T2-Weighted MR Imaging with FIESTA versus Fast Spin-Echo: Comparative Efficacy in Clinical Hepatic Imaging

A. C. Silva[1], S. D. Beaty[1], A. K. Hara[1], M. D. Patel[1], P. T. Liu[1]

[1]Radiology, Mayo Clinic Arizona, Scottsdale, AZ, United States

Introduction: Fast-Imaging Employing Steady-State Acquisition (FIESTA) is a new sequence that is currently being used to evaluate cardiac and vascular structures of the body. However, it also has the ability to provide very high signal from tissues with large T2/T1 ratios, due to its short repetition time (TR) and the symmetrical and balanced gradient around the echo time (TE). This may thus allow for similar efficacy in hepatic lesion characterization, compared to the traditional heavily T2-weighted fast spin-echo (FSE) sequence, but should additionally provide superior organ parenchymal delineation as well as improved overall image quality. We performed this study to assess the diagnostic accuracy of FIESTA, compared to heavily T2-weighted FSE, as a complementary sequence to the moderately T2-weighted FSE sequence in the characterization of focal liver lesions.

Materials and Methods: A total of 40 hepatic lesions (20 malignant tumors, 11 hemangiomas, and 9 cysts) visible on moderately (TE 80) T2-weighted MR images in 33 patients were retrospectively evaluated in this study. Three radiologists independently reviewed the moderately T2-weighted images of these lesions alone, then in combination with either the FIESTA or heavily T2-weighted (TE 160) images. The FIESTA and heavily T2-weighted images were graded for lesion characterization, delineation of solid organs & vessels, artifacts, and overall image quality. Receiver operating characteristic (ROC) analyses and quantitative measurements were performed. Lesion contrast-to-noise (CNR = lesion SI – liver SI/ SD of background noise) ratios were calculated for FIESTA images.

Results: There was no significant statistical difference in lesion characterization between the FIESTA and heavily T2-weighted sequences. The mean sensitivity and specificity for discriminating malignant from benign lesions for the moderately-weighted T2 sequence was 75% and 100%, compared to 80% & 100% for the FIESTA sequence, and 90% & 100% for the heavily T2-weighted sequence. The sensitivities of all the sequences were decreased due to four hypervascular metastases included in our lesion population, as these types of metastases have prolonged T2 values that can mimic a benign lesion on a T2-weighted sequences. However, as hypervascular metastases can be differentiated from benign hepatic lesions by evaluating all MR sequences, including dynamic, T1-enhanced sequences, the sensitivity and specificity was recalculated. Without these four metastases, recalculation showed that the 100% specificity for all three sequences remained unchanged, while the sensitivities increased to 81%, 100%, and 100% for the moderately T2-weighted, FIESTA, and heavily T2-wieghted sequences, respectively. ROC analysis yielded values of 0.898, 0.975, and 0.993 for the three radiologists. Interobserver agreements (kappa values) between different pairs of radiologists were substantial to excellent, at 0.79 – 0.95 for the FIESTA sequence. With qualitative analysis, solid organ/vascular delineation and overall image quality was significantly better with FIESTA than with heavily T2-weighted images ($p < 0.0001$), yet there was no significant difference in the presence of artifacts. The mean CNR value of benign lesions is 7.79 (standard deviation [SD] = 3.32) and that of malignant lesions was 2.71 (SD = 2.62), which is statistically significant ($p < 0.0001$).

Conclusion: As a complementary sequence, FIESTA was as efficacious as the heavily T2-weighted sequence in the characterization of focal hepatic lesions. FIESTA provides better intra-abdominal delineation and overall image quality, without increasing image artifacts. Our results indicate that FIESTA may be substituted for the heavily T2-weighted sequence in standard MR protocols for hepatic imaging. Accurate characterization of hypervascular metastases remains a diagnostic pitfall for T2-weighted sequences, requiring correlation with dynamic-enhanced sequences.

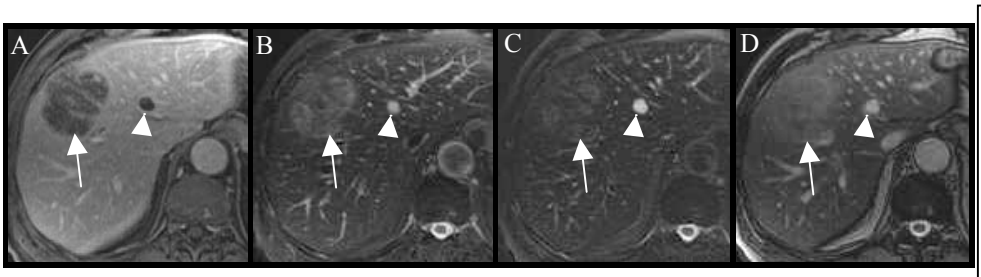

Figure 1. T1 axial-enhanced (A), moderate T2-weighted (B; TE 80), heavily T2-weighted (C; TE 160), and FIESTA (D) sequences demonstrate a large hepatic metastasis (arrows) and small cyst (arrowheads). Note that on both the heavily T2-weighted and FIESTA sequences, malignant lesions are similarly poorly defined and only mildly increased in signal compared to adjacent hepatic parenchyma, while benign lesions are well-defined and of relative increased signal intensity.

Figure 2. Outlier box plot show the distribution of lesion - liver contrast-to-noise ratio (CNR) for benign and malignant lesions. The line in the middle of the box represents the median; the plus sign represents the mean. Based on Wilcoxon rank-sum tests, the CNR values did differ significantly ($p < 0.0001$) with higher values for benign lesions.

Figure 2

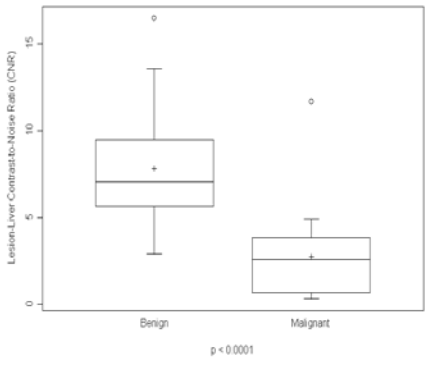

TABLE 1	Results of Quantitative Analysis of the FIESTA sequence			
Gold Std	Number	Mean(CNR)	Std Dev(CNR)	Median(CNR)
Benign	20	7.79	3.32	7.03
Malignant	20	2.71	2.62	2.54