MRI: Liver Multiphase

Image quality in the multicenter setting can be greatly influenced by variances in acquisition protocols. These variances may be related not only to equipment manufacturer and model, but also technique.

The study may permit imaging per institutional standard-of-care. However, aligning image acquisition to established standards is essential for robust quality data.

The table below is provided as a guideline and overview for MRI Multiphase Liver exams. Some modification may be needed to ensure similar SNR in the resulting images. Please refer to your site's specific MRI manufacturer's imaging protocols for the optimal scanning protocol.

The MRI Extremity exam should contain, at a minimum, the following series:

1. 3-plane localization scan
2. T2w
3. T1w ***pre-contrast***
4. Diffusion-weighted Imaging (DWI)
5. Dynamic Contrast Enhanced (DCE) MRI
6. Post-processing subtraction images

Exam and Patient Preparation

Magnet Strength	1.5T or 3T	
Coil	Phased Array Surface Coil	Unless patient body habitus prohibits, then body coil.
FOV	A FOV that includes the entire abdominal cavity without introducing undesirable artifacts	Adjust to patient body habitus.
Patient Position	Supine	Feet first, elevate knees with MR-safe sponge/wedge for patient comfort. Patient upper extremities raised above head whenever possible. If not, arms by side with added padding between upper extremities and patient body. Avoid skin-to-skin and skin-to-bore contact with appropriate padding, as indicated by magnet manufacturer, to avoid thermal burns.
Contrast Injection	Dual-chamber power injector recommended Contrast Bolus = 0.1 mmol/kg Bolus Rate = 2 mL/s Saline Flush = 20 mL	Insertion of intravenous catheter in upper extremity prior to the start of imaging.
Slice Plane	Axial Coronal (added as needed)	Scan direction based on site preference.
Respiratory Considerations		Ensure that patient's respirations are suspended in an identical manner for every sequence.

Respiratory Considerations	Breath hold technique preferable	Parallel MRI is often used to reduce scan time and increase spatial resolution. When a non–breath-hold technique is used, every effort should be made to minimize the respiratory motion artifacts by using multiple signal averages and/or respiratory compensation or respiratory triggering, which could include bellows or navigator-triggered sequence.

Image Acquisition

Localization Scan	3-plane localization scan	
T2-Weighted Sequence(s) (2D or 3D technique)	Slice thickness ≤ 7 mm Gap = 1.5 mm TR ≥ 2000 ms TE ≥ 60 ms Flip angle = 90° With and without fat suppression	Sequence Options: Accelerated fast spin-echo Single-shot accelerated fast spin-echo (FSE) Steady-state free precession
Pre-contrast T1-Weighted Sequence (2D or 3D technique	Slice thickness ≤ 7 mm Gap = 1.5 mm TR ≥ 800 ms TE ≤ 30 ms Flip angle = 90°	Included for lesion characterization and for confirmation of hepatic steatosis and iron overload; these sequences should be obtained prior to the administration of IV contrast material.
Diffusion-weighted Imaging (DWI) with ADC mapping	Slice thickness ≤ 5 mm Gap ≤ 1 mm TR ≥ 5000 ms TE = min Flip angles = 90°/180° Acceleration = up to 2X *b*-values = 20–50, 400–1000 s/mm^2 Diffusion directions = at least 3	Breath-held, free-breathing multiple averaging, and respiratory-gated SS-EPI techniques can be used. Helpful in detection and characterization of focal liver lesions, in detection and staging of liver fibrosis, and appears to be at least a value-added adjunct sequence capable of revealing additional sites of disease in the abdomen.
Dynamic Contrast Enhanced (DCE) T1-weighted **(2D or 3D technique)**	Slice thickness ≤ 6.0 mm Gap = 0 mm TR < 800 ms TE < 30 ms Flip angle = 90°	Obtain pre T1 weighted fat suppressed imaging prior to contrast bolus. Dynamic fat suppressed images should be performed utilizing a bolus

	Post contrast dynamic fat suppressed images should be timed to be acquired during the following phases: **Late hepatic arterial** **Portal venous** **2- to 5-minute delayed phases**	timing technique, such as automated bolus detection algorithm or fluoroscopic triggering, or obtaining multiple consecutive arterial-phase data sets with higher temporal but lower spatial resolution.
Post-processing Subtraction Images		Subtraction of unenhanced from contrast-enhanced images may be considered for lesions that are hyperintense on T1-weighted images prior to gadolinium administration.

References

1. ACR–SAR–SPR Practice Parameter for the Performance of Magnetic Resonance Imaging (MRI) of the Liver, Res. 3 – 2015. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MR-Liver.pdf, accessed February 17, 2021.
2. MRI Exam-Specific Parameters: Body Module. https://accreditationsupport.acr.org/support/solutions/articles/11000061022-mri-exam-specific-parameters-body-module, accessed March 26, 2021.