# In Vivo Proton MR Spectroscopic Evaluation of Hepatocellular Carcinoma, Metastasis and Hemangioma in the Liver

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**Abstract**

The purpose of this study was to evaluate the in vivo proton ($^1$H) magnetic resonance (MR) spectroscopic features and relative metabolite-to-lipid ratios of phosphomonoester (PME) of hepatic tumor. Thirty-eight patients with liver masses (25 HCCs, 5 metastasis and 8 hemangiomas) were examined with $^1$H MR spectroscopy. Each liver mass was calculated relative metabolite-to-lipid ratios of PME. The calculated mean value relative metabolite-to-lipid ratios were lower in the hemangioma group than in the hepatocellular carcinoma (HCC) and metastasis group ($p<0.05$). In vivo $^1$H MR spectroscopy is able to assess human hepatic tumor.

**Introduction**

MR spectroscopy in vivo has expanded rapidly in recent years finding increasing use in clinical research. Recent reports had analyzed in vivo $^{31}$P MR spectra of human hepatic tumor, showing increased PME signals[1-3]. Cho et al[4] demonstrated that calculated mean value relative metabolite-to-lipid ratios of PME, glutamine and glutamate complex, glycogen and glucose complex in liver, various chronic liver diseases: in vivo $^1$H MR spectroscopic evaluation of the liver. To our knowledge, no studies in vivo $^1$H MR spectroscopic findings for hepatic tumors have been performed to date. The purpose of this study was to evaluate the in vivo $^1$H MR spectroscopic features and relative metabolite-to-lipid ratios of PME of HCC, metastasis and hemangioma.

**Material and Methods**

Thirty-eight patients with liver masses (22 male and female, age range 49-88 years, mean 69 years) were examined with $^1$H MR spectroscopy. These masses were HCCs (n=25), metastases (n=5) and hemangiomas (n=8); all liver masses were diagnosed by radiological features, including abdominal ultrasonographic, computed tomographic (CT) and MR imagings. $^1$H MR spectroscopy was performed with each liver masses. $^1$H MR spectra were obtained a 1.5T super conducting system (Magnetom Symphony; Siemens, Erlangen, Germany). For acquired $^1$H MR spectra, the sequence (TR 1500ms, TE 135ms, 90$^o$ flip angle, voxel size 1X1X1 cm$^3$) was used, and the voxel was positioned maximum tumor diameter (4X4, 16 voxels). $^1$H MR spectroscopy was performed without respiratory interruption, $^1$H MR spectra was acquired approximately five minutes. The peak areas of PME and lipid were measured on the liver mass spectra. Each liver mass was calculated relative metabolite-to-lipid ratio of PME. Indirect evaluation parameters, radiological features, including CT and MR imaging findings which diagnosed and measured size of each masses; and biochemical serum markers (α-fetoprotein: AFP, protein induced by Vitamin K absence or antagonist: PIVKA-II, carcinoembryonic antigen: CEA), were being used to assess relative metabolite-to-lipid ratio of PME. Data analysis was performed using a student t-test with $p<0.05$.

**Results**

$^1$H MR spectroscopy depicted PME and lipid all liver masses. The calculated mean value relative metabolite-to-lipid ratios of HCC, hemangioma and metastasis were 1.61±1.99, 0.32±0.16, and 2.89±2.12. The relative metabolite-to-lipid ratios were lower in the hemangioma group than in the HCC and metastasis group ($p<0.05$) (Fig. 1). Comparison of biochemical serum markers and relative metabolite-to-lipid ratios indicated no significant difference, demonstrating the absence of effect of biochemical serum markers. No statistically significant differences were found between tumor size and relative metabolite-to-lipid ratio (Fig. 2).

**Discussion**

The use of MR spectroscopy in the abdominal organs has lagged behind that in the central nervous system because of motion artifact such as respiratory movement. However, in this study, $^1$H MR spectra were successfully obtained from the human hepatic tumors. The result of this study showed that the relative metabolite-to-lipid ratios were lower in the hemangioma group than in the HCC and metastasis group. Thus, the result of this study suggested that the relative metabolite-to-lipid ratios were difference between malignant liver masses and benign liver masses. Relative metabolite-to-lipid ratios demonstrated the absence of effect of biochemical serum markers and tumor size, and the ratios could be useful independent parameters for characterizing the human hepatic tumor.

**Conclusion**

In vivo $^1$H MR spectroscopy is able to assess human hepatic tumor. This method can be extended to study hepatic tumor metabolism, and relative metabolite-to-lipid ratios could be valuable parameters for characterizing the human hepatic tumor.

**References**

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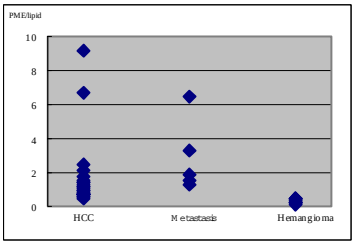
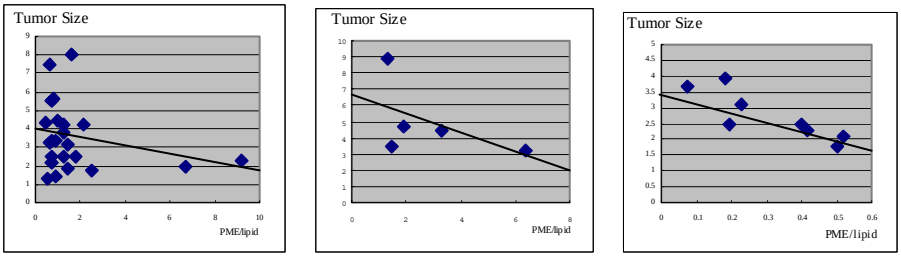



Figure 1 Metabolite-to-lipid ratio Difference between liver masses




HCC Metastasis Hemangioma

Figure 2 Correlation between metabolite-to-lipid ratio and tumor size