Hippocampal Volumetric Measurements Using Fast-Spin Echo Inversion Recovery MR Pulse Sequence

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Purpose
It has been suggested that quantitative MRI-based volume measurements of the hippocampus improve the sensitivity of atrophy detection in Temporal Lobe Epilepsy. Unfortunately, hippocampal volumetric measurements have been difficult in routine clinical settings due to difficulties of delineating this structure from the surrounding tissue. Greater differentiation can be accomplished by optimizing images for volumetric measurements, coupled with image processing software. Here we report that a modified version of fast spin echo sequence (FSE) provides the highest anatomical resolution for hippocampal delineation without magnetic susceptibility artifacts. Using this sequence, improved contrast between white/gray matter and CSF was generated in a series of contiguous and tilted heavily T2-weighted images. Thus, by combining MR images with MinIP (Minimum Intensity Projection) image processing and visualization, we accurately delineated this important structure in a routine clinical setting (Figure 1).

Materials & Methods
Three healthy volunteers (mean age, 27 years) were scanned. MR images were acquired on a 1.5 T GE NVI scanner. The MR acquisition protocol included thin sagittal T1-weighted slices for measuring the angle of long axis of hippocampi, followed by contiguous oblique images in a plane perpendicular to the long axis of the hippocampi using a fast 3D-SPGR-IR prepped sequence and FSE-IR. We determined that TI of 500 ms and 200 ms, for SPGR and FSE-IR, respectively produced optimal contrast between white/gray matter and CSF for hippocampal delineation without compromising significant image acquisition time. Data processing was conducted utilizing Vitrea v. 2.0. After delineating the hippocampus in coronal section, the volume was calculated automatically by computer programs.

Results
The volume (Mean ± SD) of the right hippocampus was 3.01 ± 0.2 cm³; and 2.95 ± 0.2 cm³; using FSE-IR and SPGR-IR, respectively. We did not observe any statistically significant difference between the two sequences as determined from a standard student t-test (p = 0.8). Our volumetric measurements were compared favorably with reported literature values. Study-study variations and intraoperator variations did not indicate significant variability as determined from the coefficient of variance in our volumetric measurements using either sequences.

Conclusion
We have shown that FSE-IR MR sequence could enhance clinical utilization of hippocampal volumetric measurements. One of the major drawbacks was the acquisition time in which it
normally takes approximately 12 minutes for acquiring images with FSE-IR in comparison to 5 minutes with SPGR. Consequently, we limit using this sequence to patients who can sustain prolonged scan times.

References