CoverScan MD

CoverScan MD Patient Acquisition Manual for Siemens Scanners

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MRA1253
August, 2021

Use and Limitation

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1. Glossary

3D	3-Dimensional
AV groove	Atrioventricular groove
B0	Main Magnetic Field
CE	Continuing Education
DICOM	Digital Imaging and Communications in Medicine
DOB	Date Of Birth
ECG	Electrocardiogram
FOV	Field of View
HLA	Horizontal Long Axis
ID	Identifier
LMS	LiverMultiScan
LVOT	Left Ventricular Outflow Track
MOLLI	Modified Look Locker Inversion Recovery
MR	Magnetic Resonance
PACS	Picture Archiving and Communication System
PDFF	Proton Density Fat Fraction
PII	Personally Identifiable Information
RIS	Radiology Information System
SNR	Signal-to-Noise Ratio
VLA	Vertical Long Axis

2. Introduction

2.1. Scope

This manual is intended to describe the correct procedure to perform the Perspectum Ltd. set up protocol to an MR operator on Siemens scanners. Please use this document as a reference guide when performing the protocol acquisitions. The manual is divided in three main sections: Preparation, Acquisition and Data Export. The acquisition section details the following sequences:

1. Localizer (1 breath-hold, 3-plane whole abdomen)
2. Liver to Kidney CoverScan DIXON VIBE (1 breath-hold, 3D acquisition covering the liver and kidney)
3. Liver LMS T2STAR DIXON (1 breath-hold 1 slice in the liver)
4. Liver LMS IDEAL (1 breath-hold, 5 slices in the liver)
5. Liver LMS MOST (1 breath-hold, single slice in the liver)
6. Liver LMS MOLLI (2 breath-holds, 2 slices in the liver)
7. Pancreas CoverScan MOLLI (1 breath-hold, 1 slice in the pancreas)
8. Pancreas CoverScan IDEAL (1 breath-hold, 5 slices in the pancreas)
9. Kidneys CoverScan MOLLI (1 breath-hold, 1 slice in the kidneys)
10. Cardiac Planning localizer (1 breath-hold, 3 planes in the heart)
11. 2 Chamber (1 breath-hold, 1 slice in the heart)
12. 4 Chamber (1 breath-hold, 1 slice in the heart)
13. Short Axis Stack (1 breath-hold, multi-slice in the heart)
14. Cardiac Cine (HLA, VLA, Short Axis Stack in the heart)
15. Cardiac T1 Map (Base, Mid, Apex in the heart)
16. Cardiac T2 Map (Base, Mid, Apex in the heart)
17. Lung planning localizer (1 breath-hold, 3 planes in the lungs)
18. Lung Imaging (Deep Inspiration and Expiration in the lungs)

2.2. Continuing Education

In some territories, such as the USA, this training is eligible for continuing education (CE) credit. The CE is sponsored by Perspectum and will be presented by a member of the Imaging Applications team. The presenter's name, date, and attendees will be written on the Imaging Staff Training Checklist at the time of training; this form will be kept in Perspectum's records of site training activities and an electronic copy will also be sent to the site. In order to qualify for CE, the document, Multiparametric Liver MRI Applications Training – MRA1157, should also be provided along with the training. This document includes post-activity evaluations that must be completed to award credit.

2.3. Compatibility And Requirements

All sequences described in this manual require scanner hardware and software to be compliant with all manufacturer's specifications, especially gradient performance, eddy current compensation, and magnetic field (B0) homogeneity and stability. The protocols cannot be utilized on scanners outside of the manufacturer's service specifications and calibration schedules. Do not use phased-array coils with failed elements or without SNR checks passed.

2.3.1. T1 Mapping And Cardiac Imaging Requirement

T1 mapping and cardiac imaging protocols require the manufacturer's clinically approved software product MyoMaps.

2.3.2. T_2^* And Proton Density Fat Fraction Mapping Requirement

The system should also have the Multi-Echo Gradient-Echo package available. This package is offered as a product on most Siemens scanners without the need of additional license.

2.3.3. Volume Requirement

The system should have 3D T1 VIBE sequences available. This will allow a three-dimensional spoiled gradient echo pulse sequence. A multi-echo variant of this sequence with a water-fat separation 3D T1 DIXON VIBE is preferred. The latter allows acquiring in-phase and out-of-phase images in one single acquisition, to calculate water-only and fat-only images.

2.3.4. Coil Requirement

- Integrated spine array coil
- Flex array coil(s) placed on the chest/abdomen. Ensure the flex array coil covers from the top of the lung to the lower pole of the kidneys. Sufficient coverage will depend on the patient size and the coil length. If one coil does not cover the region of interest as showed in Figure 1 (page 3) please use multiple flex array coils. Please note that if multiple coils are not available, after acquiring the liver, kidney and pancreas images, it's imperative to move the coil upward to cover the lungs and the heart (Please see Section 5.8 (page 13)).

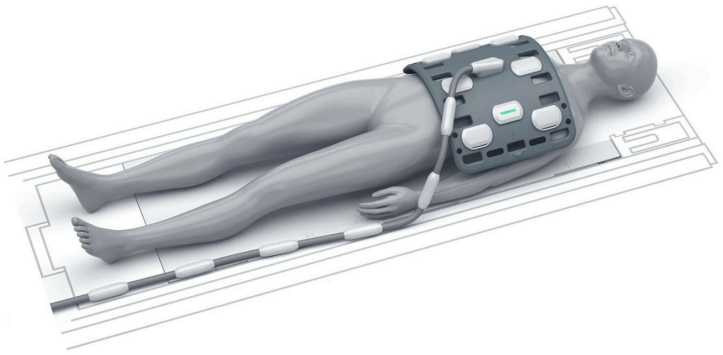


Figure 1. Sufficient flex array coil coverage from both apex of the lungs to below the lower poles of both kidneys.

2.3.5. Cardiac Trace Simulator Requirement

A cardiac trace simulator is used to acquire the T1 mapping sequences (MOLLI). If this is not available at the scanner the patient's ECG signal can be used instead.

2.3.6. Cardiac Trace Input Requirement

The scanner ECG gating is required to perform the cardiac acquisitions. The MR safe ECG electrodes and sensor will be connected to the patient's chest during the scan session.

3. Patient Registration

> ⚠ **CAUTION**
> Ensure the subject is registered to a new MR study.

The minimum required information for registering the patient is as follows:

- Patient ID: <Use agreed Subject ID Naming Scheme>
- Patient Name: <Use Agreed Subject Naming Scheme>
- Date of birth (DOB): <Use agreed DOB Scheme>
- Operator: Enter Your Initials
- The patient's height (when available), weight and sex

Subject Naming Scheme: If this scan is being performed for a research study or clinical trial, ensure no personally identifiable information (PII) has been entered. The study will have provided a Patient ID unique to each subject.

If local rules prohibit scanning without a real name, or if registration is populated from a RIS, after scanning please remove the PII from the DICOM files to send to Perspectum. The Section 6 (page 23) section and the Patient De-Identification Manual will give instructions.

If this scan is being performed as part of a clinical scan to aid diagnosis, PII may be acceptable in the patient registration.

Date of Birth (DOB) Scheme: If PII is allowed, the patient's date of birth DOB may be used. Otherwise, **please use 01-Jan, and the correct YEAR of birth.**

Please note that the MRI technician/radiographer who performs patient acquisition must have undergone training by either:

- (a) Authorised Perspectum Imaging Applications specialists
- (b) Previously trained site personnel authorised to perform internal training

A record of such internal training must be provided to Perspectum with the appropriate Imaging Staff Training Checklist.

4. Pre-Scan Preparation

4.1. Patient Positioning

- Patient should be positioned head-first supine with both arms by their side.
- Scanner isocenter should be landmarked on the xiphisternum of the patient.
- Setup ECG gating with the electrodes and sensor. Check that the signal has a clear R-wave triggering.

4.2. Breathing Instructions

Breath-holding should be explained and practiced before any data acquisition since variations in the depth of a subject's breathing can markedly alter the image quality and the consistency of the abdomen position between acquisitions. End-expiration breath-hold is chosen, as breathing out is a more consistent process. This should be explained to the patient: 'The scans are better if you hold your breath after breathing out comfortably.' The following instructions should be given to the patient ahead of each scan:

- Breathe in.
- Breathe out.
- Stop and hold your breath there.
- Breathe away or Resume breathing (after data has been acquired).

Some of the sequences are cardiac-gated, so the gradient pulse sounds can be irregular. Therefore, it is extremely important to advise the patient to hold their breath until you instruct them to breathe away regardless of the scanner noise.

5. Acquisition Guide

Please note that:

1. All protocols must be acquired before any contrast agent injection. Note that contrast agents are not necessary for any of the acquisitions
2. All scans are performed during end-expiration breath-hold, including the Localizer scan.

> ⚠ **CAUTION**
> Protocol parameters should not be changed. Any changes not specifically covered in these instructions risk corrupting the resultant parameters and cause data rejection by Perspectum Ltd.

Prior to scanning, the cardiac trace simulator (if available) should be set up as follows. If cardiac trace simulation is not available please proceed to scan using the patient's cardiac trace input.

5.1. Cardiac Trace Simulator

To set up the simulation please login as advanced user and follow these steps:

1. Open Windows menu,

   a. **On XA version:** the key combination is **Tab** + **Del** + **+**.
      Note that Siemens MR keyboard is Windows modified keyboard. The **+** key on the numeric side of the Windows keyboard is the "Send to node 1" key on Siemens MR keyboard.
   b. **On the other versions:** hold **Ctrl**+**esc** to have the windows menu appear.
2. Select **<Advanced User>** (or medadmin on XA versions) – this will prompt you for the password. The Siemens engineer for the site or a site staff will have access to this password.
3. Hold **Ctrl**+**esc** to bring up windows start menu.
4. Open a terminal window, either **<Command Prompt>** or **<Run>**

5. In **<Command Prompt>** type **`ideacmdtool`** and press **Enter**
6. From IDEACmdTool Menu please select the number correspondent to **<PMU Control>** option (in general it is **1**) Then press **Enter**
7. From the PMU control menu please select **<PMU Signal simulation>** option (in general it is **1**) then press **Enter**.
8. From the menu please select **<startSignalSimulation>** option (in general it is **4**) Then press **Enter**.
9. To set all the ECG simulator parameters to the values below (for VE11 and XA versions, please simply press **Enter** 4 times):
   a. ECG-period duration to 1000 ms
   b. Respiration-period duration to 3000 ms
   c. Pulse-period duration to 1000 ms
   d. External signal period duration to 2000 ms

The simulated heartbeat should appear on the Exam tab as shown in Figure 2 (page 8).

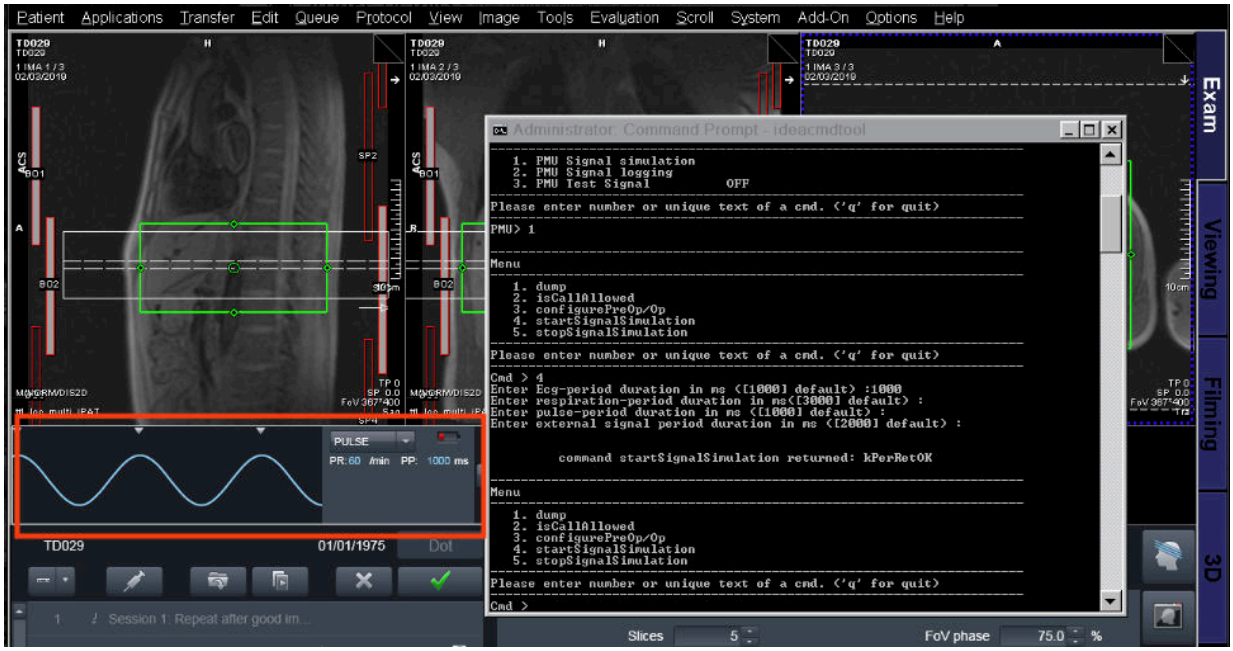


Figure 2. The simulated heartbeat is highlighted with a red box. Please note, this is a VE11 interface.

5.2. Three-Plane Localizer

A three-plane Localizer should be run in expiration breath-hold to produce at least one sagittal, one coronal and one transverse view of the abdomen.

5.3. Liver To Kidney CoverScan DIXON VIBE

This is a 3D spoiled gradient echo acquisition performed at end-expiration breath-hold and lasts approximately 15 seconds. This acquisition will be used to measure the length and/or volume of the liver and kidney.

1. Use the localizer images as the planning images
2. Prescribe the axial DIXON VIBE slab to cover from above the liver domes to below the lower poles of both the kidneys as shown in Figure 3 (page 9).
3. Set the shim volume as the same coverage of the FOV

IMPORTANT

Make sure to cover the entire liver and both kidneys from top to bottom and allow for some superior and inferior margins.

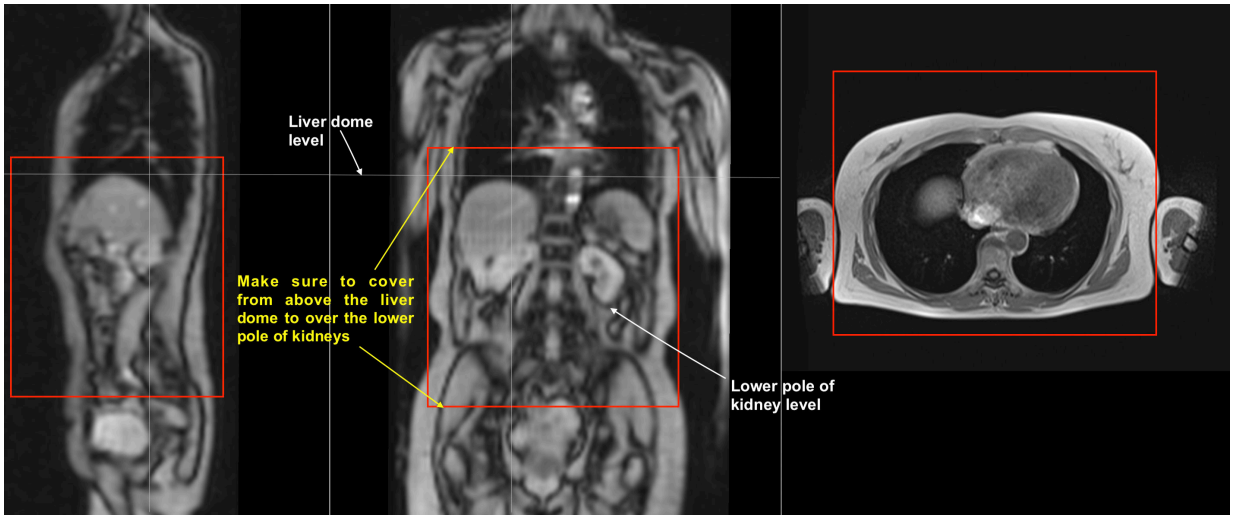


Figure 3. Liver to Kidney CoverScan DIXON VIBE slice stack positioning.

5.4. Liver LMS Sequences

1. **Liver LMS T2STAR DIXON (one slice)** :
   Prescribe the single axial slice at the level of the porta hepatis. It should cover the entire liver and spleen (it may also contain the stomach) → Adjust the shim volume's R-L and A-P directions to cover the imaging slice and to exclude the subcutaneous fat → Apply. (Please refer to Figure 4 (page 10) for planning)
2. **Liver LMS MOST (one slice)** :
   Right click the Liver LMS T2TAR DIXON sequence and select "Copy Parameters" → select "Center of slice and saturation regions". → Right click the Liver LMS T2TAR DIXON sequence again and select "Copy Parameters" → select "Adjust volume" → Apply.
3. **Liver LMS MOLLI (1st Slice)** :
   Right click the Liver LMS T2TAR DIXON sequence and select "Copy Parameters" → select "Center of slice and saturation regions". → Right click the Liver LMS T2TAR DIXON sequence again and select "Copy Parameters" → select "Adjust volume" → Apply.
4. **Liver LMS MOLLI (2nd Slice)** :
   Copy and paste the previous LMS MOLLI scanned (slice 1) and click on the coronal or sagittal image of the localizer and press **Ctrl+3** to move the slice down. → Right click on the Liver LMS MOLLI (1st Slice) and select "Copy Parameters" → select "Adjust volume" → Apply.
5. **Liver LMS IDEAL (5 slices)** :
   Right click Liver LMS T2TAR DIXON sequence and select "Copy Parameters" → select "Center of slice and saturation regions" → Right click the Liver LMS T2TAR DIXON sequence again and select "Copy Parameters" → select "Adjust volume". At the Detail view of the Exam task card, click "System" → "Adjustment volume" → manually change the shim volume thickness (F>>H) to 90mm → Apply.

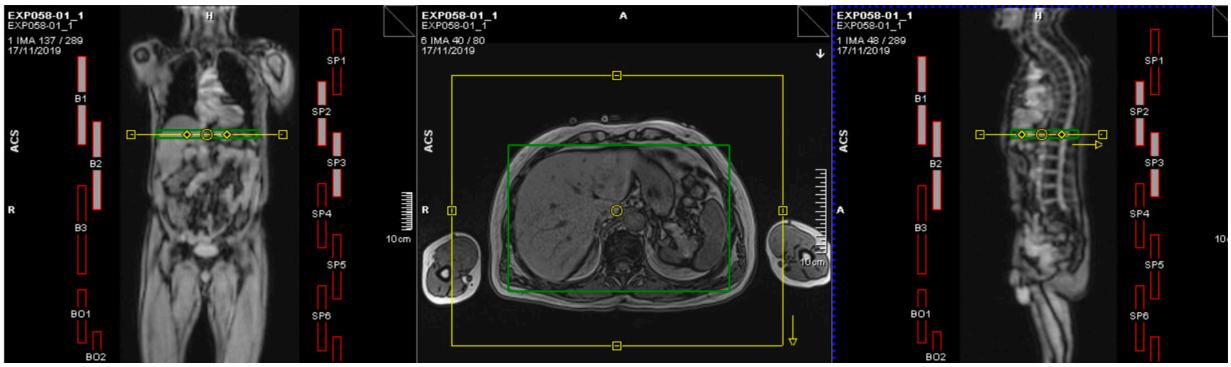


Figure 4. Example of slice prescription on porta hepatis. It should display the liver, spleen, and may also contain the stomach. The shim box should cover the entire liver and spleen and exclude the subcutaneous fat.

5.5. Pancreas MOLLI

This is a single slice acquisition performed at end-expiration breath-hold and lasts approximately 14 seconds. This acquisition will be used to generate a T1 map of the pancreas slice.

To plan this acquisition, use the 3-Point tool to create an axial-oblique plane with the following steps:

1. Load the Liver to Kidney DIXON VIBE images into one of the planning windows.
2. Scroll through the images within the stack to identify the pancreas body, tail and head in the most possible axial planes.
3. Prescribe 3 points by clicking the cursor on the tail, body and head of the pancreas.
   a. **On E11 software version:** Select "Tools" from the top of the drop-down menu and click on "Create Slice(Slab) Group 3 points" as shown in Figure 5 (page 11) upper row.
   b. **On XA software version:** Select the "3-point Mode" from the top toolbar as shown inFigure 5 (page 11) lower row.
4. This should generate a slice in an axial-oblique orientation. Please repeat step 2 and step 3 if the slice orientation appears to be coronal oblique.
5. Adjust the shim volume to mimic the axial-oblique plane orientation and reduce the shim size to cover just the pancreas. Figure 6 (page 12).

NOTE

Aim to prescribe the slice in an axial-oblique plane as much as possible. If the resultant plane appears overly coronal, please repeat steps 2 to 3.

If an axial-oblique plane becomes too hard to obtain and/or the sequence parameters change because of the imaging plane angle, please get back to the original sequence setting and prescribe a straight axial image where the largest volume of the pancreas can be identified in the axial plane.

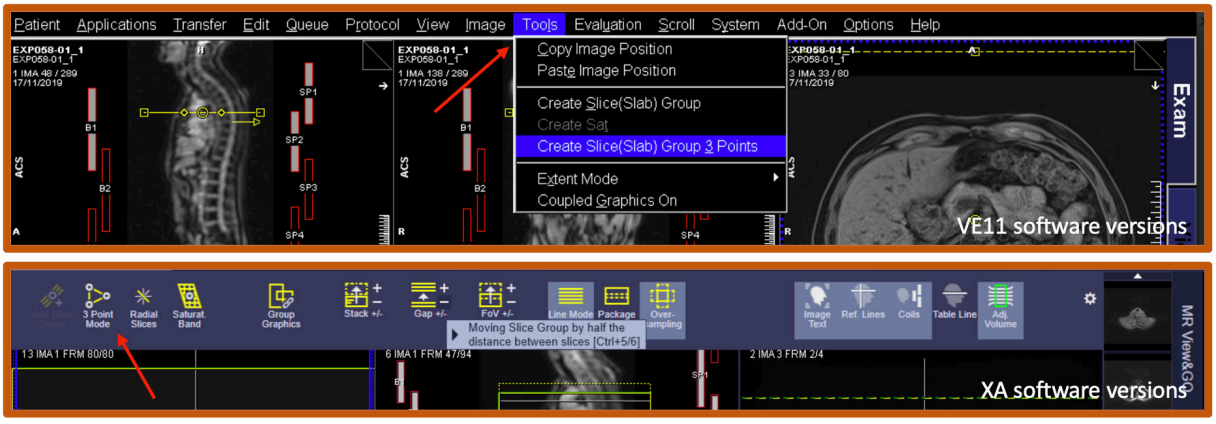


Figure 5. Prescribing the Pancreas MOLLI sequence using the 3-point tool on E11 (upper row) and XA (lower row) software versions

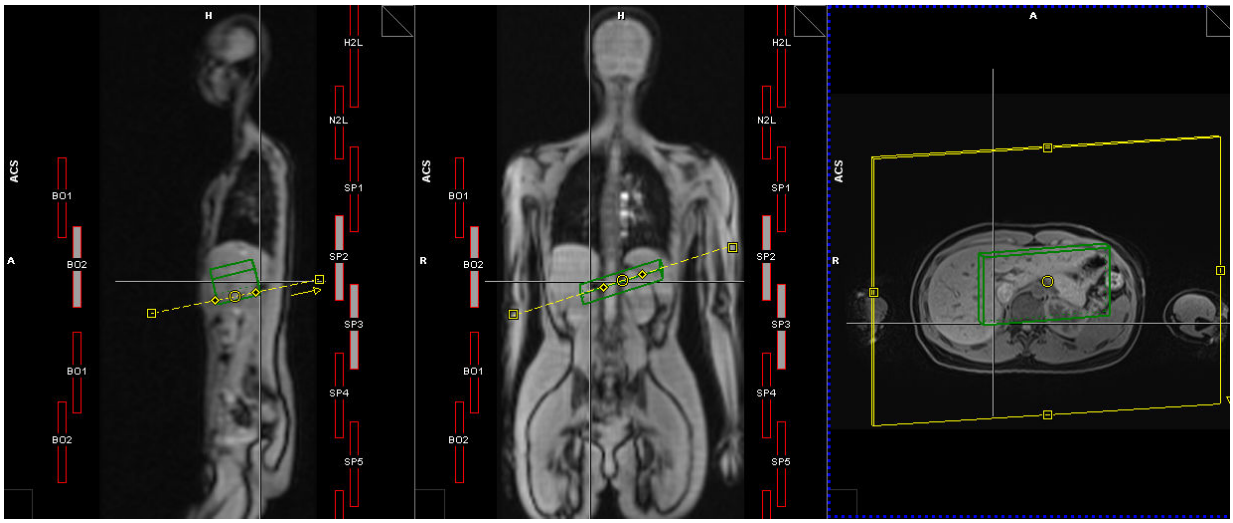


Figure 6. Pancreas MOLLI planning

5.6. Pancreas CoverScan IDEAL

This is multi-slice, multi-echo gradient echo acquisition performed during end-expiration breath-hold and lasts approximately 15 seconds. This acquisition will be used to generate a PDFF map of the pancreas.

1. Right click the Pancreas CoverScan MOLLI sequence and select "Copy Parameters" → select "Center of slice groups and saturation regions" → Right click again on the Pancreas CoverScan MOLLI sequence and select "Copy Parameters" → select"Adjust Volume".
2. At "System" → "Adjustment volume", manually change the shim volume thickness (F>>H) to 60 mm so that the shim thickness cover the whole slice stack. (Please refer to Figure 7 (page 12) for planning)

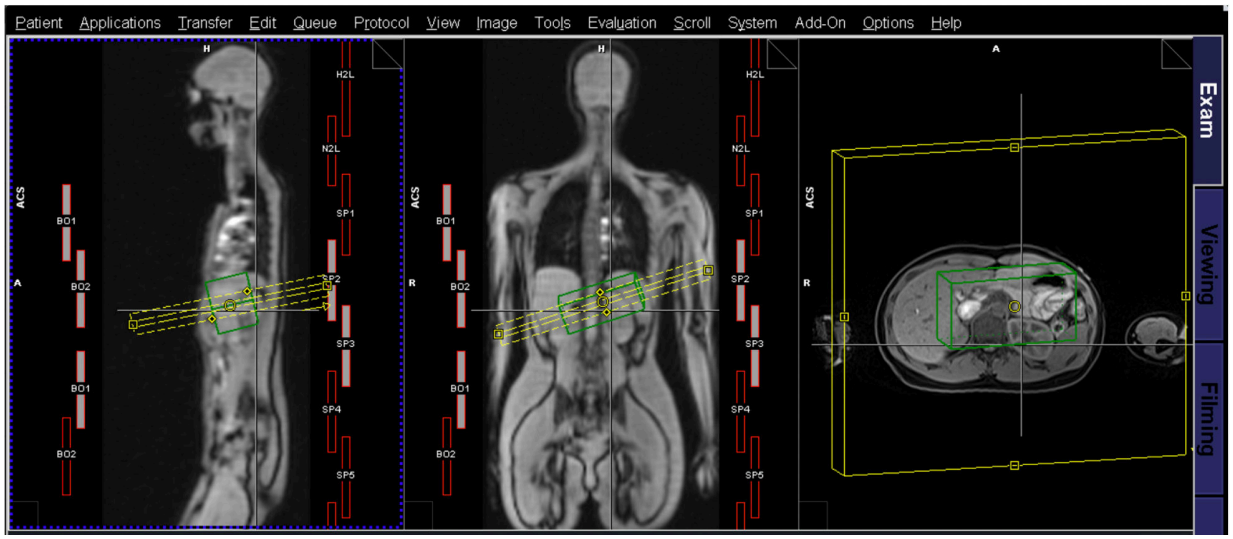


Figure 7. Pancreas CoverScan IDEAL Prescription, make sure the shim box of the F-H covers the entire stack of slices(60 mm recommended)

5.7. Kidneys MOLLI

This is a single slice acquisition performed at end-expiration breath-hold and lasts approximately 14 seconds. This acquisition will be used to generate a T1 map of the kidneys.

1. Load the Liver to Kidney DIXON VIBE images and the localizer coronal image as the planning images.
2. Prescribe the imaging slice to intersect through the middle of both kidneys on the axial view.
   a. On the coronal view, centre the acquisition FOV at the level of both kidneys, while avoiding the aorta being included in the acquisition FOV as much as possible (please refer to Figure 8 (page 13) for planning)
3. Adjust the shim volume to cover the slice and both kidneys.

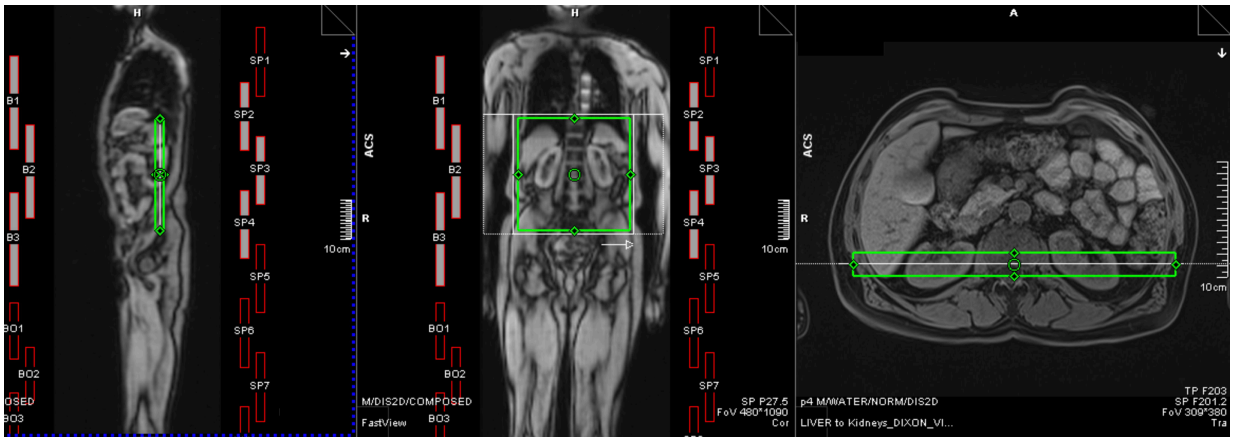


Figure 8. Kidneys MOLLI prescription

5.8. Cardiac Trace Simulator Off And Coil Coverage Adjustment

> ⚠ **CAUTION**
> The sequences from now on will require the cardiac trace input. Make sure to turn off the heart trace simulator prior to acquiring these sequences.

If cardiac simulation is available at the site it should be turned off at this step using the following instructions:

1. Open Windows menu

a. **On XA versions:** the key combination is **Tab**+ **Del++**.
   Note that Siemens MR keyboard is Windows modified keyboard. The **+** key on the numeric side of the Windows keyboard is the "Send to node 1" key on Siemens MR keyboard.
b. **On other versions:** hold **Ctrl+esc** to have the windows menu appear

2. Open a terminal window, either **<Command prompt>** or **<Run>**.
3. In **<Command Prompt>** type **`ideacmdtool`** and press enter.
4. From IDEACmdTool Menu please select the **<PMU Control>** option. (in general it is **1**) then press **Enter**
5. From the PMU control menu please select **<PMU Signal simulation>** option. (in general it is **1**) then press **Enter**
6. Select **<stopSignalSimulation>** option. (in general it is **5**)

Note that if you have not closed the terminal window you can also immediately select the <stopSignalSimulation> by pressing **5** then press **Enter**

The simulated heartbeat should disappear on the Exam tab.

IMPORTANT

Coil Coverage: The sequences from now on require sufficient coil coverage of the lungs and the heart. If only one flex array coil is used and does not cover the apex of both lungs and the heart, make sure to re-position the coil prior to scanning the following sequences.

5.9. Cardiac Planning Localizer

The localizers acquired here will be used for planning the cardiac imaging and is acquired during expiration breath-hold. Position this localizer so that the heart is at the centre of all three imaging planes.

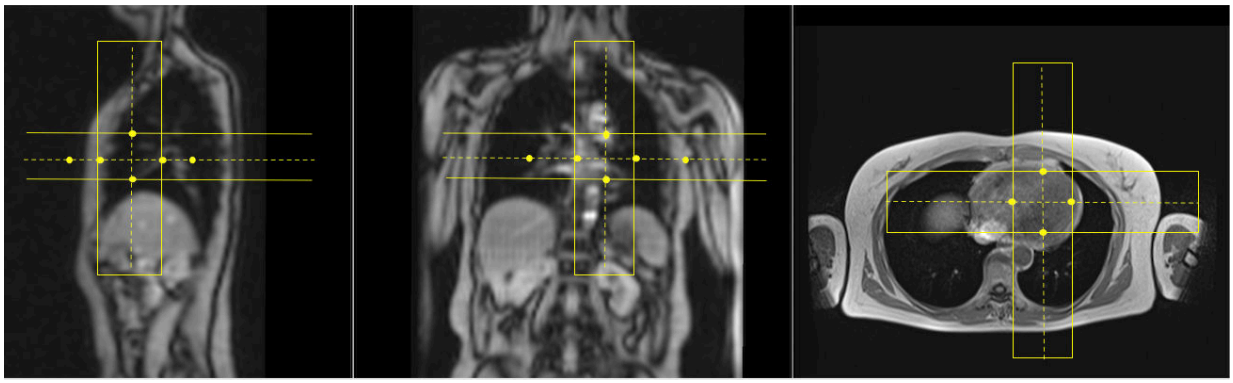


Figure 9. Cardiac planning localizer prescription

5.10. Two Chamber

This is an ECG gated balanced steady-state free precession sequence (bright blood is preferred).

1. Prescribe the slice as shown in Figure 10 (page 15) and make sure the slice is:

- Parallel to the interventricular septum
- Cutting through the mid-point of the mitral valve
- Cutting through the left ventricular apex

2. Set the shim volume to only covers the heart. The shim volume should remain the same throughout all the cardiac sequences.

3. Ensure the acquisition is performed during end-expiration breath-hold acquired in late diastole phase of the cardiac cycle if possible.

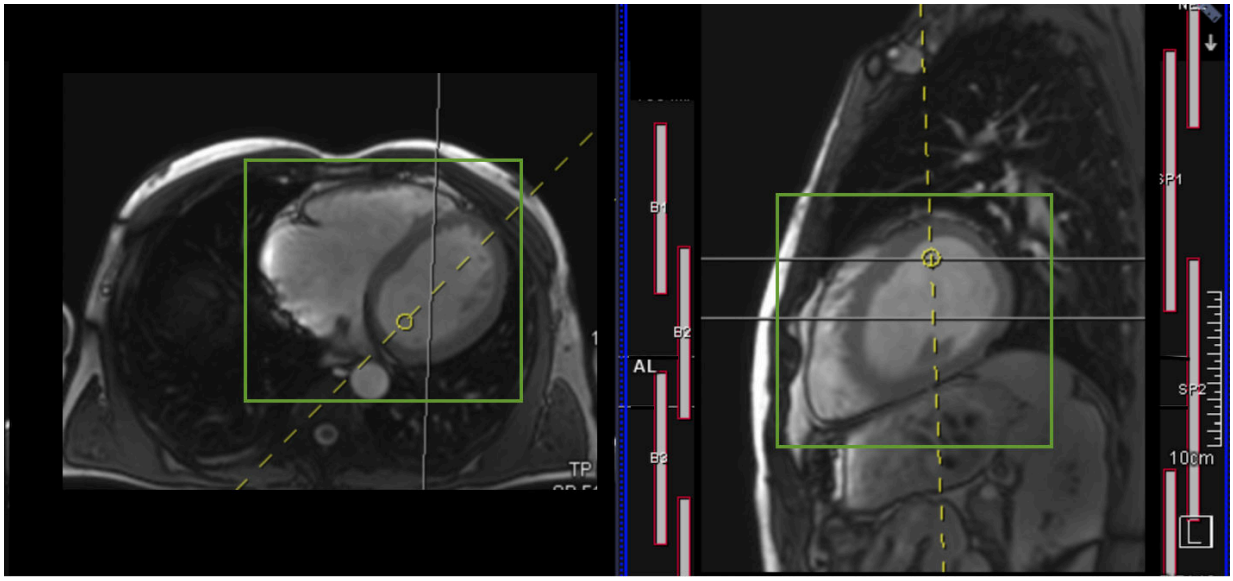


Figure 10. Two chamber Localizer slice prescription.

5.11. Four Chamber

This is an ECG gated balanced steady-state free precession sequence (bright blood is preferred).

1. Plan this sequence using the two chamber acquisition as shown in Figure 11 (page 16) and make sure the slice is:

- Cutting through the mid-point of the mitral valve
- Cutting through the left ventricular apex

2. Ensure the acquisition is performed during end-expiration breath-hold and during the late diastole phase of the cardiac cycle if possible.

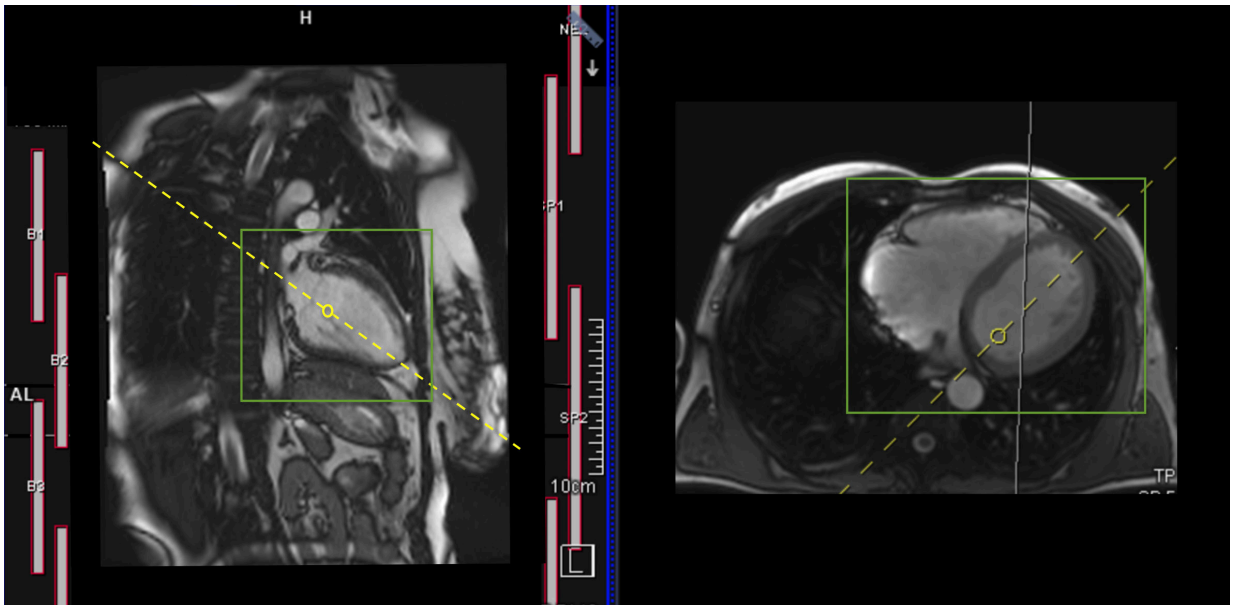


Figure 11. Four chamber localizer slice prescription.

5.12. Short Axis Stack

This is an ECG gated balanced steady-state free precession sequence (bright blood is preferred).

1. Plan this sequence using the two chamber and four chamber acquisitions as shown in Figure 12 (page 17) and make sure the slice:

- Covers from the mid atrium to the apex of both ventricles entirely.
- Parallel to the atrioventricular groove (AV groove)

2. Ensure the acquisition is performed during end-expiration breath-hold and during the late diastole phase of the cardiac cycle if possible.

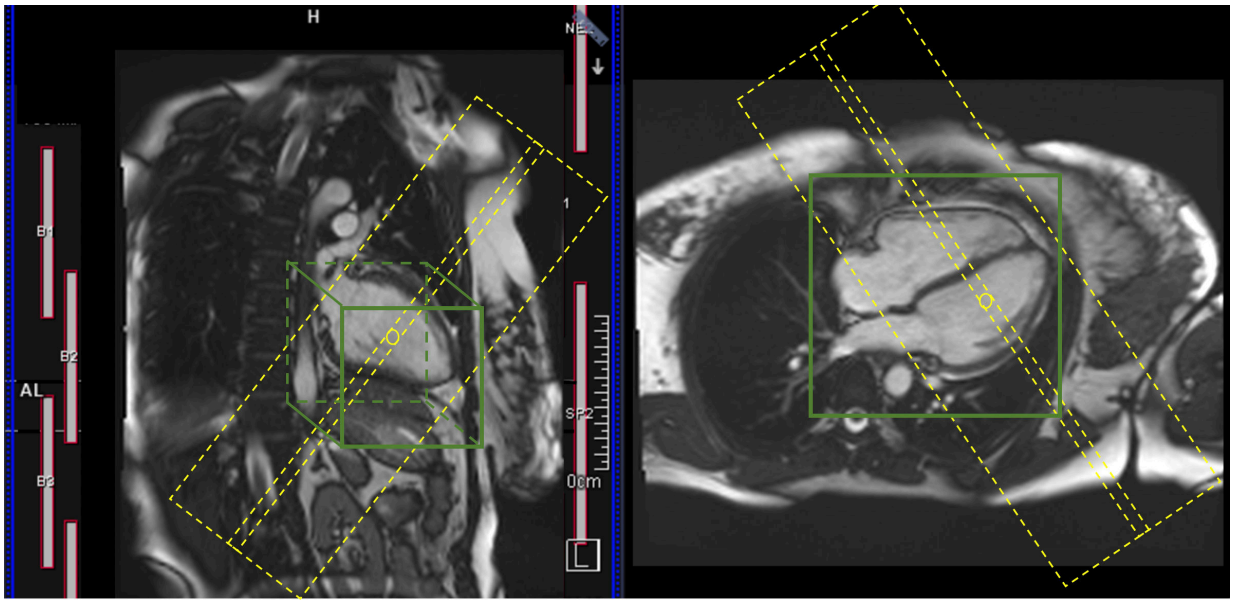


Figure 12. Short axis stack localizer prescription

TIP

Please acquire from the mid point of the atirums, i.e., **the slice should cover over the AV groove.** This will allow the left ventricular outflow track (LVOT) be be present for better planning for the later HLA cine acquisition.

5.13. Cine Acquisitions

These acquisitions are done using retrospective ECG gating and expiration breath-hold. Prospective ECG gating can also be used for difficult ECG traces. Ensure the shim box only covers the heart for all these acquisitions.

5.13.1. HLA (Horizontal Long Axis) Cine

1. Plan this sequence using the two chamber and the short axis stack acquisitions as shown in Figure 13 (page 18) , and ensure:

- The positioning is through the maximum lateral dimensions of both ventricles
- Avoid the left ventricular outflow tract (LVOT) as shown in the **Tip** below
- Cut through the mid-point of the mitral valves
- Cut through the left ventricular apex
- Use a late diastole frame if possible

2. Adjust the shim volume to only cover the heart (usually 150 mm for A-P, R-L, F-H directions will be sufficient).

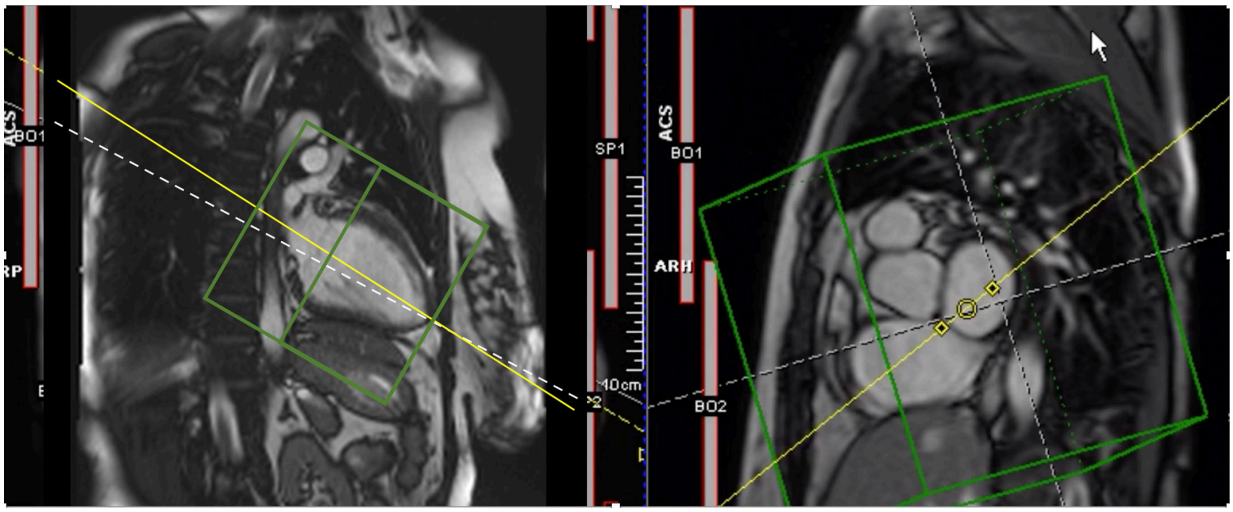
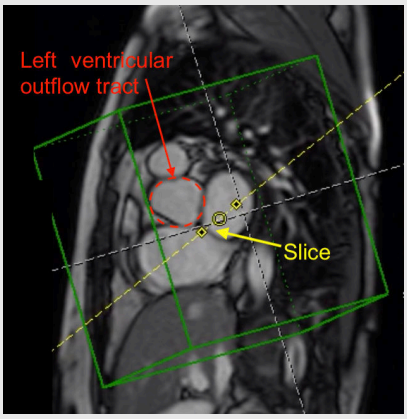


Figure 13. HLA Cine prescription.

TIP

When planning the slice, avoid cutting through the left ventricular outflow tract (LVOT).



5.13.2. VLA (Vertical Long Axis) Cine

1. Plan this sequence using the HLA cine and short axis stack images as shown in Figure 14 (page 19) , and make sure:

- The positioning is through the maximum dimensions of the left ventricle, approximately parallel to the interventricular septum and to the insertion points of the right ventricle
- Cut through the mid-point of the mitral valve
- Cut through the left ventricular apex
- Use a late diastole frame if possible

2. Adjust the shim volume to only cover the heart (usually 150 mm for A-P, R-L, F-H directions will be sufficient).

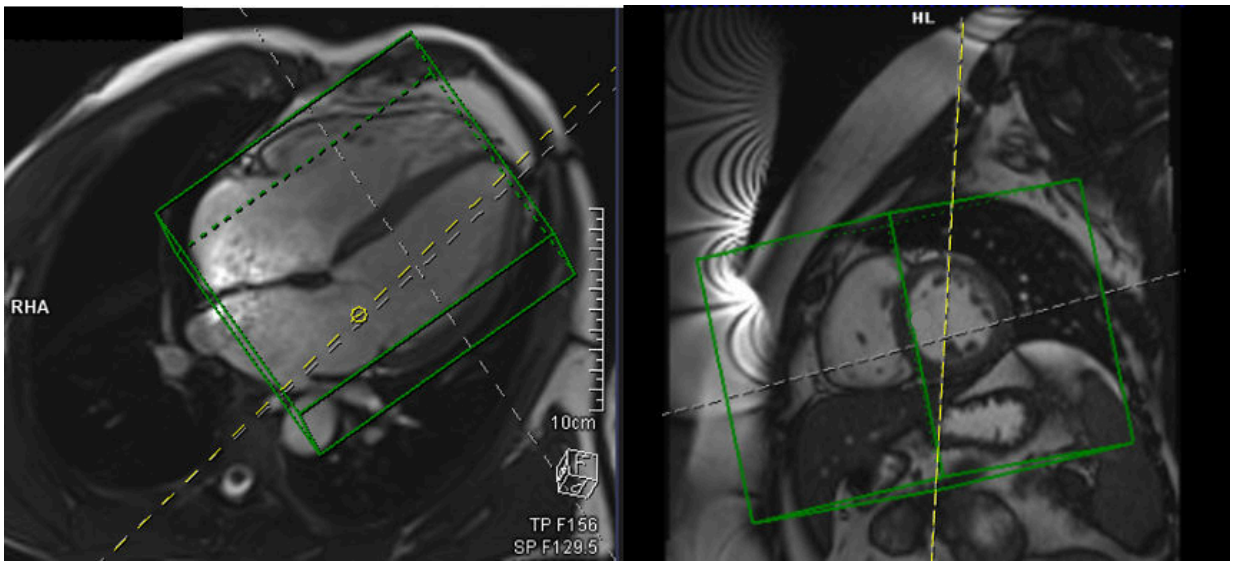


Figure 14. VLA Cine prescription

5.13.3. Short Axis Stack Cine

1. Plan this sequence using the HLA and VLA cine acquisitions as shown in Figure 15 (page 19) make sure:

- Use a late diastole frame on both HLA and VLA cine images
- Plan the basal slice through the atrioventricular groove (AV groove)
- Cover the entire ventricles by running a multi-slice stack from base to apex of the ventricles.
- Allow some margin beyond the apex of the ventricles.

2. Adjust the shim volume to only covers the heart (usually 150 mm for A-P, R-L, F-H directions will be sufficient).

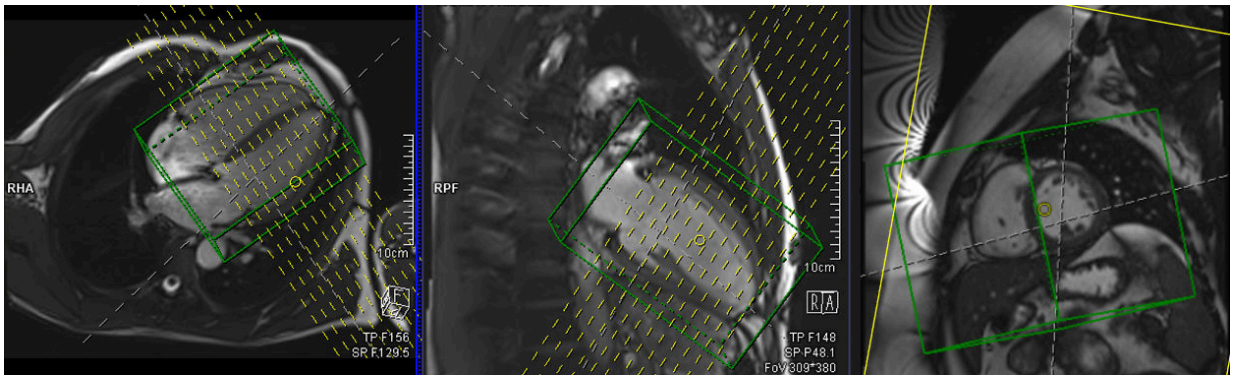


Figure 15. Short axis stack cine prescription

5.14. Cardiac T1 Map

T1 mapping will be acquired at three different levels along the left ventricle: basal, mid, and apex. Make sure all three acquisitions are acquired at the same cardiac phase (e.g. late diastole; no need to press capture cycle). Note that trigger delay and acquisition window should not be changed if not strictly necessary. In cases with fast heart rates, acquisition in systole should be considered. Please see below the suggested steps for planning **Base T1 Map**, **Mid T1 Map**, and **Apex T1 Map** acquisitions.

1. Load the Short Axis Stack Cine as the planning images, scroll through each slice stack and find the appropriate **"Base"** position. (Tip: also use HLA and VLA as reference) as shown in Figure 16 (page 20)
2. Right click on the chosen Short Axis Stack Cine image → select "Copy image position"
3. Right click on the Short Axis Stack Cine sequence → select "Copy Parameters" → select "Adjustment volume"
4. For Mid T1 Map and Apex T1 Map, repeat steps 1 to 3 with correspond to the **"Mid"** and **"Apex"** positions

When acquiring the cardiac T1 maps, follow the criteria below:

- Make sure the sequence is using the LongT1 sequence.
- Check the average RR of the participant, based on this value either scan with **RR-interval>700 ms** or **RR-interval < 700 ms**.
- If any mistriggering occurs, please adjust Trigger Delay and Acquisition Window and reacquire. Please label the new acquisition as REPEAT.

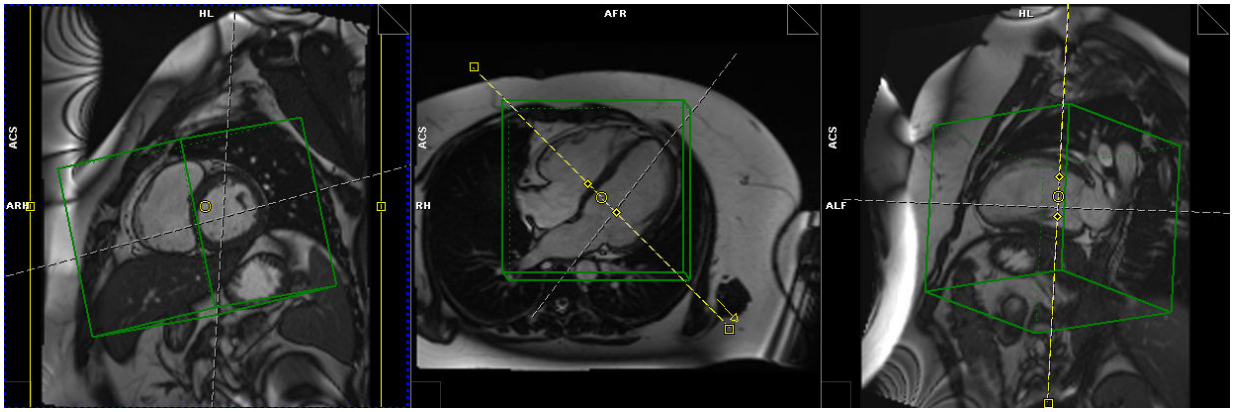


Figure 16. Base T1 Map planning. Use Short Axis Stack cine sequence as reference for Cardiac T1 map planning.

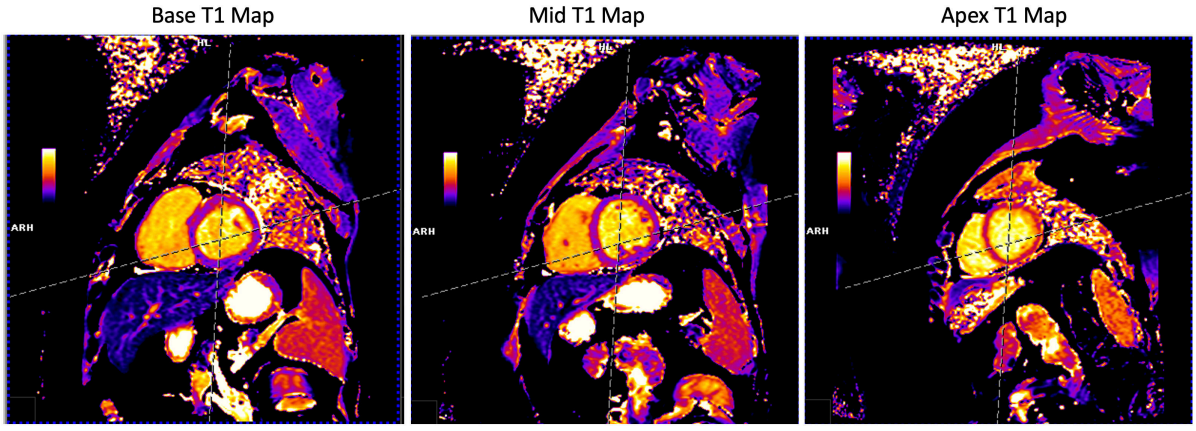


Figure 17. Example of resulting T1 Maps.

5.15. Cardiac T2 Map

T2 mapping acquisitions should resemble the locations as per Cardiac T1 Map: basal, mid and apex slices. Make sure all three acquisitions are acquired at the same cardiac phase. Note that trigger delay and acquisition window should not be changed if not strictly necessary. Ideally, acquire the sequences at late diastole. In cases with fast heart rates, acquisition in systole should be considered. Please see below the suggested steps for planning **Base T2 Map**, **Mid T2 Map**, and **Apex T2 Map** acquisitions.

1. Double click on the Base T2 Map sequence and select 'Manual' when prompt by the 'Scanning Assistant'.
2. Right click on the Base T1 Map sequence, select "Copy Parameters" → select "Center of slice goups and regions". Repeat this procedure again and select "Adjustment volume".
3. Make sure the shim mode is set as "Cardiac".
4. For Mid T2 Map and Apex T2 Map, please repeat steps 1 to 3 by copy the parameters from Mid and Apex T1 Map.
5. If any mis-triggering occurs, please adjust Trigger Delay and Acquisition Window and re-acquire as necessary. Please label the new acquisition as REPEAT.

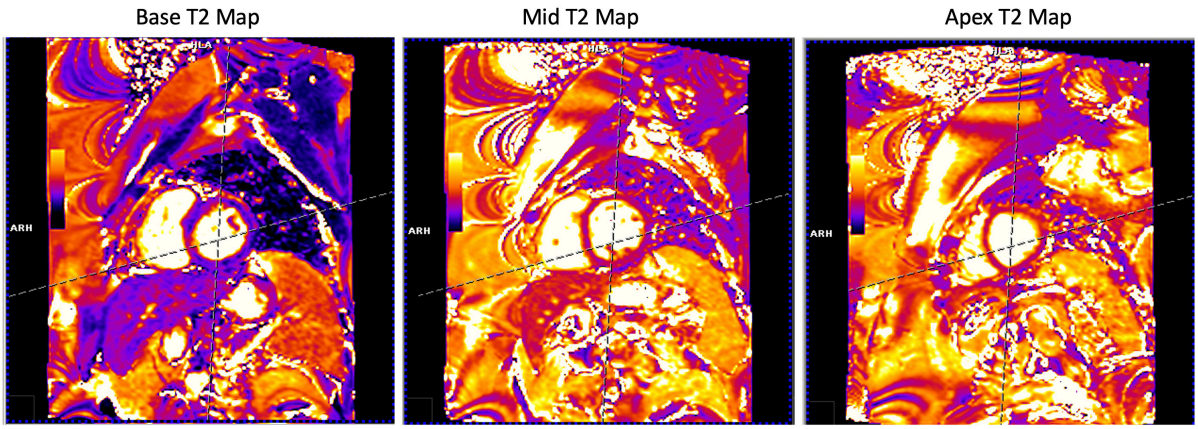


Figure 18. Example of Base, Mid and Apex T2 Maps

5.16. Lung Planning Localizer

The localizers acquired here will be used for planning the lung imaging and are acquired during expiration breath-hold. Position the sagittal and coronal localizers centred at the apex of the lung so that the largest dimension of the lung can be visualized.

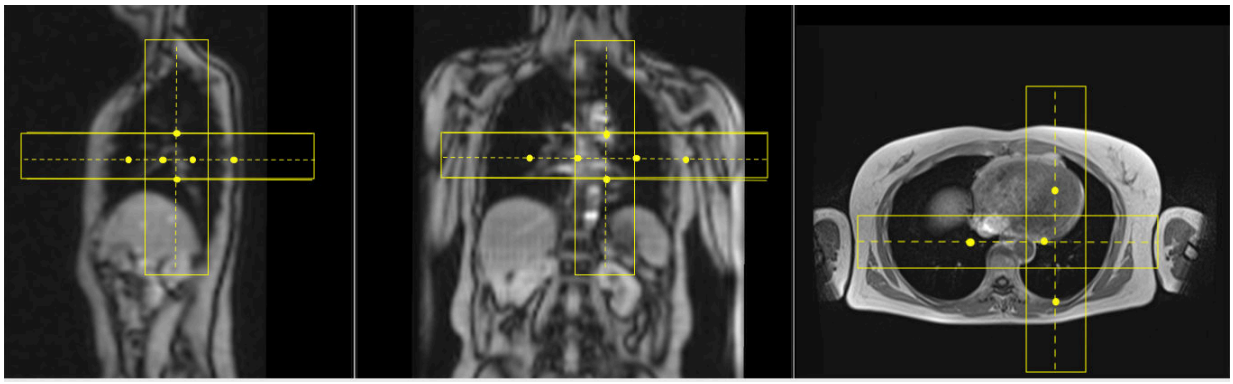


Figure 19. Lung planning localizer prescription

5.17. Lung Imaging

This acquisition lasts approximately 30 seconds and aims to acquire the dynamic coronal views of both lungs in deep inspiration and deep expiration.

Prior to starting the acquisition, instruct the patient to **"continuously breathe deeply in and out at a steady pace during the scan"**

Coronal view slice prescription:

1. Ensure the FOV covers the entire bilateral lung volumes (both in the S-I and L-R directions).
2. When centring the FOV, please accommodate the change in the diaphragm locations due to deep breathing.
3. The image slice should cut through the apex of both lungs while keeping the slice coronal (please do not angle the slice) as shown in Figure 20 (page 22) .

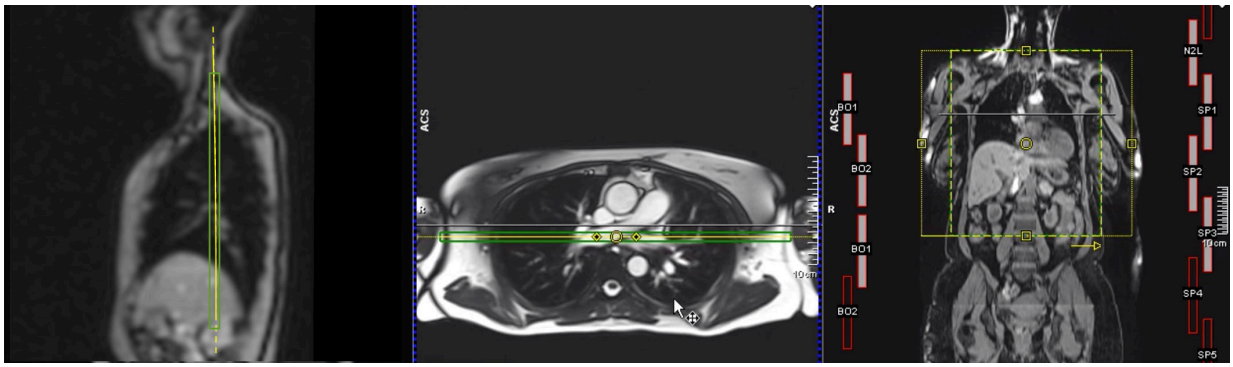


Figure 20. Lung imaging prescription

6. Data Export

UPLOAD SINGLE COMPRESSED FILE

Please compress all sets of data for the **same** patient into **one** file and proceed with the upload.

IMPORTANT

Please follow the arrangement for personally identifiable information (PII) as agreed for your site, as the removal of PII may not be necessary for your site.

If the patient registration contains PII, please refer to the Patient de-Identification Manual for help removing the PII but preserving the private DICOM tags necessary for describing the image acquisition.

Private DICOM tags are special tags added by the manufacturer to describe the MRI sequence. They do NOT refer to private information, nor PII. Many DICOM anonymization tools have an option to remove all Private Tags. Do not remove Private Tags when exporting data.

CAUTION

Private DICOM tags must be preserved in any data export. Private DICOM tags are not PII tags.

These instructions cover exporting data from the Siemens scanner for transfer. If your site is unable to export from the scanner directly and transfers data via a PACS system please use the PACS export to save the DICOM images.

6.1. Saving DICOM Images For Transfer

To export data from the Siemens MRI Scanner directly, save the data from the <Patient browser> to a location where it can be uploaded to Perspectum portal. Select the data you want to export.

6.1.1. Export Data To A CD Or DVD

1. In <Patient Browser> select the appropriate subject folder.
2. Select <Transfer> and then <Export to CD-R>
3. In the <Enter Label> enter a unique name.
   For XA software version ensure the *properties* is selected as "Create DICOM file System" and *Image Conversion* is selected as "Interoperability".

6.1.2. Export Data With A USB Stick Or External Hard Drive

1. In <Patient Browser> select the appropriate subject folder.
2. Select <Transfer> and then <Export to off-line>
3. Select the path and folder from the path selection list (this could be a USB stick, external hard drive or CD).
4. Select DICOM in <Select format>.
   For XA software version, select " Create DICOM file System" and select "Interoperability" for the image conversion option.
5. **DO NOT** select <Anonymously>. For XA software **DO NOT** select " anonymize as...".
6. Confirm with OK. For XA software version click on "Export".

6.1.3. Check The Data Is Transferred Completely

1. Select <Transfer> → <Local job status>.
2. A window will pop up to show the data transfer status

It is preferable to compress the folder of exported DICOMs and submit the single compressed file to the Portal.

- **On a Windows**: right click on the folder in Windows Explorer and select <Send To> and <Compress (zipped) folder>. If the folder resides on a CD or DVD, you will need to copy the folder to a location that can be saved to.
- **On a Mac**: hold Ctrl and click on the folder, then select <Compress>.

Upload the compressed file to the Perspectum Portal.

For additional instruction on using the Portal, please see the Portal Customer User Guide - PDM0077 on the Portal website.

7. Acquisition Checklist

	Prior to scan
☐	Attach ECG triggering device to the patient
	List of sequences
☐	Set up cardiac trace simulator
☐	Three-plane localizer
☐	Liver to Kidney CoverScan DIXON VIBE
☐	Liver LMS T2STAR DIXON
☐	Liver LMS MOST
☐	Liver LMS MOLLI 1st Slice
☐	Liver LMS MOLLI 2nd Slice
☐	Liver LMS IDEAL
☐	Pancreas CoverScan MOLLI
☐	Pancreas CoverScan IDEAL
☐	Kidneys CoverScan MOLLI
☐	Turn off cardiac trace simulator and use the patient's heart trace with ECG
☐	Change coil position to cover the lungs and the heart if coil coverage is not sufficient to cover the apex of both lungs
☐	Cardiac planning localizer
☐	2 chamber
☐	4 chamber
☐	Short Axis stack
☐	HLA cine
☐	VLA cine
☐	Short Axis stack cine
☐	Cardiac T1 Map: Base
☐	Cardiac T1 Map: Mid
☐	Cardiac T1 Map: Apex
☐	Cardiac T2 Map: Base
☐	Cardiac T2 Map: Mid
☐	Cardiac T2 Map: Apex
☐	Lung planning localizer
☐	Lung imaging: consistent deep inspiration and expiration
☐	Data export and upload to the portal

8. Issue Control

Issue	Details	Date	Initial
1.0	New document	23 Oct 2020	FSN
2.0	Protocol changes to reflect the addition of cardiac T2 Map and lung imaging	25 Feb 2021	YCW/JL
2.1	Specify sequence names as per product	16 July 2021	YCW

9. Approvals

Head of Imaging Solutions	Head of Imaging Applications
Dr. Alex Smith	Andrea Borghetto

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