Detection of hepatocellular carcinoma: Comparison of in-phase and out-of-phase gradient recalled echo dynamic MR imaging using double-echo FLASH sequence during the hepatic arterial phase

Tomohiro NAMIMOTO1, Yasuyuki YAMASHITA2, Akihiko Arakawa3, Naoko Tsunoda1, Kazuhiro Yoshizumi1, Yukinori Koga1, Mutsumasa TAKAHASHI1

1Kumamoto national hospital, 2-5, Ninomaru, Kumamoto, Kumamoto Japan; 2Kumamoto University, school of medicine, 3Kumamoto university, 1-1-1, Honjyo, Kumamoto, Kumamoto Japan; 4Kumamoto Univ. School of Medicine, Department of Radiology, Kumamoto, Japan;

Introduction
MR imaging with T1-weighted gradient recalled echo (GRE) pulse sequences during the hepatic arterial phase of contrast enhancement techniques provides better liver lesion detection and characterization particularly for detection of hypervascular liver neoplasms. However, the shortest TE available on GRE pulse sequence is occasionally at the opposed-phase TE, at which images can be limited by poor liver signal-to-noise ratio (SNR) in patients with fatty infiltration of the liver. Furthermore, the signal intensity of some fatty masses may actually decrease on opposed-phase MR images after administration of gadolinium chelates. The purpose of this study was to compare the performance of in-phase and out-of-phase images with double-echo chemical shift fast low-angle shot (FLASH) on paramagnetic contrast-enhanced MR imaging of hepatocellular carcinoma (HCC) during the hepatic arterial phase.

Methods
Thirty-four patients (30 men 4 women, mean age 67.2 years) with known or suspected 86 HCCs, nine of whom had a fatty liver, were examined at 1.5 T imager (Magnetom Vision, Siemens) before and 30 sec after injection of gadopentenate dimeglumine at a dose of 0.1 mmol/kg. Double-echo FLASH MR imaging was performed with TR of 119 msec, double TEs of 2.4 msec (opposed-phase) and 5.0 msec (in-phase) and flip angle of 70°. Three radiologists prospectively evaluated in-phase images, and opposed-phase images for lesion detection during the hepatic arterial phase. SNR, lesion-liver contrast-to-noise ratio (CNR), and enhancement ratio (ER) [ER = (SI lesion - SI pre-lesion) / SI pre-lesion] were calculated for largest lesion of each patients.

Results
In dynamic gadolinium-enhanced images of 86 HCCs evaluated at prospective review, 81 (96.4%) were detected on both in- and opposed-phase images, 2 (2.4 %)were detected on only in-phase images, and 1 (1.2%) were detected on only opposed-phase images. Liver SNR, CNR, ER were 46.7±16.1, 15.2±10.3, 0.637±0.268 on in-phase images, and 48.9±16.9, 16.3±11.8, 0.647±0.309 on opposed-phase images, respectively. There were no significant statistical differences between in-phase and opposed-phase. In patients with a fatty liver, SNR, CNR, ER were 46.0±18.1, 21.7±17.9, 0.525±0.231 on in-phase images, and 44.3±18.7, 26.0±21.3, 0.793±0.124 on opposed-phase images, respectively. In patients with a fatty liver, CNR, ER were increased on opposed-phase, however the difference between in-phase and opposed-phase was not statistically significant.

Discussion
MR imaging techniques during the hepatic arterial phase of contrast enhancement techniques provide better liver lesion detection and characterization than is provided with portal venous phase and equilibrium phase contrast-enhanced imaging particularly for detection of hypervascular liver neoplasms such as HCCs. However, the shortest TE available on GRE pulse sequence is at the opposed-phase TE. SI in fatty liver is diminished on opposed-phase GRE images, resulting in relatively poorer lesion-liver contrast. Because HCCs are usually hyperintense during the hepatic arterial phase, opposed-phase GRE imaging showed relatively better lesion-liver contrast in our study. Use of the in-phase technique avoids the potential of paradoxical decrease in SI of masses with partial lipid content on paramagnetic chelate enhanced T1-weighted MR images. In our study, however only one lesion could not detect on opposed-phase image because of paradoxical decrease. However, for detection of small amounts of lipid, such as fatty well differentiated HCC, opposed-phase images are generally preferred over in-phase images.

In conclusion, this study shows that opposed-phase GRE imaging is equivalent to in-phase GRE sequences in patients with or without fatty liver for detection of HCC. Chemical shift GRE MR imaging can be used to detect fatty metamorphosis in HCC.

References