Abstract: With improvements in pulse sequence design and gradient amplifiers complete breath-hold MR imaging of the liver is possible enabling rapid evaluation, which is relatively free of motion artifacts. The combination of Single Shot Fast Spin-Echo (SSFSE) and Fast Multiplanar Spoiled Gradient-Echo (FMSPGR) sequences provide both breath-hold T2- and T1-weighted non-contrast images, as well as multiphase dynamic T1-weighted post-contrast information. There is, however, little data characterizing the appearance of focal liver lesions using the SSFSE sequence. The purpose of this study is to characterize the appearance of focal liver lesions on T2-weighted SSFSE sequences using dynamic post-contrast sequence information and biopsy results.

Introduction: SSFSE is a half-fourier fast spin-echo pulse sequence, which utilizes a single excitation pulse to collect all imaging data with a long echo train of multiple refocusing pulses. In abdominal imaging SSFSE permits breath-hold T2-weighted acquisitions, which minimize motion and susceptibility artifacts while maintaining sensitivity for identifying focal liver lesions compared to other T2-weighted sequences (1). The qualitative contrast relationship of focal liver lesions to surrounding tissues on SSFSE imaging, however, have not been extensively evaluated or corroborated. The purpose of this study is to characterize the signal relationships of focal liver lesions imaged with SSFSE T2-weighted sequences.

Methods: 75 patients were imaged on a 1.5 Tesla magnet (General Electric, Milwaukee, WI) utilizing 23-40 mT/m gradient amplifiers and the body transmit and receiver coil. Coronal and axial 7mm skip 2.5mm T2-weighted SSFSE sequences were obtained through the liver during suspended respiration (TR=23,900-41,254, TE=93-6.973, Receiver Bandwidth=62.5 kHz, Matrix=512x192, NEX=0.5). A dynamic contrast exam was obtained in each patient using a series of six axial 8mm skip 1.5mm T1-weighted breath-hold FMSPGR (TR=150mS, TE=19mS, Matrix=256x160, NEX=1, Receiver Bandwidth=62.5 kHz) utilizing spectral fat pre-saturation. Following a baseline non-contrast FMSPGR sequence, Gadodiamide (Omniscan) (Nycomed-Amersham, Bucks, UK) was injected intravenously with a Medrad power injector (Medrad, Indianola, PA) at 2 cc's per second for a total dose of 0.1mmol per Kg of body weight. Five post-contrast FMSPGR sequences were obtained up to 5 minutes post injection with the first three sequences obtained in subcutaneous fat, and liver signal intensity using body coil images which pattern were correlated with biopsy results.

Results: The 75 patients aging from 32 to 78 years of age yielded 172 focal liver lesions. 36 patients had a total of 54 focal liver lesions characterized by the cavernous hemangioma enhancement pattern. In all but one of these patients the lesions were homogeneous in signal intensity and iso-intense with fat. One patient with a 6 cm hemangioma demonstrated central hyperintensity which was increased relative to fat. There were five patients with pathology confirmed as focal nodular hyperplasia. Three of these patients had a solitary lesion with signal intensity slightly more intense than liver on the T2-weighted SSFSE sequence with a central scar, which was slightly hypointense relative to fat. Two of these patients had signal intensity slightly less than that of the liver, but with the central scar, which, was slightly less signal intensity compared to fat. One patient with cirrhosis had a regenerating nodule confirmed pathologically which demonstrated signal intensity between liver and fat. Eight patients having a total of 35 homogenous lesions iso-intense with CSF and 5 lesions, which were slightly hypointense to CSF demonstrated no contrast enhancement at five minutes and thus were defined as hepatic cysts. There were 19 patients with 19 lesions pathologically confirmed at hepatocellular carcinoma. These lesions had inhomogeneous T2 signal varying from slightly hyperintense relative to liver to slightly hypointense relative to fat. There were seven patients with 47 lesions confirmed to be metastatic disease. These lesions demonstrated signal intensity between liver and fat on the T2 SSFSE images although 8 lesions from demonstrated central hyperintensity iso-intense to slightly hyper intense relative to fat but, less intense than CSF. The remaining two patients had pathologically confirmed lymphoma and cholangiocarcinomas respectively. Both these lesions had T2 SSFSE signal intensity between liver and fat with scattered foci with signal intensity similar or slightly less than fat.

Discussion: Our results indicate that in contradistinction to a prior study reporting the signal characteristic of focal liver lesions using a similar T2-weighted half-fourier single shot pulse sequence or HASTE imaging (2) hemangiomas were consistently less hypointense compared to CSF as opposed to hepatic cysts which were similar in signal intensity to CSF or slightly hypointense presumably due to increase protein content. Hemangiomas were similar in signal intensity to surrounding subcutaneous fat, which was consistently higher signal intensity compared to the bulk of other solid liver lesions benign or malignant. Our results demonstrate that other than hemangiomas and hepatic cysts there were no homogenous masses lesions iso-intense or hyperintense relative to subcutaneous fat. In our study group. There were however, carcinomas and metastatic disease, which demonstrated inhomogeneous signal intensity with focal areas containing signal intensity which could be slightly greater intensity compared to fat but, less than that of CSF.

Conclusion: The SSFSE pulse sequence is a robust sequence for evaluation of focal liver lesions. SSFSE significantly reduces the time to acquire T2-weighted information regarding the liver. An entire series of images of the liver can be obtained in a single breath-hold with reduced motion artifacts relative to other fast spin-echo sequences. The results of our study indicate that cavernous hemangiomas are characterized by predominant homogeneous hyperintensity iso-intense with fat. This is in contradistinction to the signal intensity of cavernous hemangiomas on spin-echo, fast spin-echo and HASTE sequences which characterized cavernous hemangiomas as having hyperintensity similar to that of CSF. Only hepatic cysts were found to have homogeneous hyperintensity similar or slightly less than that of CSF in our series. Malignant and other benign solid lesions were characterized by signal intensity, which was predominantly less than fat with occasional focal areas, which were could be slightly hypointense compared to fat.

References