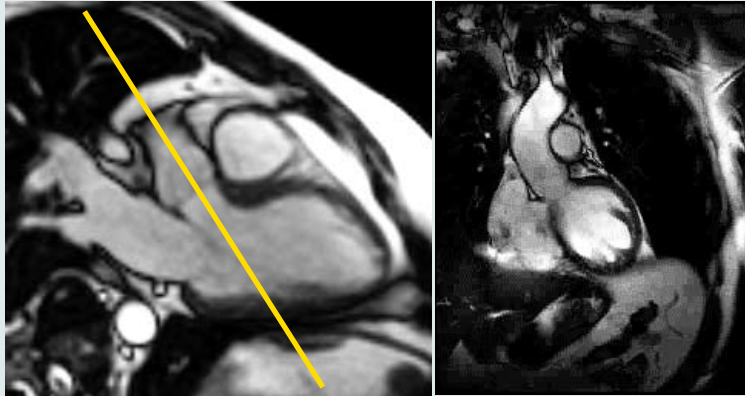


Congenital Disease

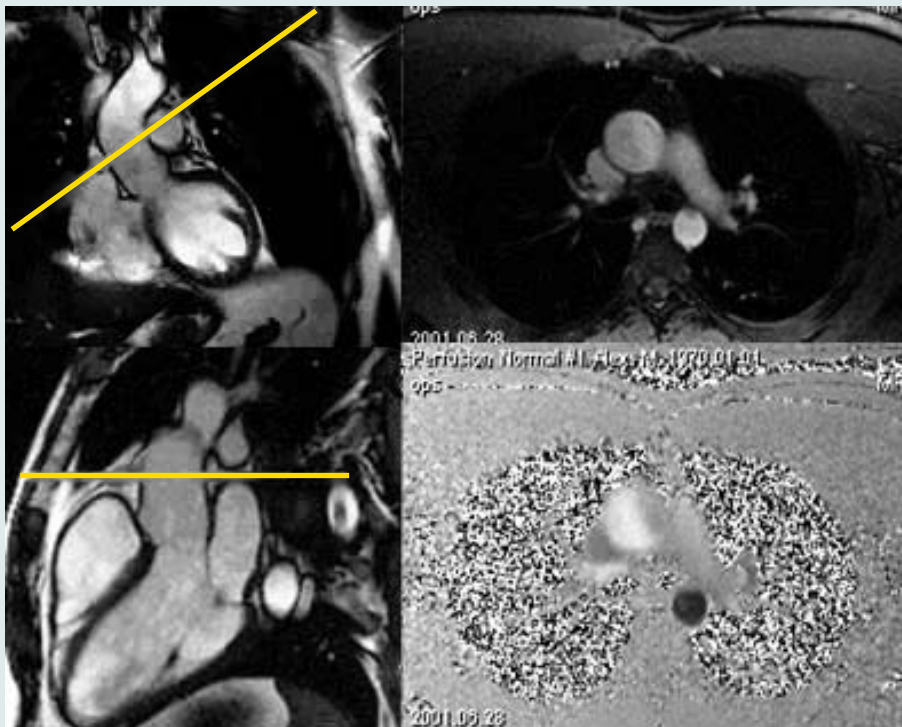
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

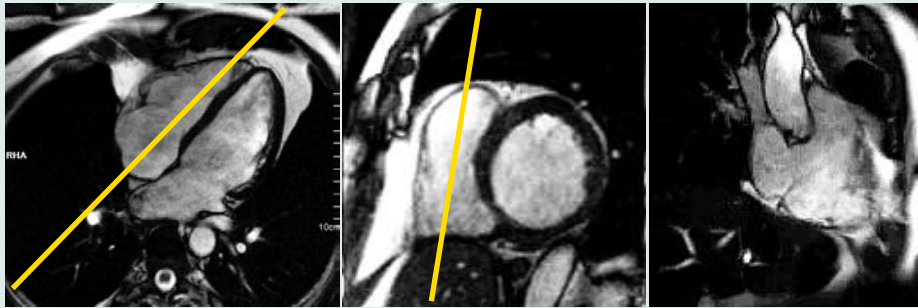
3. **Coronal Aortic Outflow Cine:** prescribe 1 coronal oblique aortic outflow slice from three chamber view, bisect LV outflow tract, aortic valve, and ascending aorta, single breathhold, retrospective gating.



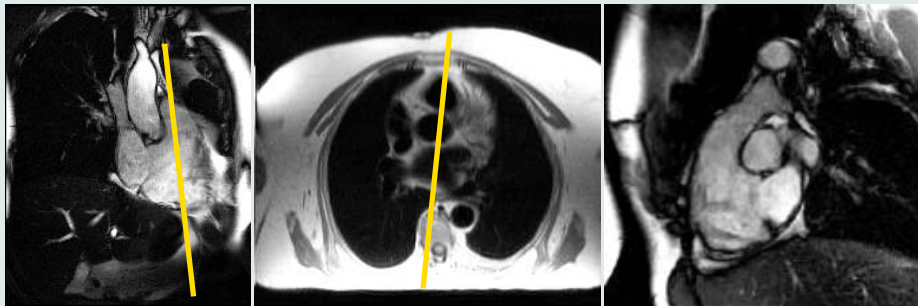
4. **Aorta Through-Plane Flow Qs:** prescribe from three chamber view and coronal aorta view, 1 cross-sectional slice perpendicular to ascending aorta distal to valve leaflet tips, repeat 1 cross-sectional slice across aortic valve orifice, through-plane VENC 150 cm/sec for normal flow (or greater for stenosis), single breathhold, retrospective gating, short TE for optimal flow sensitivity.



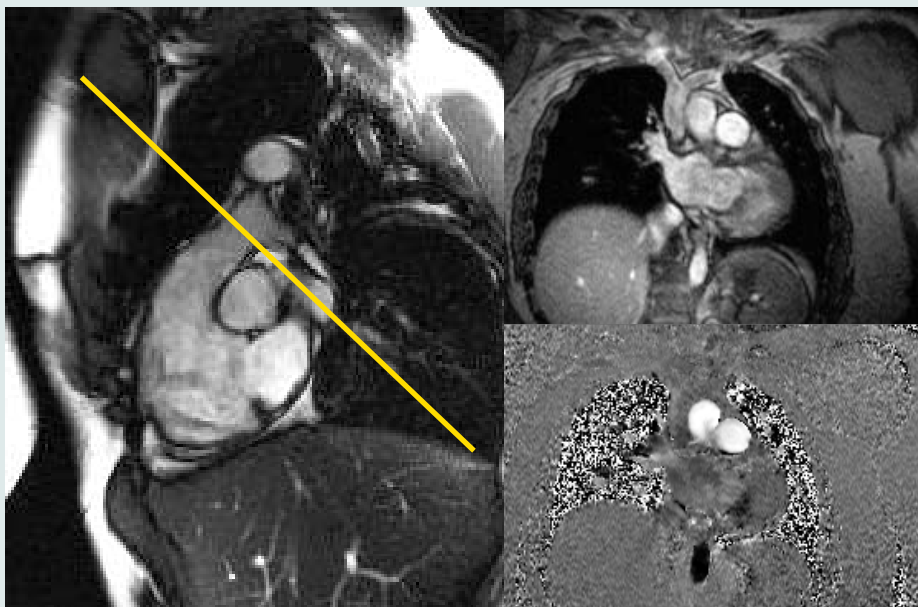
- 5. Right Ventricular Vertical Long Axis Cine:** prescribe 1 right ventricular long axis slice from four chamber and basal short axis views, parallel to ventricular septum bisecting tricuspid valve, right atrium, and right ventricle, single breathhold, retrospective gating.



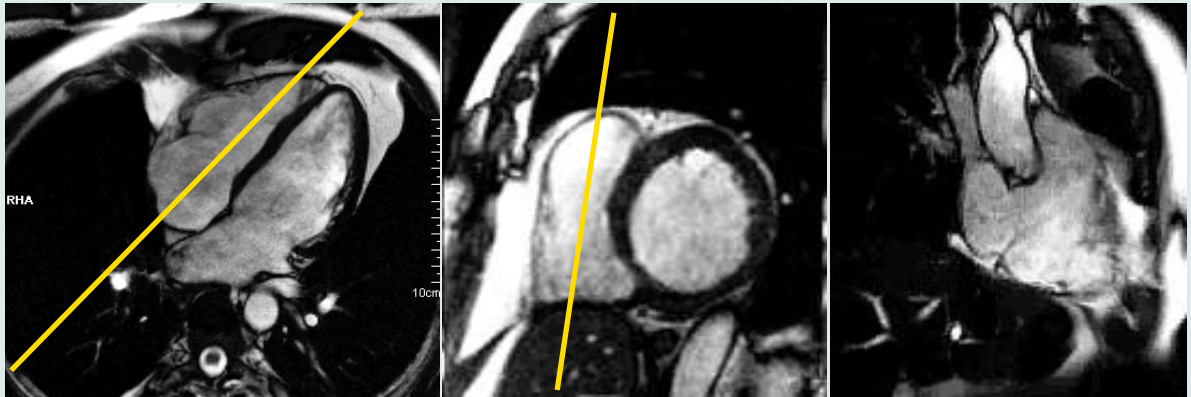
- 6. Right Ventricular Outflow Tract Cine:** prescribe 1 slice from right ventricular vertical long axis and axial views, bisect pulmonary outflow tract, pulmonic valve, and main pulmonary artery, single breathhold, retrospective gating.



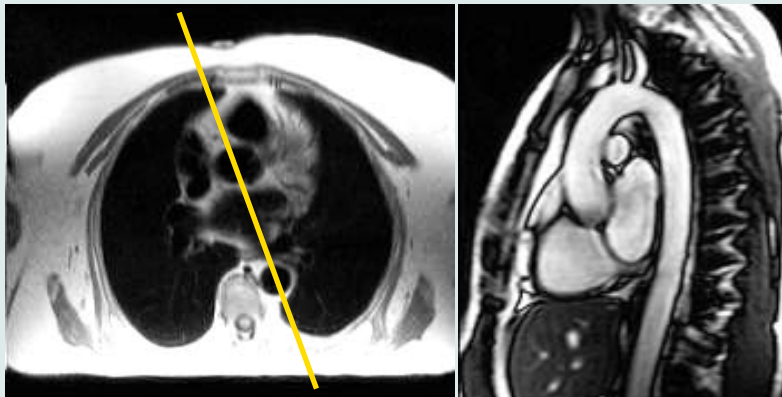
- 7. Pulmonary Through-Plane Flow Qp:** prescribe from right ventricular outflow tract view, 1 cross-sectional slice perpendicular to main pulmonary artery distal to valve leaflet tips, repeat 1 cross-sectional slice across pulmonic valve orifice, through-plane VENC 90 cm/sec for normal flow (or greater for stenosis), single breathhold, retrospective gating, short TE.



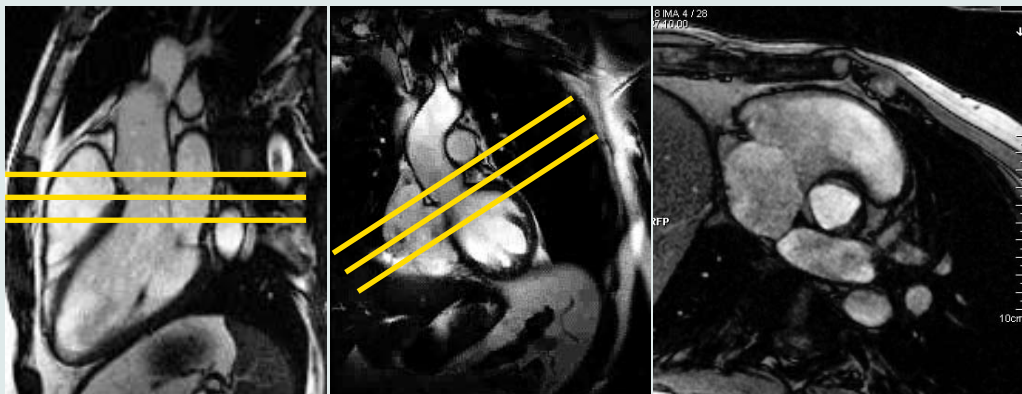
- 8. Optional Axial Cine:** 15 slices, from coronal and sagittal views, adjust gap to cover entire heart from aortic arch to apex, multiple breathholds, retrospective gating.



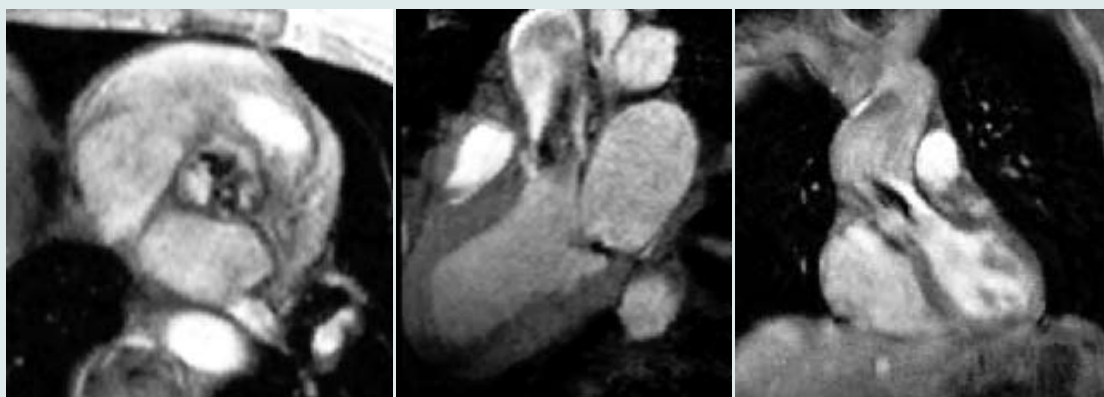
- 9. Optional Sagittal Aorta Cine:** prescribe 1 sagittal oblique candy cane slice from axial view, single breathhold, retrospective gating.



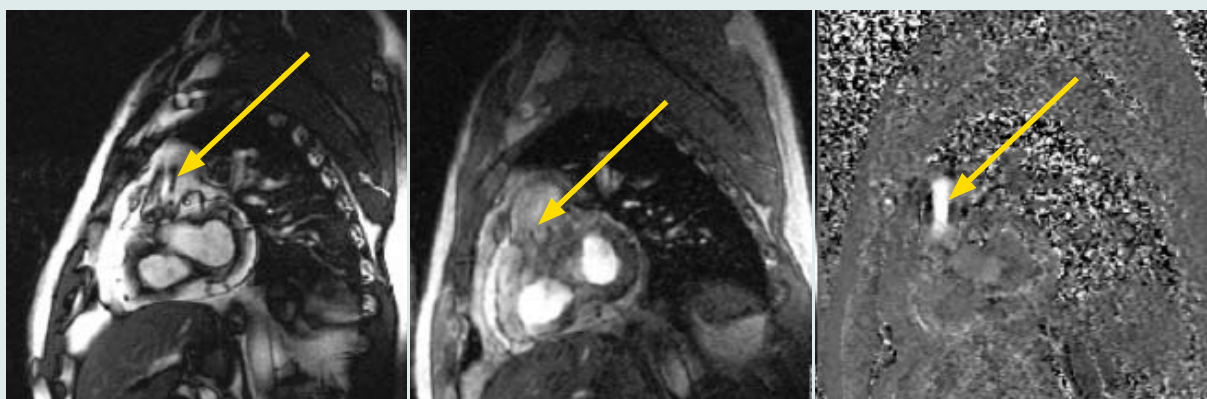
- 10. Optional GRE Cross-Sectional Valve Cine:** 3 contiguous cross-sectional slices across valve plane, 3 breathholds, short TE for bright flow through orifice, retrospective gating.



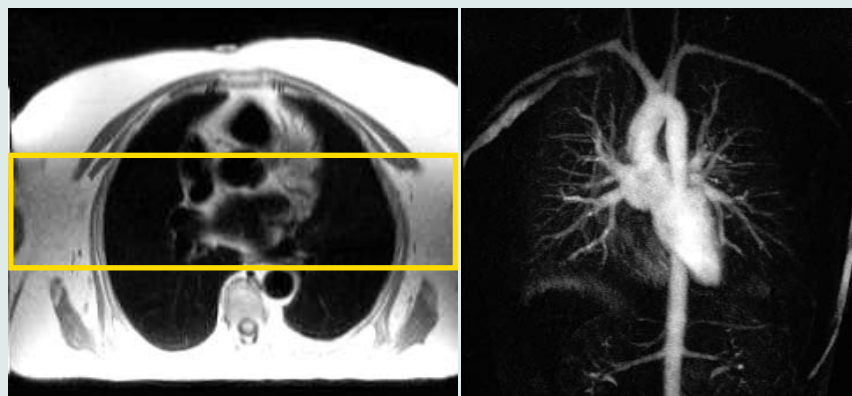
- 11. Optional GRE Stenotic Jet Cine:** 1 slice in the best long axis view to see the stenotic flow jet, single breathhold, long TE for dark turbulent flow void, retrospective gating.



- 12. Optional Stenotic Jet In-Plane Flow:** 1 slice in the best long axis view to see the stenotic flow jet, single breathhold, retrospective gating, in-plane VENC 250 cm/sec or greater, short TE for optimal flow sensitivity.



- 13. Coronal Dynamic:** prescribe 1 slab in coronal view through lungs and aorta from axial view, 5 measurements of 7 seconds each, first one is subtraction mask and must contain no bolus, untriggered breathhold, automatic subtraction and mip.

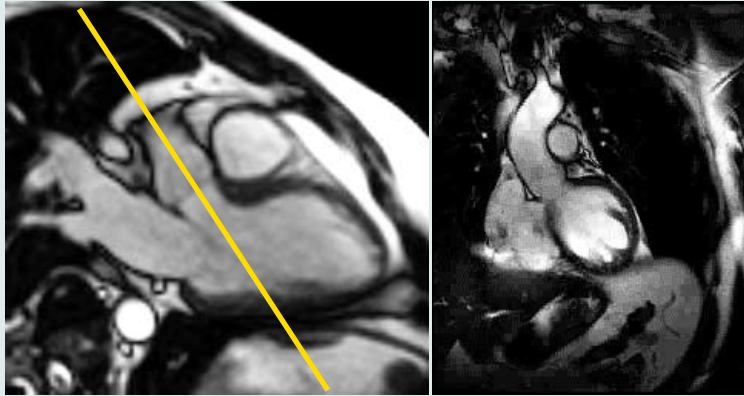


Valvular Disease

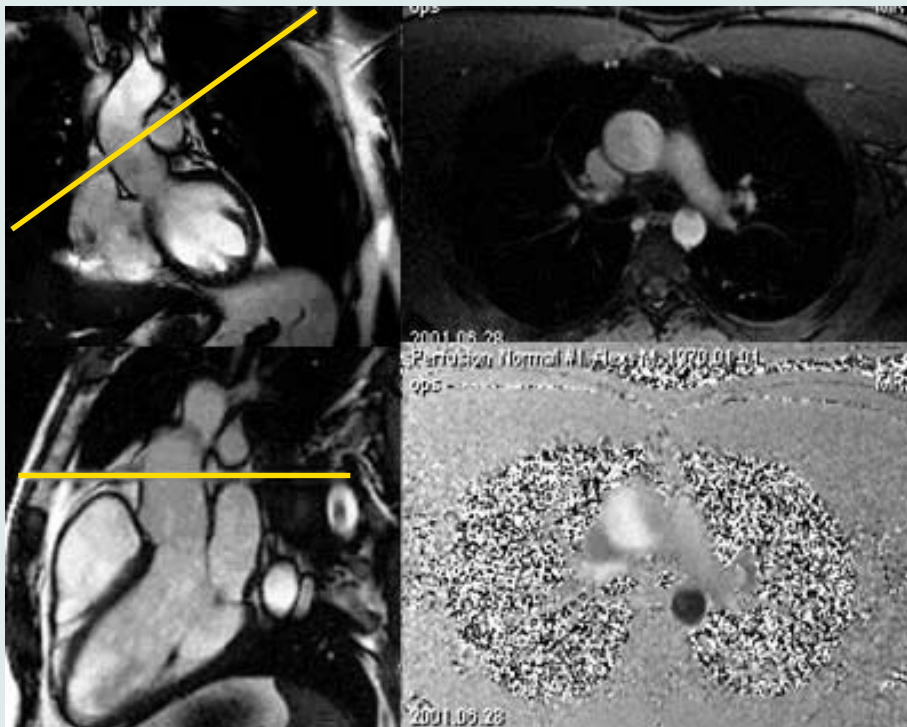
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

3. **Coronal Aortic Outflow Cine:** prescribe 1 coronal oblique aortic outflow slice from three chamber view, bisect LV outflow tract, aortic valve, and ascending aorta, single breathhold, retrospective gating.



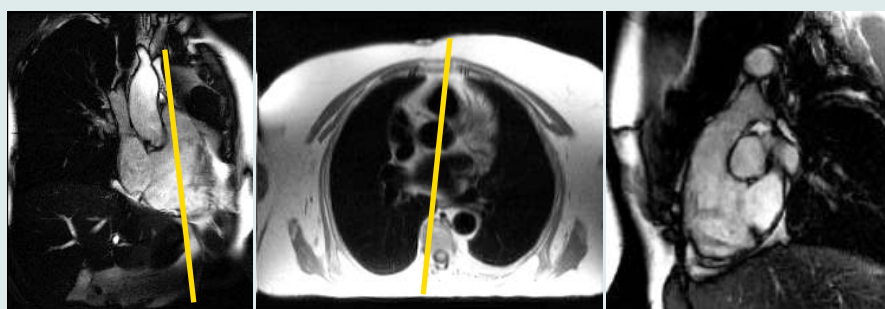
4. **Aorta Through-Plane Flow Qs:** prescribe from three chamber view and coronal aorta view, 1 cross-sectional slice perpendicular to ascending aorta distal to valve leaflet tips, repeat 1 cross-sectional slice across aortic valve orifice, through-plane VENC 150 cm/sec for normal flow (or greater for stenosis), single breathhold, retrospective gating, short TE for optimal flow sensitivity.



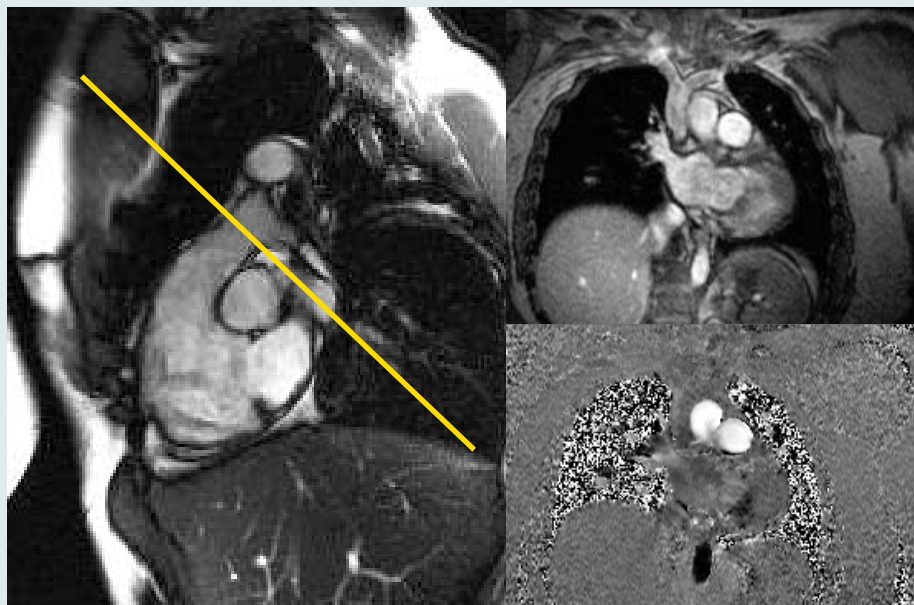
- 5. Right Ventricular Vertical Long Axis Cine:** prescribe 1 right ventricular long axis slice from four chamber and basal short axis views, parallel to ventricular septum bisecting tricuspid valve, right atrium, and right ventricle, single breathhold, retrospective gating.



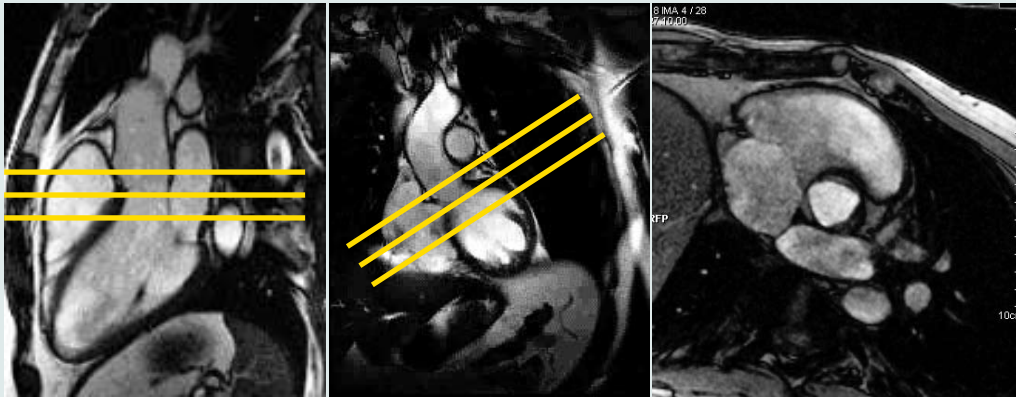
- 6. Right Ventricular Outflow Tract Cine:** prescribe 1 slice from right ventricular vertical long axis and axial views, bisect pulmonary outflow tract, pulmonic valve, and main pulmonary artery, single breathhold, retrospective gating.



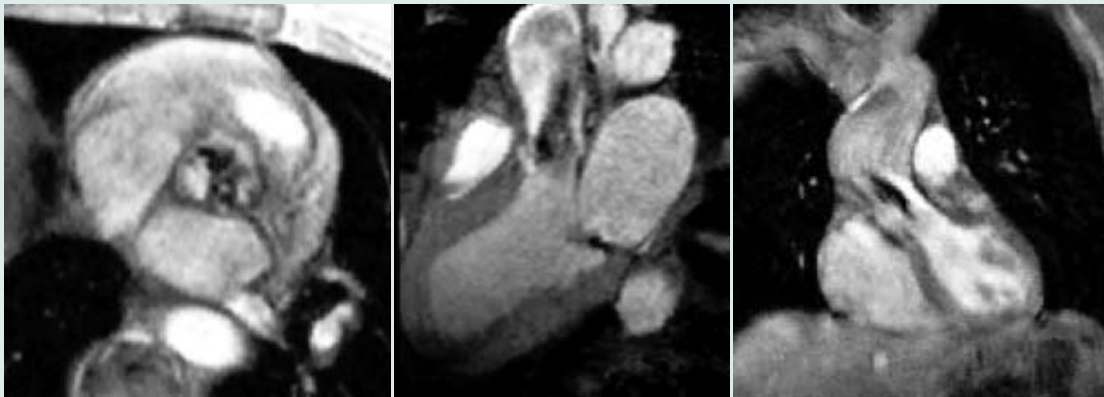
- 7. Pulmonary Through-Plane Flow Qp:** prescribe from right ventricular outflow tract view, 1 cross-sectional slice perpendicular to main pulmonary artery distal to valve leaflet tips, repeat 1 cross-sectional slice across pulmonic valve orifice, through-plane VENC 90 cm/sec for normal flow (or greater for stenosis), single breathhold, retrospective gating, short TE.



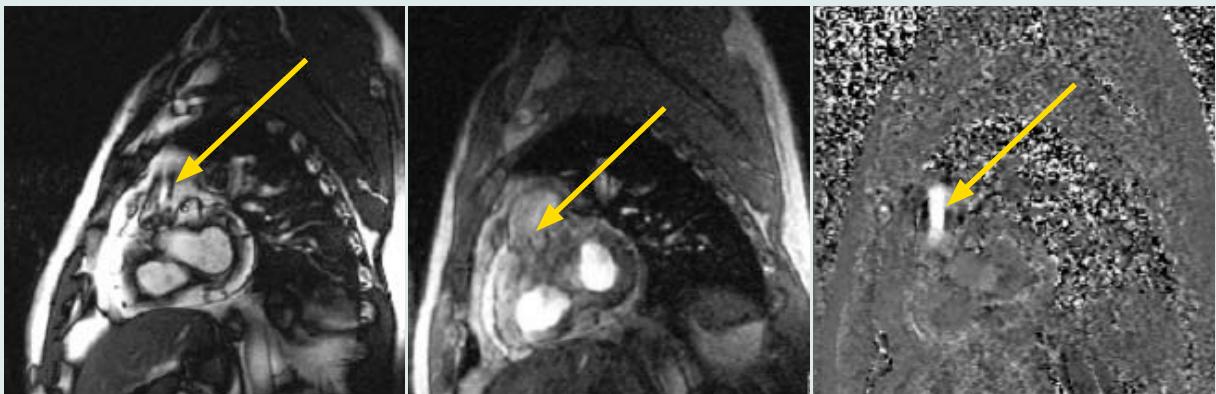
- 8. GRE Cross-Sectional Valve Cine:** 3 contiguous cross-sectional slices across valve plane, 3 breathholds, short TE for bright flow through orifice, retrospective gating.



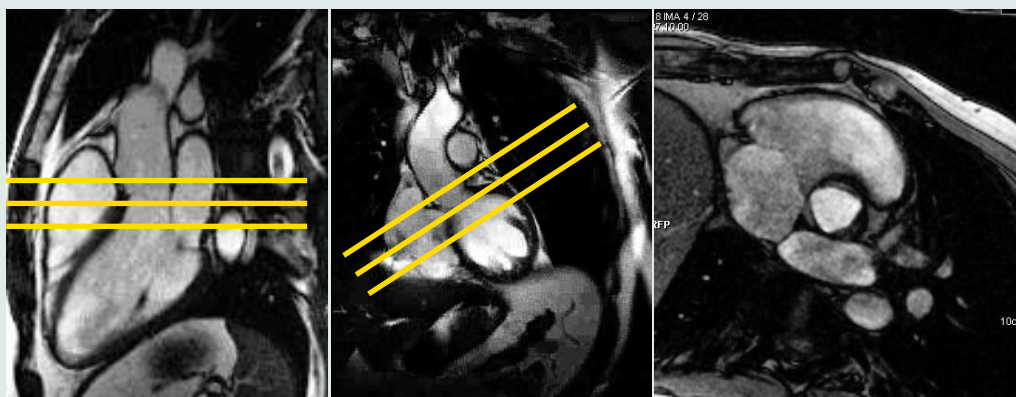
- 9. Optional GRE Stenotic Jet Cine:** 1 slice in the best long axis view to see the stenotic flow jet, long TE for dark turbulent flow void, retrospective gating.



- 10. Optional Stenotic Jet In-Plane Flow:** 1 slice in the best long axis view to see the stenotic flow jet, single breathhold, retrospective gating, in-plane VENC 250 cm/sec or greater, short TE for optimal flow sensitivity.



- 11. Optional Radial Valve Cine:** 3 contiguous cross-sectional slices across valve plane, high resolution truefisp radial eliminates wrap with small FoV, multiple breathholds, retrospective gating.

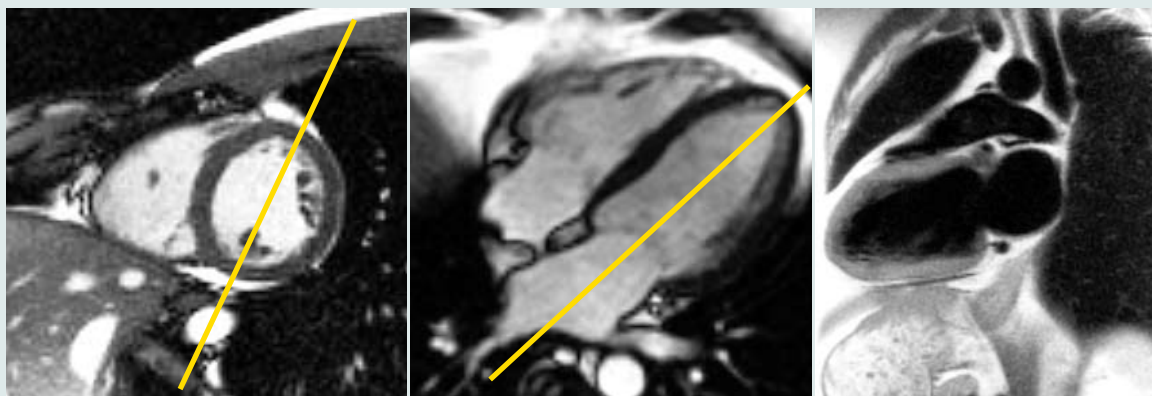


Pericardial Disease

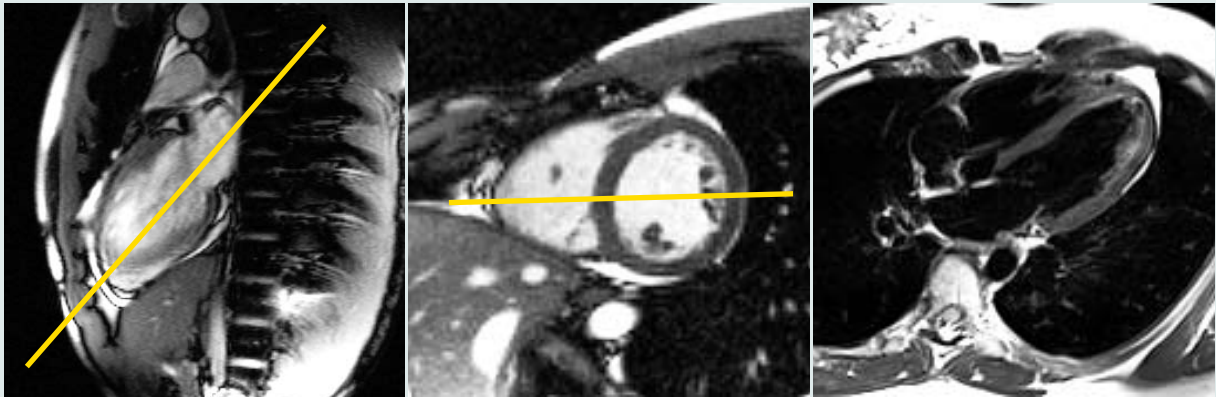
- 1. Localizer Module** for localization.

- 2. LV Function Module** to assess ventricular function.

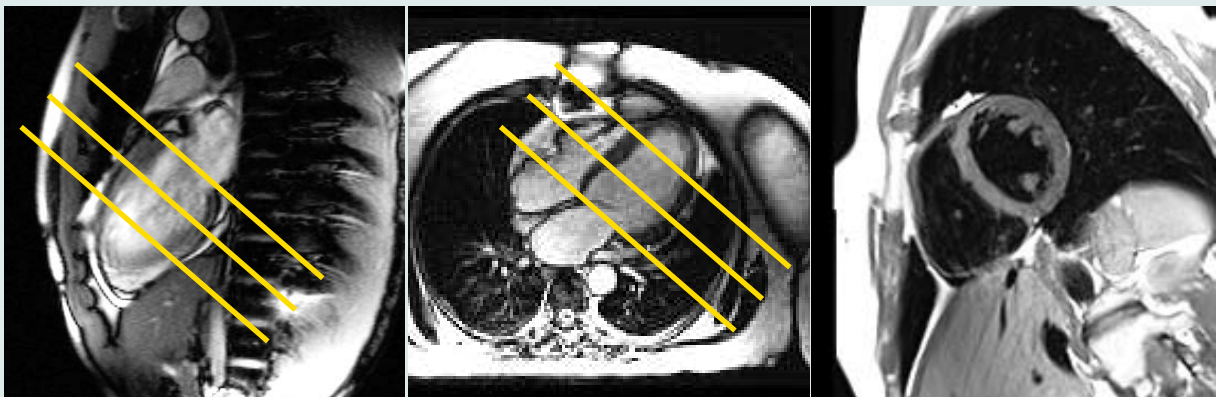
- 3. Two Chamber TSE Dark Blood T2:** segmented tse dark blood T2 to evaluate pericardial thickening, 1 slice in a single breathhold, rotate FoV to avoid wrap, trigger on every second heartbeat, capture cycle for diastolic gating.



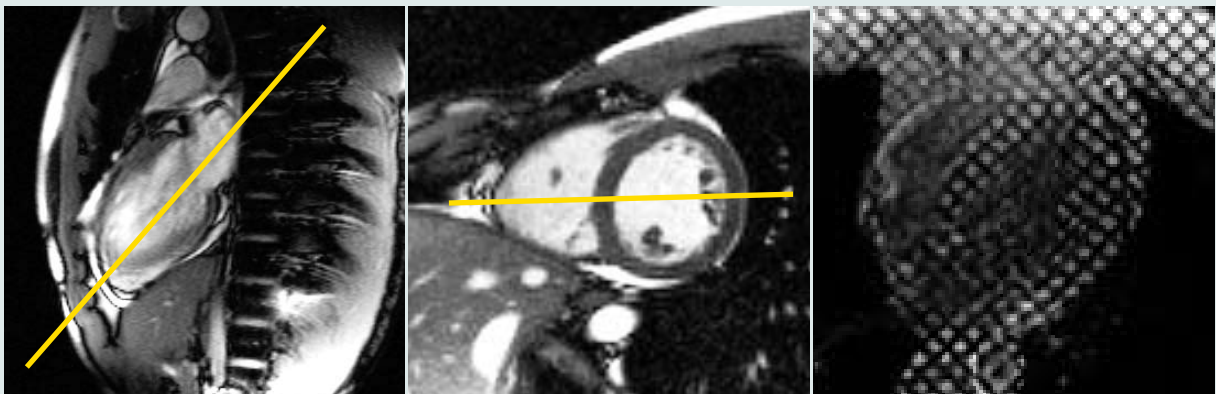
- 4. Four Chamber TSE Dark Blood T2:** segmented tse dark blood T2 to evaluate pericardial thickening, 1 slice in a single breathhold, rotate FoV to avoid wrap, trigger on every second heartbeat, capture cycle for diastolic gating.



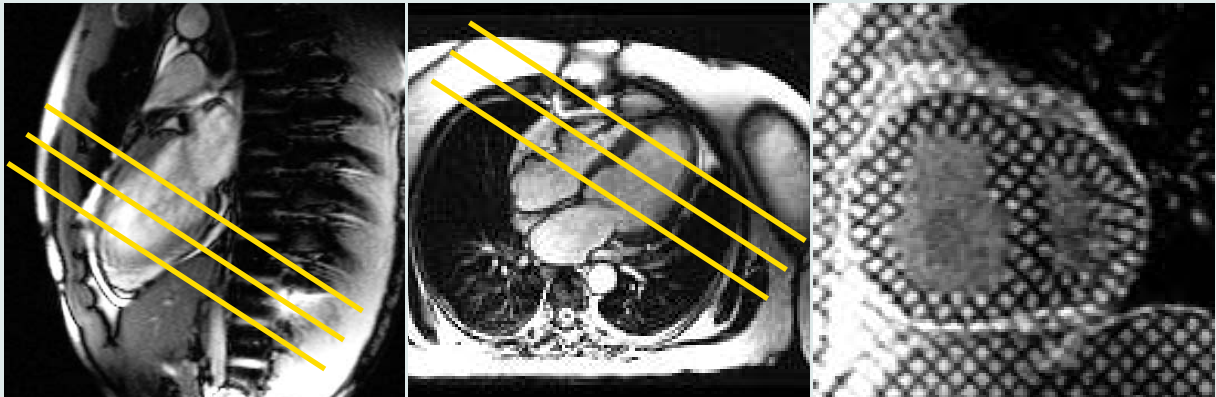
- 5. Short Axis TSE Dark Blood T2:** segmented tse dark blood T2 to evaluate pericardial thickening, 3 slices at base, mid, and apex in 3 breathholds, rotate FoV to avoid wrap, trigger on every second heartbeat, capture cycle for diastolic gating.



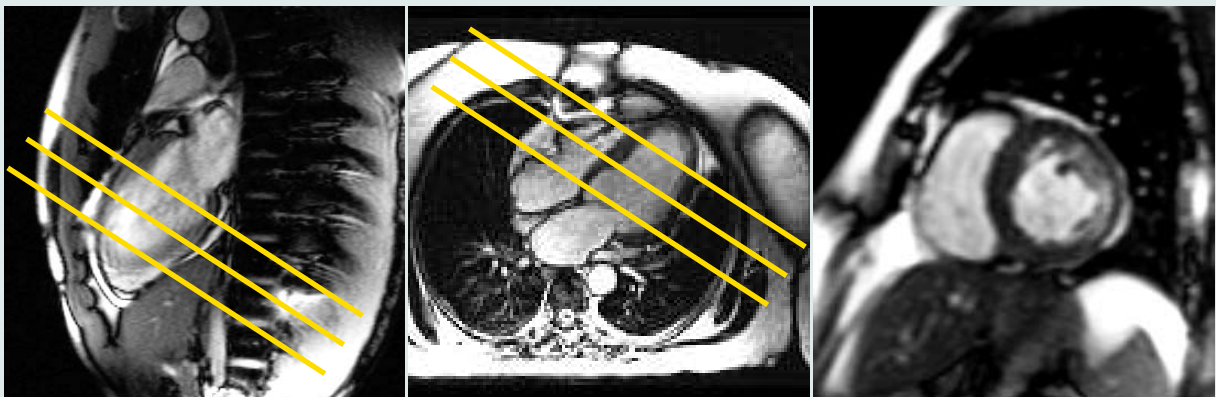
- 6. Optional Four Chamber Grid Tag:** 1 slice in 1 breathhold to evaluate pericardial adhesion, rotate FoV to avoid wrap, retrospective gating.



- 7. Optional Short Axis Grid Tag:** 3 slices in 1 breathholds at base, mid, and apex to evaluate pericardial adhesion, rotate FoV to avoid wrap, retrospective gating.



- 8. Optional Real-Time Free-Breathing Cine:** 3 slices in free-breathing at base, mid, and apex, rotate FoV to avoid wrap, scans for 3 seconds per slice to evaluate ventricular interdependence.



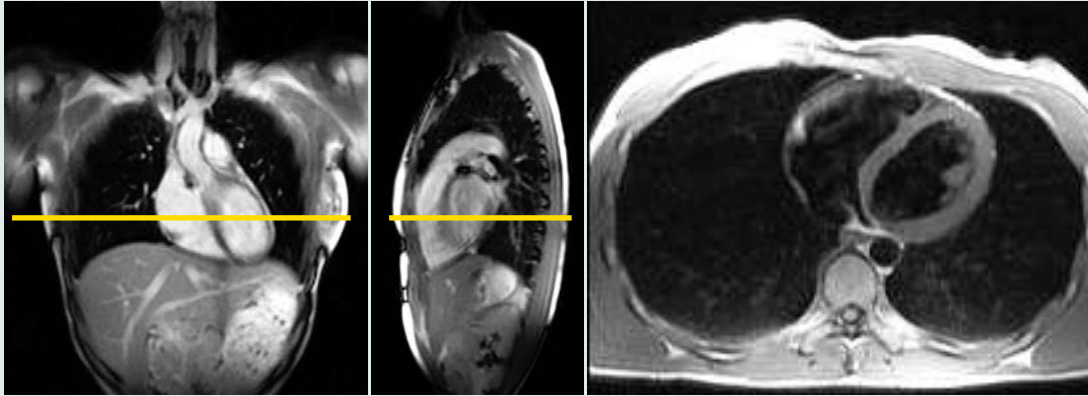
- 9. Delayed Module** late after injection to assess pericardial disease.

Cardiac Mass or Thrombus

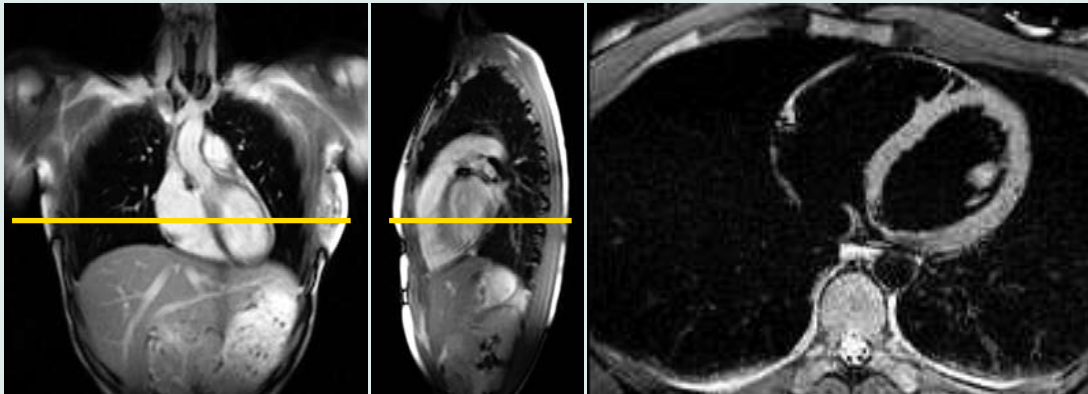
1. **Localizer Module** for localization.

2. **LV Function Module** to assess ventricular function.

3. **TSE Dark Blood T1:** for selected slice levels through mass or thrombus, segmented dark blood tse T1, single slice, single breathhold, trigger on every heartbeat, capture cycle for diastolic gating.

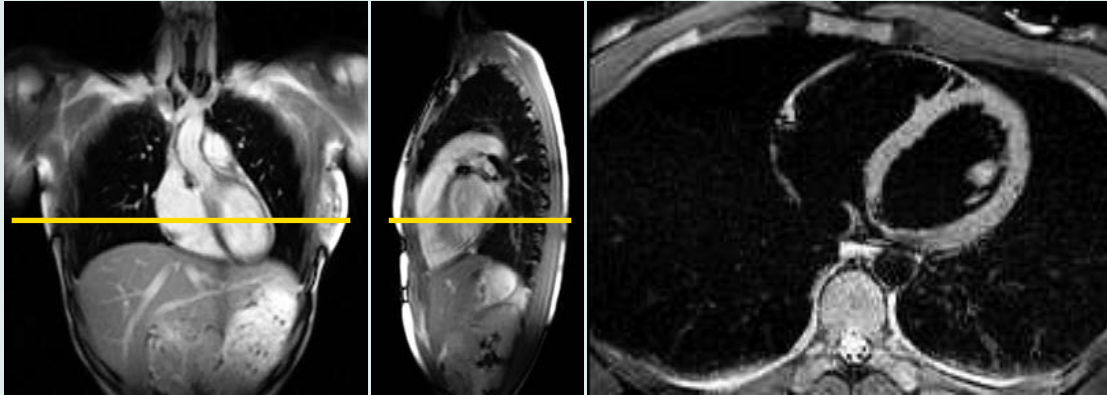


4. **TSE Dark Blood T2 Fatsat:** for selected slice levels through mass or thrombus, segmented dark blood tse T2 with fatsat, single slice, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.

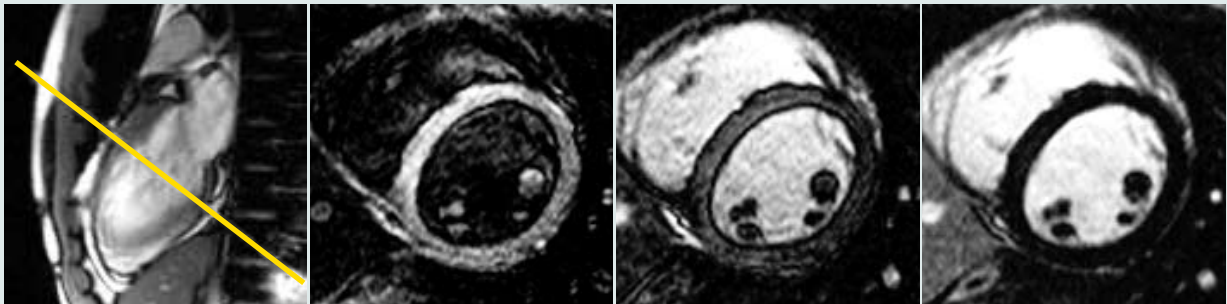


5. Dynamic Module without Adenosine to assess mass or thrombus.

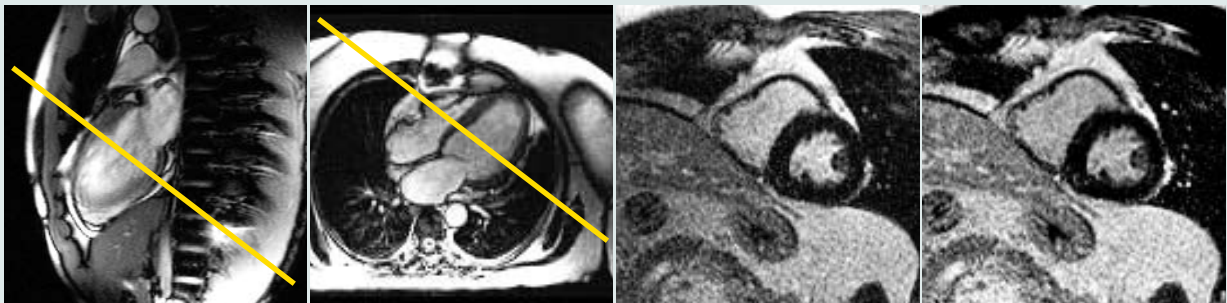
6. TSE Dark Blood T1 Fatsat: for selected slice levels through mass or thrombus, segmented dark blood tse T2-weighted with fatsat, single breathhold, trigger on every second heartbeat, capture cycle for diastolic gating.



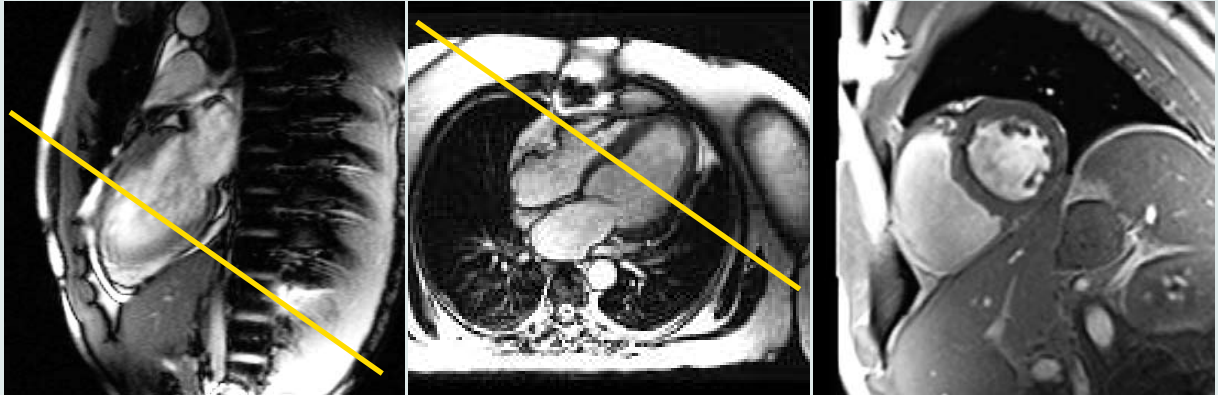
7. Optional T1 Scout: determine optimal TI for nulling of normal myocardium, prescribe as a mid ventricular short axis slice, rotate FoV to avoid wrap, single breathhold, trigger on every second heartbeat, capture cycle for optimal acquisition window.



8. Optional Early Enhance: 1 slice in 1 breathhold, acquire early after injection to assess mass or thrombus, segmented phase sensitive inversion recovery turboflash technique, adjust TI for nulling of mass or thrombus, trigger on every second heartbeat, capture cycle for diastolic gating.



9. Optional GRE Cine: prescribe slice through mass or thrombus, 1 slice in 1 breathhold, retrospective gating.



10. Delayed Module late after injection to assess mass or thrombus.

The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.

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syngo Evolve Package: In the event that upgrades require FDA approval, Siemens cannot predict whether or when the FDA will issue its approval. Therefore, if regulatory clearance is obtained and is applicable to this package, it will be made available according to the terms of this offer.

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