CoverScan MD

CoverScan MD Patient Acquisition Manual for GE Scanners

Download PDF

MRA1270
August, 2021

Use and Limitation

This Manual is intended to be used as a reference guide for the acquisition of images using at a GE 1.5T MRI system. Perspectum Ltd. shall not be held liable for improper installation, operation, or maintenance of the system in circumstances where procedures and specifications set out in this Manual have not been followed correctly. It is essential therefore, that you follow the specifications, procedures, and recommendations outlined in this Manual.

Disclaimer

Except as required by law, Perspectum Ltd. makes no representations or warranties, either expressed or implied, with respect to the contents hereof. Every effort has been made to ensure the reliability and accuracy of the information contained in this Manual at the time of going to print. However, specifications and procedures are subject to change due to our constant endeavours to meet customer requirements, and to maintain a research and development process of continuous improvement for all Perspectum Ltd. products. Consequently, Perspectum Ltd. reserves the right to make changes to the Manual at any time and without notice. You should always check with Perspectum Ltd. first to make sure that the version of the Manual you are referring to is the latest version. Unauthorised use means that the user assumes all liability for its use. To the maximum extent permitted by law, in no event shall Perspectum Ltd. be liable for damages or for, without limitation, loss of profits, business, revenue, loss of use, time, data, reputation, opportunity, goodwill, or savings, inconvenience, incidental, indirect or consequential damages, or damages arising from the use or failure to use the Manual strictly as prescribed herein.

Table of Contents

This page is intentionally left blank.

1. Glossary

3D	3-Dimensional
A-P	Anterior-Posterior
AV groove	Atrioventricular groove
B0	Main Magnetic Field
CE	Continuing Education
DICOM	Digital Imaging and Communications in Medicine
DOB	Date Of Birth
ECG	Electrocardiogram
F-H	Feet-Head
FOV	Field of View
HLA	Horizontal Long Axis
ID	Identifier
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
PG	Peripheral Gating
PII	Personally Identifiable Information
RIS	Radiology Information System
R-L	Right-Left
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 GE 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 Flex LAVA (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, multi 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 CardioMaps.

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

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

2.3.3. Volume Requirement

The system should have 3D T1 LAVA 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 Flex LAVA 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 14)).

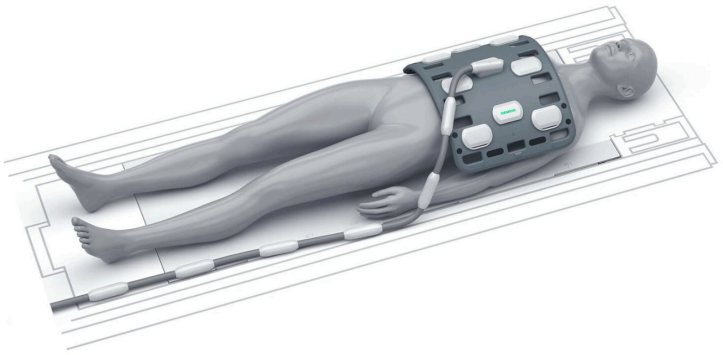


Figure 1. Sufficient flex array coil coverage from both apex of the lungs to below the lower poles of both kidneys.

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 24) 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 feet-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

Note that the ECG simulator only runs if the system has SimulatePac.

If a 60bpm trace cannot be set as shown at the following instructions, please use the standard cardiac gating (ECG or PG leads) to obtain cardiac trace input.

Method 1:

1. Go to "Service Desktop Manager" and click on "C-shell".
2. In the "xterm" box type **`mgd_termc`** and **Enter**.
   If nothing happens, please go to the **Method 3, point 2**.
3. Two new windows/terminals will appear. In the SCP windows/terminal, press **Enter** (a sign **"->"** will appear).
   If it pops up just 1 window called ICE terminal, please go to the **Method 2**, **point 3**.
4. In the SCP window/terminal type **`EmulatePac`** and press **Enter**.
5. In the AGP window/terminal, type **`sendPPGBPMUpdate 60`**. (in the case of selecting the "VCG gating")
   If you select the "PG gating", the command will be **`sendPPGBPMUpdate 60`**. If it gives an error, unluckily it's not possible to select 60bpm.

> ⓘ **TIP**
> If only one window/terminal pops up, please go to **Method 2, point 4**.

Method 2:

1. Go to "Service Desktop Manager" and click on "C-shell".
2. In the "xterm" box type **`mgd_termc`** and press **Enter**.
3. A new window/terminal called "ICE Terminal" will appear. In this window/terminal, press **Enter**
4. Type **`EmulatePac`** and press **Enter**
5. Return to the xterm and type **`rlogin agp`** and press **Enter**.
6. Type **`agp`** and press **Enter**.
7. Type the password: **`agpservice`** and press **Enter** (the password may not be visualized while typing).
8. Type **`updateECGBPM 60`** and press **Enter**.

Method 3:

1. Go to "Service Desktop Manager" and click on "C-shell".
2. In the "xterm" box type **`rlogin scp`** and press **Enter**.
3. As login, type **`scp`**and press **Enter**.
4. As password, type **`scpservice`** and press **Enter** (letters may not be visualised while typing).
5. Type **`EmulatePac`** and press **Enter**.
6. Type **`exit`** and return to the xterm and type **`rlogin agp`** and press **Enter**.
7. As login, type **`agp`** and press **Enter**.As password, type **`agpservice`** and press **Enter** (letters may not be visualised while typing).
8. Type **`updateECGBPM 60`** and press **Enter** (in the case of selecting the "VCG gating")
   If you select the PG gating, the command will be **`updatePPGBPM 60`**.

If 60bpm cannot be selected, please use standard cardiac gating (PG or ECG leads) to obtain cardiac trace input. Once the simulator required scan is completed, the ECG simulator can be turned off by "TPS Reset".

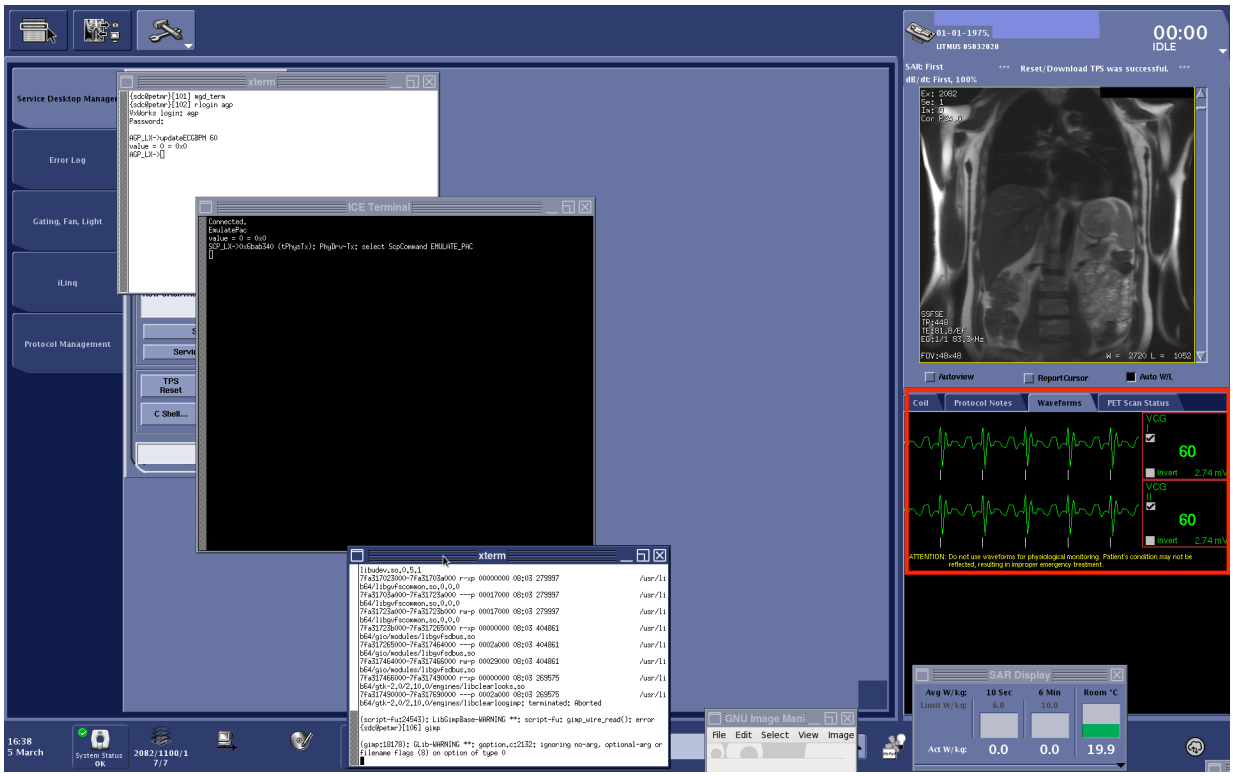


Figure 2. The simulated heartbeat is highlighted with a red box.

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 Flex LAVA

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 Flex LAVA slab to cover from above the liver domes to below the lower poles of both the kidneys as shown in Figure 3 (page 10).
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.

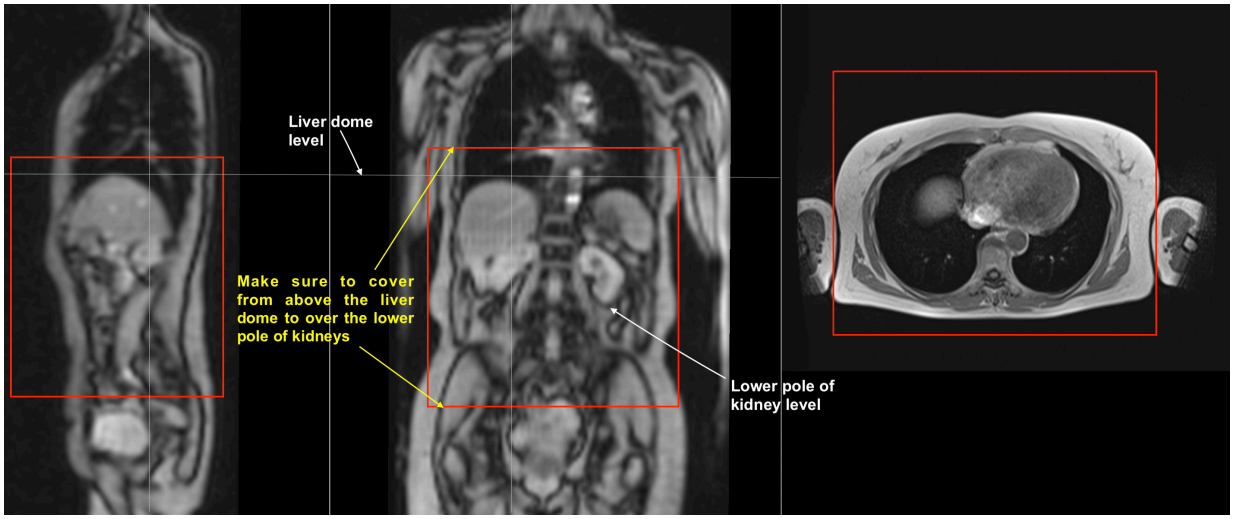


Figure 3. Liver to Kidney CoverScan Flex LAVA slice stack positioning.

5.4. Liver LMS Sequences

1. **Liver LMS T2STAR DIXON (one slice)**:
   Prescribe the slice so that it intersects porta hepatis. It should cover the liver, spleen, and may also contain the stomach → Adapt the shim volume R-L and A-P directions to cover the entire liver and spleen and exclude the subcutaneous fat → Make sure the shim volume's F-H direction is 6cm. (Please refer to Figure 4 (page 11) for planning)
2. **Liver LMS MOST (7 slices for 1.5T and 12 slices for 3T)**:
   a. Load the acquired Liver LMS T2STAR DIXON sequence into one of the planning windows.
   b. Link the centre of the slice and the shim volume to the Liver LMS T2STAR DIXON sequence by selecting only "scan coverage", "shim volume" and "Present Loc" marked as ticked (de-select all other boxes)
   b. Change the shim volume's F-H direction to 6cm. If the number of slices changes, please go back to 7 slices (1.5 T) or 12 slices (3 T).
   c. In the R-L and A-P directions, the shim volume can be adapted to cover the entire liver and spleen and exclude the subcutaneous fat.
3. **Liver LMS MOLLI (2 slices)**:
   a. Link the centre of the slice and the shim volume to the Liver LMS T2STAR DIXON sequence by selecting only "Scan Coverage", "Shim Volume" and "Present Loc" marked as ticked (de-select all other boxes).
   b. Drag inferiorly from the 1st slice to create the 2nd slice.
   c. Make sure the shim box cover both slices.
4. **Liver LMS IDEAL (5 slices)**:
   a. Link the centre of the slice stack to the Liver LMS T2STAR DIXON sequence by selecting only "Scan Coverage", "Shim Volume" and "Present Loc" marked as ticked (de-select all other boxes).
   b. Make sure the number of slices (# Slices) is 5 slices.
   b. The shim volume can be adapted in the R-L and A-P directions to cover the entire liver and spleen and exclude the subcutaneous fat.
   c. In the F-H direction the shim thickness is centred to the slice stack and it should be thicker than the acquired slices → Set the shim volume thickness to 90 mm, (the protocol should have set the shim volume thickness to 90 mm).

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

1. Use the images from Liver to Kidney Flex LAVA series, scroll through the images to find the slice where the majority of the pancreas can be identified in the axial plane.
2. Use the coronal Localizer image to ensure that most part of the pancreas is covered by the slice thickness
   a. Due to the anatomy of the pancreas, it is normal that not the whole pancreas can be captured perfectly in one slice. However, please try to cover the pancreas with the slice as much as possible.
3. Reduce the shim size to cover just the pancreas. (Please refer to Figure 5 (page 12) for planning)

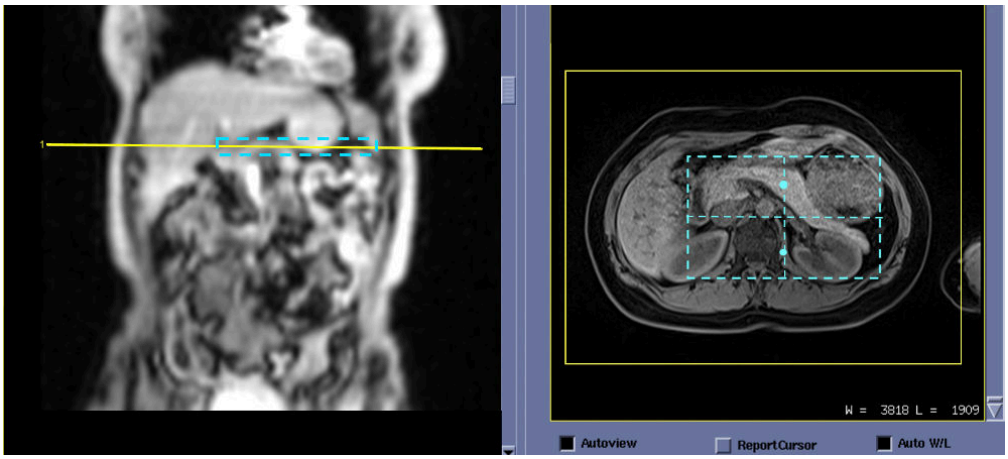


Figure 5. Prescribe the Pancreas MOLLI sequence

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. Link the centre of the slice to the Pancreas CoverScan MOLLI sequence by selecting "scan coverage" and "shim volume" as ticked (de-select all other boxes).
2. Manually change the number of slices (#Slice) to 5.
3. Adjust the shim volume so the shim thickness covers the whole slice stack. (Please refer to Figure 6 (page 13) for planning)

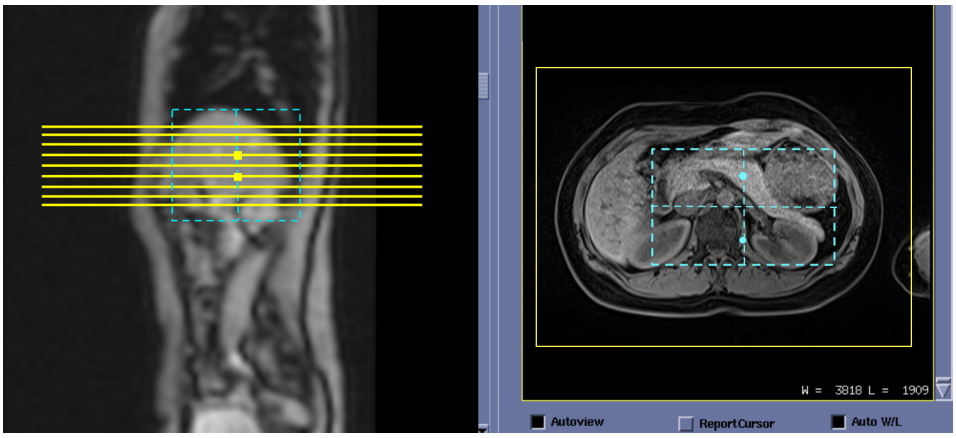


Figure 6. Pancreas CoverScan IDEAL Prescription, ensure the shim volume covers the entire slice stack.

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 Flex LAVA 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 7 (page 14) for planning)
3. Adjust the shim volume to cover the slice and both kidneys.

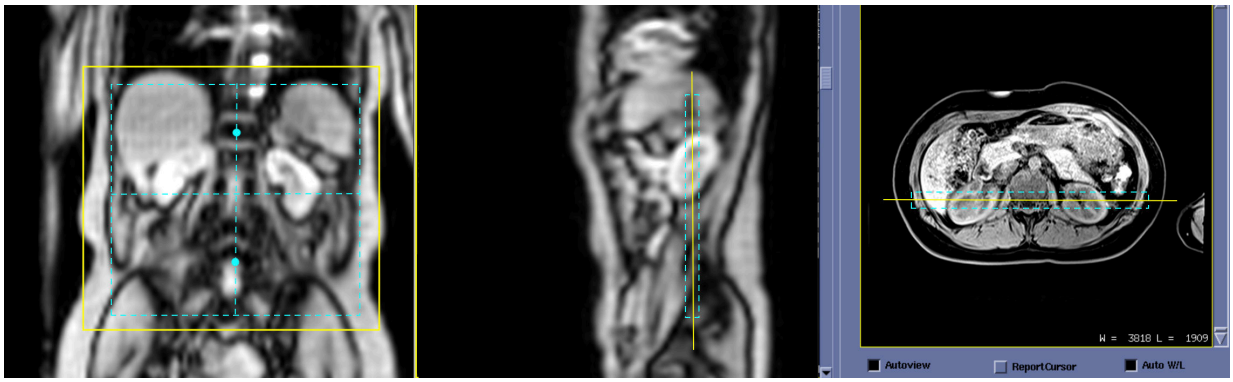


Figure 7. Kidneys MOLLI prescription

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:

Once the simulator required scan is completed, turn off the ECG simulator by "TPS Reset".

IMPORTANT

Make sure to select only one channel of the ECG as the input signal when acquiring the Cardiac sequences.

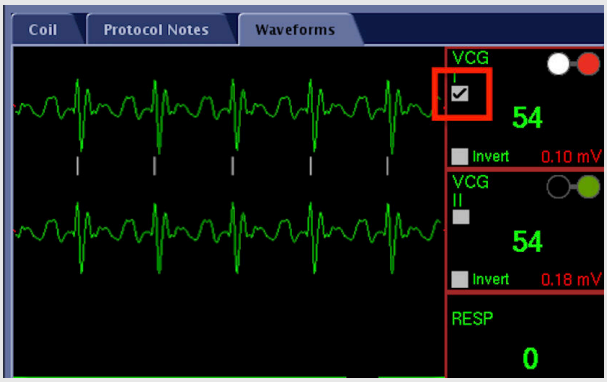


Figure 8. Select one of the ECG channels as the input signal.

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.

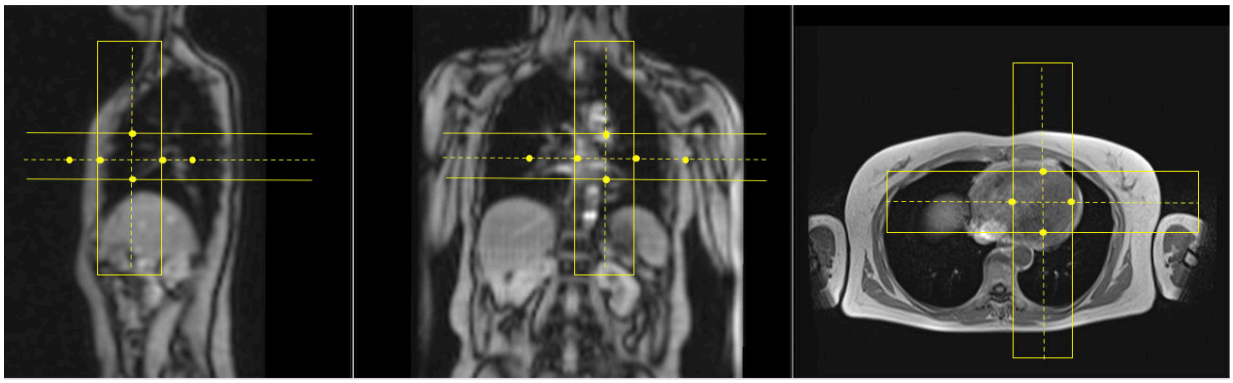


Figure 9. Cardiac planning localizer prescription

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 16) 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.

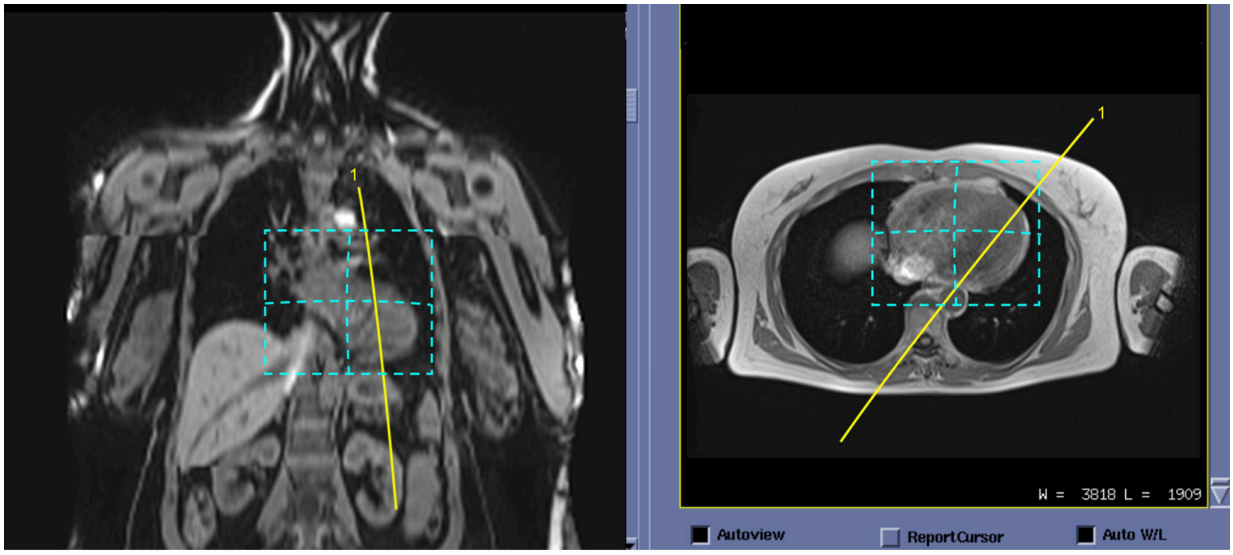


Figure 10. Two chamber Localizer slice prescription.

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 17) 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.

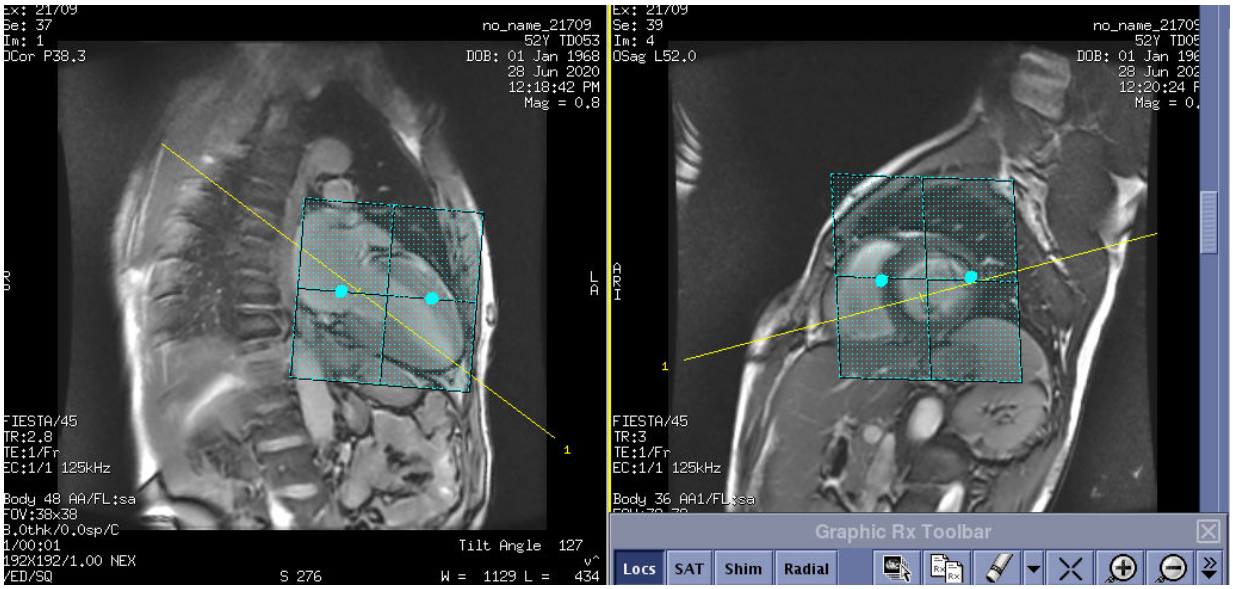


Figure 11. Four chamber localizer slice prescription.

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.

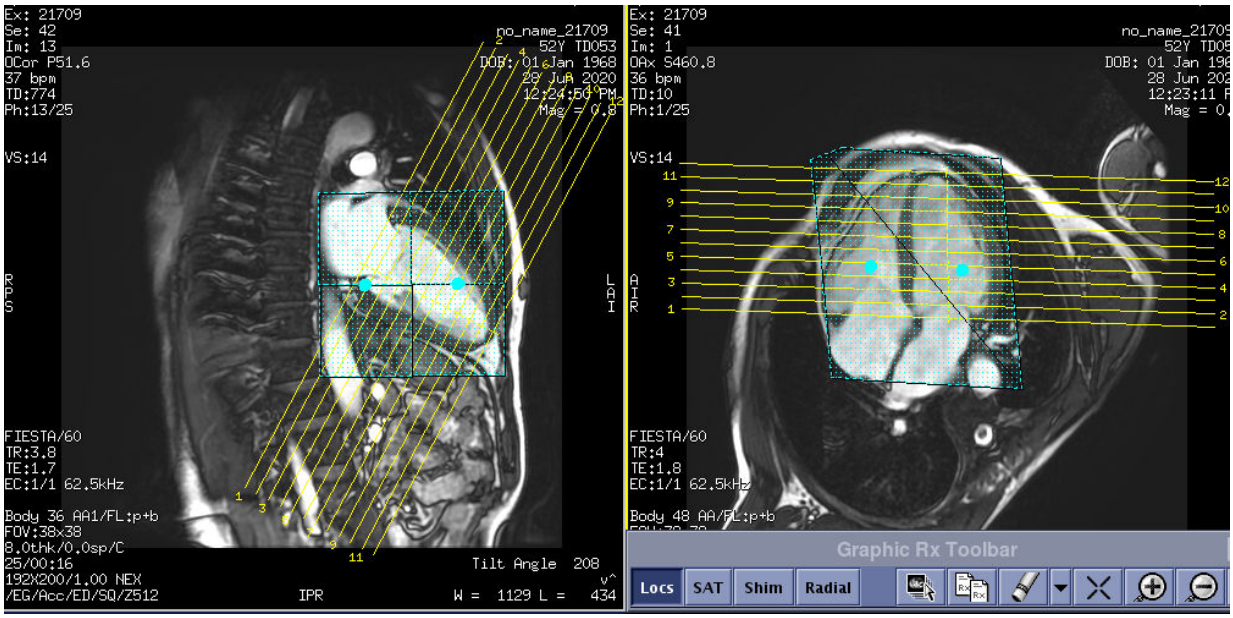


Figure 12. Short axis stack localizer prescription

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).

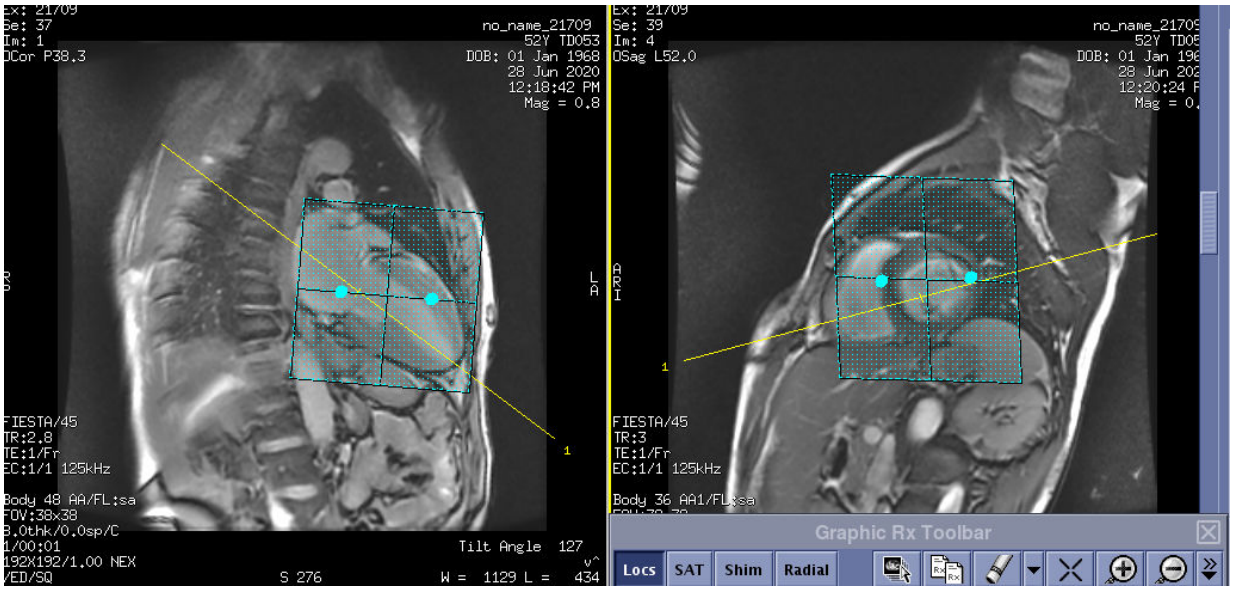
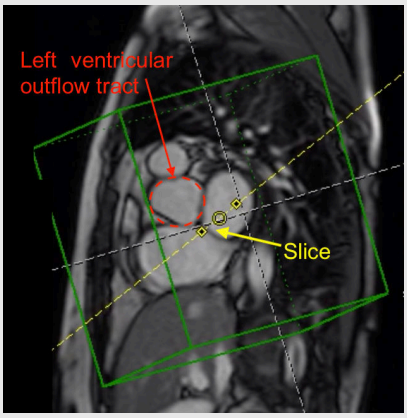


Figure 13. HLA Cine prescription.

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 20) 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. 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 T1 Map**, **Mid T1 Map**, and **Apex T1 Map** acquisitions.

1. Load the Short Axis Stack Cine as the planning images. Scroll through the images to find the best base location.
2. After finding the best slice location, use Graphic Rx Toolbar to select the Short Axis Stack Cine sequence as the reference. Only select "scan coverage", "shim volume" and "Present loc" as ticked (de-select all other boxes) as shown in Figure 16 (page 21).
3. Apply and change the number of slices (# Slices) to 1 slice.
4. Run the sequence and check the acquisition is properly triggered.
5. For Mid and Apex T1 Map, repeat the same process.
6. If any mis-triggering occurs, please adjust trigger delay, acquisition window, and projected heart rate as required. 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.

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. Load the Base T1 Map image in one of the planning windows.
2. Open the Base T2 Map sequence and use Graphic Rx Toolbar to select the Base T1 Map as the reference. Only select "scan coverage", "shim volume" and "Present location" (de-select all other boxes).
3. For Mid T2 Map and Apex T2 Map, please repeat step 1 and 2 with the appropriate Mid and Apex location.
4. If any mis-triggering occurs, please adjust trigger delay, acquisition window, and projected heart rate as required. Please label the new acquisition as REPEAT.

1. Open the Base T2 Map sequence and set the centre of the slice and shim volume identical to Base T1 Map (same GEO name).
2. For Mid T2 Map and Apex T2 Map, please repeat step 1 with the appropriate Mid and Apex location.
3. If any mis-triggering occurs, please adjust trigger delay, acquisition window, and projected heart rate as required. Please label the new acquisition as REPEAT.

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.

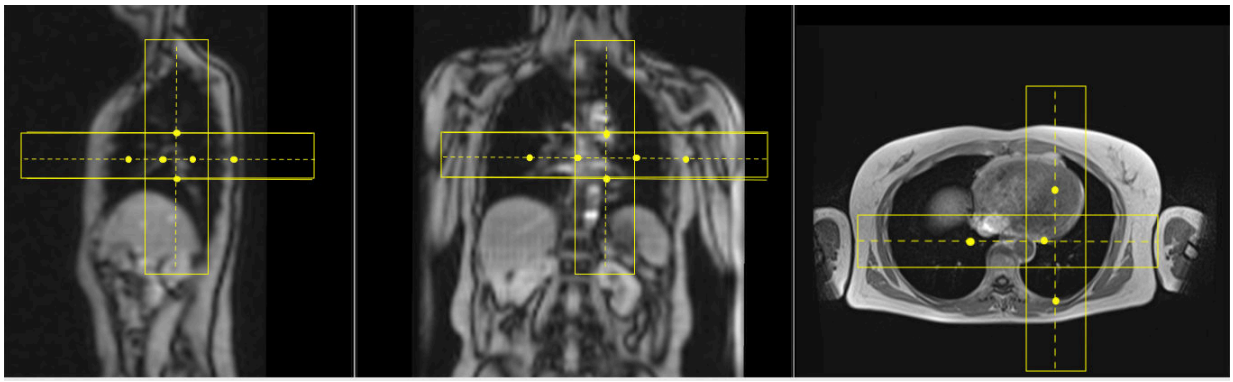


Figure 17. Lung planning localizer prescription

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 18 (page 23).

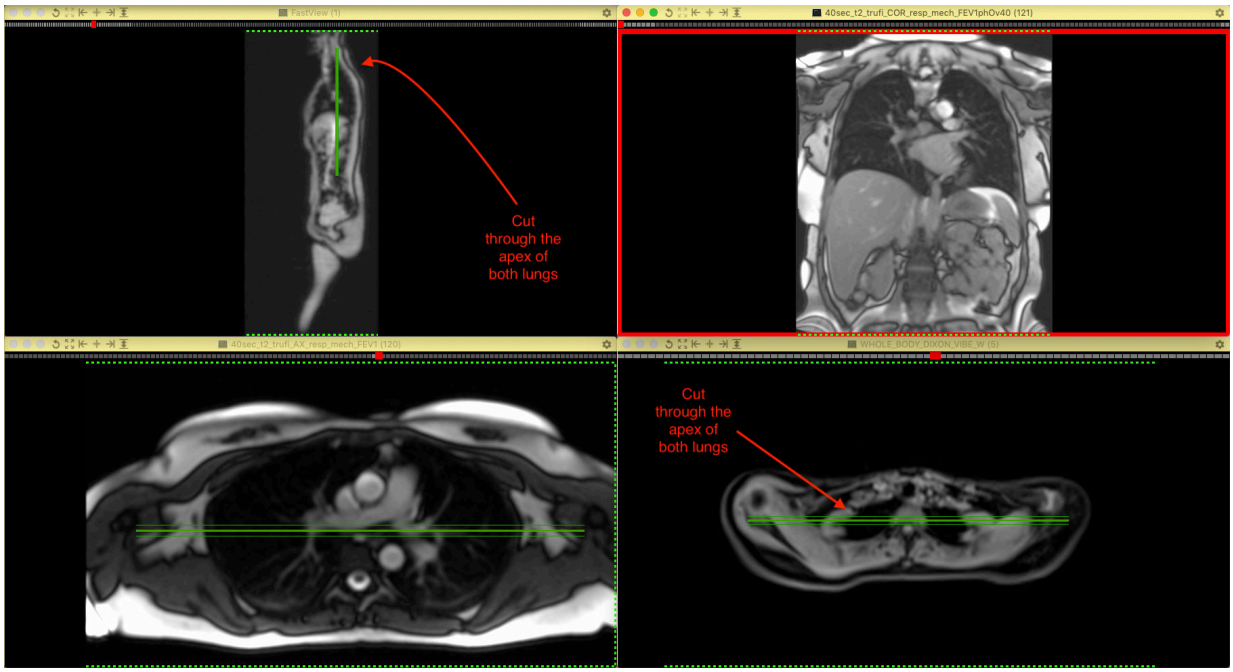


Figure 18. Lung imaging prescription

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 GE 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 GE MRI Scanner directly, save the data from the Image browser to a location where it can be uploaded to Perspectum portal.

Exporting data to a CD, DVD, USB or external hard drive:

Please export the data with the following steps:

1. Select CD/DVD/USB from the Data Apps.
2. Select the media to be used from the drop down.

3. Click on the export button.

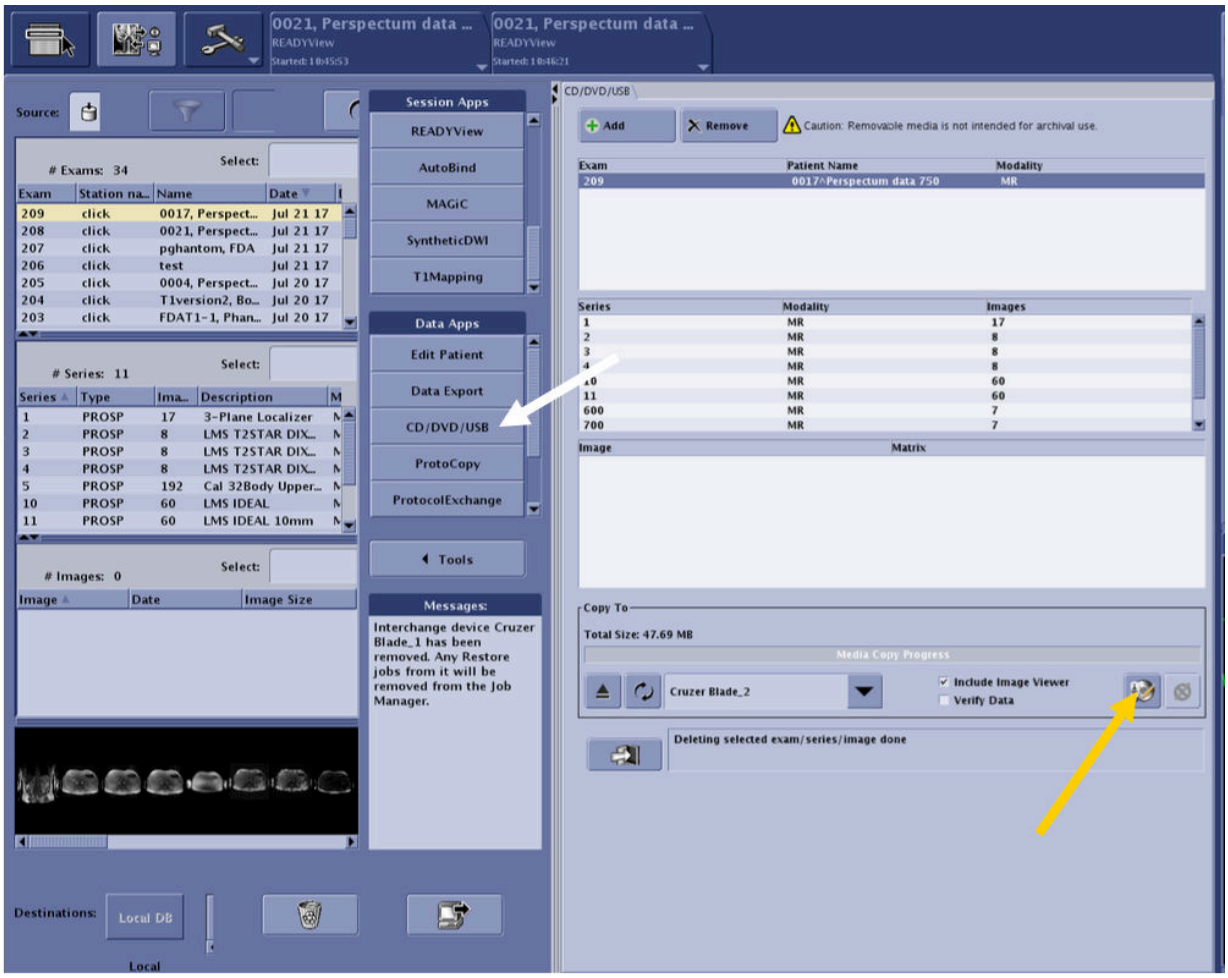


Figure 19. Exporting data. Select the data to be sent to Perspectum in the browser, then press the CD/DVD/USB button (white arrow). Press the copy button (yellow arrow) to start copying to the selected media. Please do not include the image viewer.

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 Flex LAVA
☐	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
☐	Select only one channel as heartbeat input for cardiac acquisition
☐	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	25 Feb 2021	YCW/JL
1.1	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