Characterization of Focal Hepatic Lesion Containing Fat with Balance SSFP Chemical Shift Imaging Sequence

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Introduction

Detection of fat within focal hepatic lesions is an important for characterization of these lesions [1-4], and the differentiated diagnosis will be limited in relatively small region. Fat saturation technique, STIR sequence and SPGR T1-weighted chemical shift imaging have been used to detect fat in focal hepatic lesion. Balance SSFP (B-FFE, True FSIP or FIESTA) have been used in recent years. We have reported the application of balance SSFP opposed phase imaging in upper abdomen, however, in-phase imaging sequence was not available in our previous reports [4]. In this study, we want to investigate the usefulness of in-phase and opposed phase imaging with balance SSFP sequence in characterization of focal hepatic lesions containing fat in comparison with SPGR sequence.

Methods

37 cases with focal hepatic lesions formed the study population including 14 cases with focal lesion containing fat (hepatocellular carcinoma (HCC) with fat degeneration in 9 cases, liver angiomyolipoma in 3 cases, and hepatic adenoma in 2 cases) and 23 cases with focal malignant lesion without fat (HCC without fat in 11, and metastases in 12 cases). All hepatic lesions were proved histopathologically. Axial MR images were obtained at a 1.5 T MR scanner (GE, Twin Speed), and an 8-element phased array coil was used to receive MR signal. The pulse sequences included fat saturated FSE T2WI, SPGR T1WI (in-phase [TE=4.2 ms] and opposed-phase [TE=2.1ms]), and balance SSFP sequence (in-phase [TR/TE=6.3ms/4.2 ms] and opposed-phase [TR/TE=3.8/1.9 ms]). The changes of signal intensity of the lesions in different sequence were analyzed.

Results

HCC with fat degeneration: Mildly or moderately hyperintense region was found within all 9 HCCs containing fat on in-phase SPGR T_1WI (Fig A), which showed decreased signal on opposed SPGR T1WI (Fig B). Similar signal changes were showed on in-phase and opposed-phase balance SSFP images (Fig C). Compared with in-phase SPGR T1WI, mean "lesion to hepatic parenchyma signal intensity ratio" on opposed-phase SPGR T1WI decreased 35%, while 29% on opposed-phase balance SSFP images in comparison with in-phase SSFP images.

Hepatic angiomyolipoma: Hyperintense fat was detected in all 3 lesions on both SPGR in-phase T1WI (Fig D) and in-phase SSFP images (Fig E), which showed dark signal on both opposed SPGR T1WI (Fig F) and opposed-phase SSFP images (Fig G). Hyperintense vessels were found in 2 lesions on opposed-phase SSFP images (Fig G), however, which were not showed with SPGR chemical shift imaging.

Hepatic adenoma: Both 2 lesions showed hyperintense on in-phase SPGR T1WI and in-phase SSFP images, while dark signal on opposed SGPR T1WI and opposed SSFP images.

Hepatic malignant lesions without fat: All lesions showed mildly or moderately hypointense on both in-phase and opposed-phase SPGR T1WI, while isointense or mildly hyperintense on both in-phase and opposed-phase SSFP images. "Lesion to hepatic parenchyma signal intensity ratio" decreased or increased less than 5 % on opposed-phase SPGR T1WI or opposed SSFP images in comparison with in-phase SPGR T1WI or SSFP images.

Discussion and Conclusion

Some focal hepatic lesions contain fat. The detection of fat within lesions is very important for the characterization of lesions, because most lesions containing fat are well-differentiated HCC, hepatic adenoma and hepatic angiomyolipoma, while most moderate-defferentiated or poor-differentiated HCC and liver metastases hardly contain fat [1-3]. With a high sensitivity and specificity, chemical shift MR imaging using spoiled GRE T_1WI has been an indispensable tool for detecting small amount of fat within the lesions. Due to different precession phase between water and fat, the lesions containing fat show decreased signal intensity on opposed-phase T1WI.

In this study, in-phase and opposed-phase images were obtained with a balance SSFP. Focal hepatic lesions containing fat showed similar reduction of signal intensity on opposed-phase SSFP images as on opposed-phase SPGR T1WI, and had similar changes of "lesion to hepatic parenchyma signal intensity ratio" on both opposed-phase sequences in comparison with both in-phase sequence. Vessels within 2 hepatic angiomyolipomas were detected with opposed-phase SSFP sequence, while not with SPGR chemical shift imaging sequence.

In Conclusion, our results indicate that compared with SPGR chemical shift imaging sequence, balance SSFP images can provide similar or more effective information in detection and characterization of focal hepatic lesion containing fat. However, due to our small study population, further evaluation is needed to confirm our conclusion.

References

1. Soyer P, Rondeau Y, Dufresne A, et al. Eur Radiol 1997; 7:1048.
2. Burdeny DA, Semelka RC, Kelekis NL, et al. Magn Reson Imaging 1997; 15:141.
3. Martin J, Sentis M, Zidan A, et al. Radiology 1995; 195:125.
4. Yang ZH, Sun F, Chen M, et al. ISMRM 2004 proceeding.

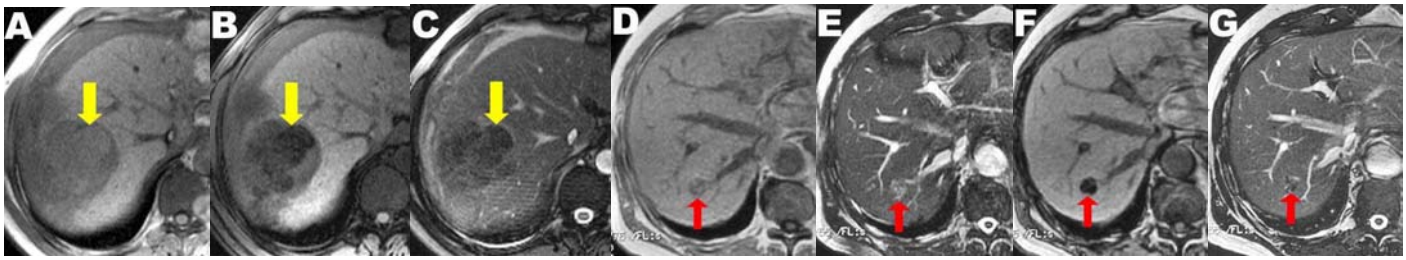

Figure A-C. A ruptured HCC with fat degeneration in a 57 year-old man. Mildly hyperintense region (yellow arrow) in the lesion was found on in-phase SPGR T1WI (Fig A), which became dark (yellow arrow) on both opposed-phase SPGR T1WI (Fig B) and opposed-phase balance SSFP image (Fig C).

Figure D-G. A hepatic angiomyolipomas (red arrow) in a 43 year-old woman. The lesion showed mildly hyperintense on in-phase SPGR T1WI (Fig D) and moderately hyperintense on in-phase balance SSFP image (Fig E), which became dark on both opposed-phase SPGR T1WI (Fig F) and opposed-phase balance SSFP image (Fig G). vessels in the lesion maintained hyperintense on opposed-phase balance SSFP image (Fig G), which was not showed on both in-phase and opposed-phase SPGR T1WI.