# Opposed-phase MR Imaging with FIESTA or True FISP Sequence in the Upper Abdomen: Comparison with Opposed-phase GRE T1WI

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**Synopsis**

The purpose of this study is to investigate the usefulness of opposed-phase True FISP/FIESTA sequence in the detection and characterization of focal lesions containing fat in the upper abdomen. In-phase GRE $T_1$WI, opposed-phase GRE $T_1$WI, and True FISP/FIESTA opposed-phase images were performed in 54 patients with various upper abdominal lesions containing fat. Our results indicate that compared with opposed-phase spoiled GRE $T_1$WI, opposed-phase True FISP/FIESTA sequence can provide similar or more effective information in the detection and characterization of lesions containing fat in the upper abdomen.

**Introduction**

In-phase and opposed-phase MR imaging has played an important role in the detection and characterization of abdominal lesions containing fat [1-5]. In the majority of reports concerning chemical shift MR imaging, spoiled gradient-recalled echo (GRE) $T_1$-weighted imaging ($T_1$WI) sequences have been used [1-5]. However, to our knowledge, True fast imaging with steady-state precession (True FISP, Siemens) or FIESTA (GE) sequence has never been included in chemical shift MR imaging. In this study, we want to investigate the usefulness of True FISP or FIESTA opposed-phase sequence in the detection and characterization of focal lesion containing fat in the upper abdomen.

**Methods**

54 patients formed the clinical study population, and their diseases included focal fatty liver in 24 cases (28 lesions), hepatocellular carcinoma (HCC) with fat degeneration in 7 cases, adrenal adenoma in 9 cases, and angiomyolipoma in 14 cases (17 lesions). MR imaging was performed at a Twinspeed (GE) or Vision (Siemens) 1.5T MR scanner. The pulse sequences included HASTE $T_2$WI or FSE $T_2$WI, FLASH (or SPGR) $T_1$WI (in-phase [TE=4.2 ms] and opposed-phase [TE=2.1ms]), and True FISP opposed-phase (TE=2.3ms) or FIESTA opposed-phase (TE=1.9 ms). The changes of signal intensity of the lesions in different sequence were analyzed, and the contrast-noise ratio (CNR) between lesion and normal tissue was measured in each sequence.

**Results**

***1. Focal fatty liver:*** On in-phase FLASH/SPGR $T_1$WI, 13 lesions were mildly hyperintense, and 15 were isointense (Fig B). On opposed-phase FLASH/SPGR $T_1$WI, 21 lesions were mildly hypointense (Fig C), and 7 showed isointense. On opposed-phase True FISP/FIESTA images, 25 lesions showed mildly or moderately hypointense (Fig D), and 3 were isointense. The mean CNR of lesions on opposed-phase True FISP/FIESTA images was little higher than that in opposed-phase $T_1$WI (*P>0.05*). ***2. HCC with fat degeneration:*** All 7 lesions were mildly hyperintense on in-phase FLASH/SPGR $T_1$WI, isointense or mildly hypointense on opposed-phase FLASH/SPGR $T_1$WI, and however mildly or moderately hypointense on opposed-phase True FISP/FIESTA images. ***3. Adrenal adenoma:*** All 9 lesions were isointense or mildly hyperintense on in-phase FLASH/SPGR $T_1$WI. On opposed-phase FLASH/SPGR $T_1$WI, 3 lesions were mildly hypointense and 6 were isointense. On opposed-phase True FISP/FIESTA images, 6 lesions showed mildly or moderately hypointense, and 3 were isointense. ***4. Renal angiomyolipoma:*** 12 lesions were mildly or moderately hyperintense on in-phase FLASH/SPGR $T_1$WI, and 5 were isointense. On opposed-phase FLASH/SPGR $T_1$WI, 10 lesions were mildly hypointense, 4 were isointense, and 3 were mildly hyperintense. On opposed-phase True FISP/FIESTA images, all 17 lesions were mildly or moderately hypointense (Fig E). The mean CNR of lesions on opposed-phase True FISP/FIESTA images was significantly higher than that on opposed-phase $T_1$WI (*P<0.01*).

**Discussion and Conclusion**

Some lesions in the upper abdomen contain fat. The detection of fat within lesions is very important for the characterization of lesions, because most lesions containing fat are benign or well-differentiated malignant tumors. With a high sensitivity and specificity, chemical shift MR imaging using spoiled GRE $T_1$WI has been an indispensable tool for detecting fat within the lesions. Due to different precession phase between water and fat, the lesions containing fat show decreased signal intensity on opposed-phase $T_1$WI. In this study, opposed-phase images were obtained with a True FISP or FIESTA sequence in a reasonable short TE (2.3 ms in 1.5 Tesla). The lesions containing fat showed similar reduction of signal intensity on opposed-phase True FISP/FIESTA images as on opposed-phase FLASH/SPGR $T_1$WI. The mean CNR between renal angiomyolipoma and renal parenchyma was significantly higher on opposed-phase True FISP/FIESTA images than that on opposed-phase FLASH/SPGR $T_1$WI.

In Conclusion, our results indicate that compared with opposed-phase spoiled GRE $T_1$WI, opposed-phase True FISP or FIESTA images can provide similar or more effective information in detection and characterization of lesion containing fat in the upper abdomen. However, due to technique limitation in our MR scanner, in-phase True FISP or FIESTA images is not included in this study. Further evaluation of comparison including in-phase True FISP or FIESTA sequence is needed to confirm our conclusion.

**References**

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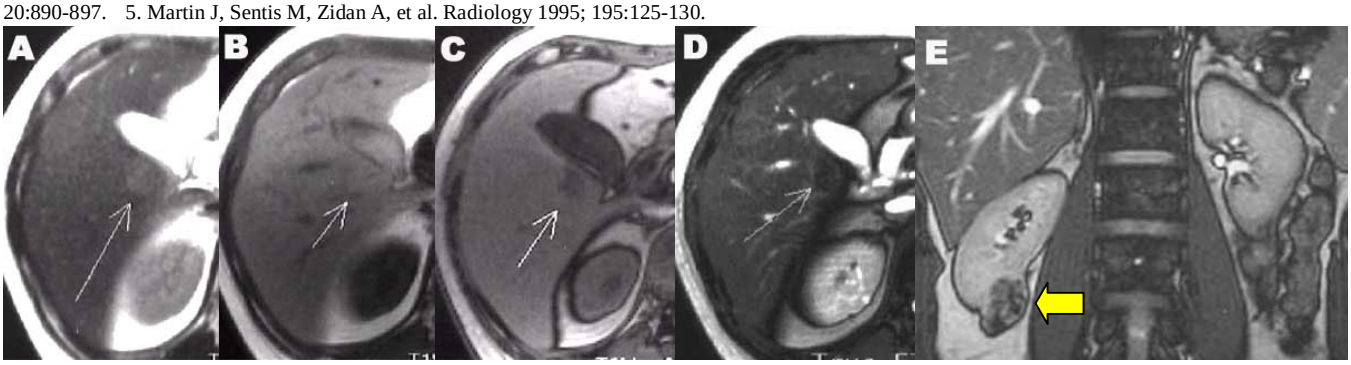


**Figure A-D.** A lesion of focal fatty liver (arrows) in 1 53-year-old woman. On HASTE $T_2$WI (A), the lesion is mildly hyperintense, which mimicks malignant lesion. The lesion was isointense on FLASH in-phase $T_1$WI (B). The lesion appears hypointense on both FLASH opposed-phase $T_1$WI and True FISP opposed-phase image.
**Figure E.** A angiomyolipoma of the right kidney in 43-year-old man. The lesion (yellow arrow) is heterogeneous hypointense on True FISP opposed-phase image (E).