Recommended Dynamic Contrast - Enhanced (DCE) - MRI Protocol

Description
The DCE-MRI consists of 3-5 short series used for T1 mapping, followed by the dynamic, contrast-enhanced MRI series. The dynamic series is a “multiphase” technique with images acquired before, during, and after intravenous injection of gadolinium (Gd)-based contrast agent.

General technique
- The slice locations and positioning for the T1 mapping and the dynamic series should be identical.
- For all series, do not use normalization filters such as SCIC or PURE.
- If magnets and multichannel head coils are available to perform parallel imaging, speed factors for ASSET or IPAT of 2 can be used. Do not use higher speed factors.
- If parallel imaging techniques are used, identical parallel imaging techniques must be used on all series.
- If parallel imaging techniques are not available, sites can use zero-filled interpolation in the phase and frequency direction “Zip x 2.”
- Images on the dynamic run should be acquired as **3D SPGR/MPRAGE axial at a 20-35 degree flip-angle**; do not acquire as oblique.
- 3 to 5mm slice thickness – yielding a 6cm slab of effective coverage
- A contrast agent power injector should be used for contrast administration. The power injector should be set up per standard protocol.
- The rate of injection should be 3 to 5 cc/sec, followed by a saline flush at the same rate.

T1 Mapping Series Technique (run prior to injection):
- It is necessary to collect three to five **3D SPGR/MPRAGE** series (with same slice prescription as the dynamic series) so that the pre-contrast T1 map can be determined. Collect one series each, at 30, 20, 15, 10, and 2 degrees prior to the dynamic series. Tune/pre-scan before collecting the first series and do not re-run pre-scan again for the remainder of the flip angle data collections. This often entails running manual pre-scan in between each acquisition without changing any settings. (Always begin with the acquisition for which the signal will be highest so that subsequent scans do not saturate at the fixed prescan setting.)
- The repetition time (TR) must be identical for all flip angles.
- The lowest flip angle should be 2 degrees.

For the baseline study

- If prior studies are available, center the slice locations (in the z-direction) for T1 mapping series on the area with the largest enhancing abnormality.
- If no prior studies are available, center slice locations on the area with largest abnormality on T2-weighted images.
- Note that if the largest abnormality is near the top or bottom of the brain, it is acceptable for the highest or lowest slice locations (respectively) to be outside of the brain or outside of coil coverage.

For subsequent studies

- Center the slice locations for mapping sequence to match those of the baseline study.

DCE-MRI Dynamic Series Technique

- The contrast agent should be administered using a power injector. Patients will require a heparin lock or other similar device for the administration of contrast agent during the dynamic sequence with the patient in the scanner.
- The frame rate (time per phase) of the multiphase acquisition should be acquired in **6 seconds or less** such that each volume should be completely sampled every six seconds or more frequently, if possible.
- Injection takes place **after 10 baseline frames** (phases) are obtained.
- **The total imaging time should be 5.5 minutes**. This amounts to 55 to 95 frames (phases), depending upon the acquisition time. The total number of slices acquired should be 660 to 1,900, depending on the number of slices in each frame.

For example: *If your time per phase works out to 5 seconds per phase, then:*
5 seconds x 66 phases = 330 seconds (5.5 minutes)
66 phases x 10 slices per phase = 660 slices
Inject at 50 seconds (5 seconds x 10 frames)

Contrast agent administration is 0.1 mmol/kg via power injector (3 to 5 cc/sec), followed by a flush with 20 cc of normal saline at the same rate.

The administration and total dose of the contrast agent used must be in accordance with FDA guidelines.