Hemodynamics changes of Liver Cirrhosis measured by Dynamic Contrast Enhanced MRI using Compartment Modeling analysis

H. Kubo[1], M. Harada[2], M. Ishikawa[3], H. Nishitani[4]

[1]Radiologic Technology, University of Tokushima, Tokushima, Japan, [2]Radiologic Technology, University of Tokushima, Tokushima, Tokushima, Japan, [3]Bioenergetics Research Office, Otsuka Pharmaceutical Co., Ltd. Tokushima Research Institute, Tokushima, Tokushima, Japan, [4]Radiology, University of Tokushima, Tokushima, Tokushima, Japan

Synopsis

To evaluate hemodynamic changes of liver cirrhosis in the rat, dynamic contrast enhanced MRI was used and compartment modeling analysis was applied for quantitative evaluation. As a result, the increase of K_1 and decrease of k_2 were shown in liver cirrhosis suggesting the increase of permeability from vessels and the decrease of washout. This may reflect congestion and fibrosis in cirrhotic liver.

Introduction

To the best of our knowledge, a little paper has been reported to evaluating hemodynamics of liver parenchyma on MRI. The purpose of this study was to evaluate hemodynamic changes of liver cirrhosis using dynamic contrast enhanced MRI by applies to compartment modeling analysis as preliminary study.

Materials and Methods

Animals used in this study were mail Wistar rat (7-8 weeks old). Thioacetamide (TAA) and carbon tetra chloride (CCl4) were treated to induce cirrhosis. TAA (200mg/kg body weight) was injected intraperitoneally 3times per week for 7□8 weeks for four rats. 2.0 ml/kg of 25%(V/V) carbon tetra chloride (CCl4) -olive oil solution was administrated orally 2 times per week for 7□8 weeks for three rats. Four nontreatment rats were used as normal control. MR imaging was performed in all rats within 1 week after the end of TAA or CCl4 administration. The animal was anesthetized with 50mg/kg Nembutal, then a 25-gauge butterfly needle wad inserted into the tail vein for contrast agent injection. For contrast agent, Gd-DTPA was selected and administrated as bolus injection with 0.2mmol/kg. All studies were performed with a 1.5T clinical scanner (Signa Horizon) and a 3 inches surface coil. Dynamic contrast enhanced MRI was obtained by the use of Spin echo (TR=120ms., TE=18ms.) sequence with 3mm slice thickness setting one slice per animals (fig.1). Other acquisition parameters were as follows: FOV=12cm; matrix 256*128; 0.75NEX and acquisition time 15 second per phase. 70 phases were taken for observation Gd-DTPA kinetics every about eighteen seconds. Region of interest (ROI) was localized at liver, abdominal aorta and muscle at each subject. Pharmacokinetics of Gd-DTPA was shown in fig.2. For quantitative analysis, two compartment model analysis was adopted in this study (fig.3). Analyses were done by Microsoft Excel using self-made worksheets.

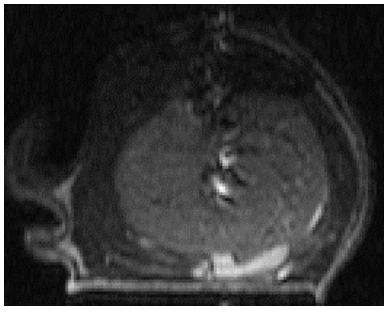

Fig. 1 Dynamic image using Gd-DTPA in control rat model.

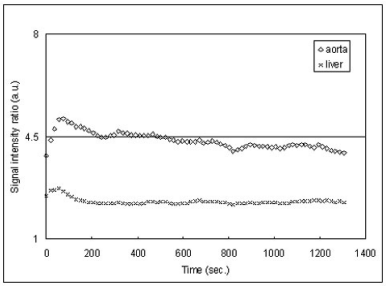

Fig. 2 Pharmacokinetics of Gd-DTPA in CCl4 induced cirrhosis rat model.

Results and Discussions

Fig. 3 showed the result of K_1 and k_2 in each model. In contradistinction to control rats, increase of K_1 and decrease of k_2 were shown in the model rats of liver cirrhosis. This result suggested the increase of permeability from vessels to the liver and the decrease of washout from the liver. This pathological changes may reflect congestion and fibrosis in cirrhotic liver.

Conclusions

Our result suggested that compartment modeling analysis may be useful to evaluate hemodynamic changes in liver cirrhosis.

References

1. Ilmuro Y. Gastroenterology. 2003; 124: 445-458

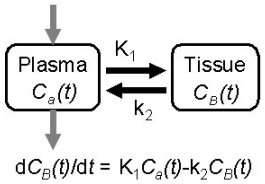

Fig. 3 Two compartment model for this study.

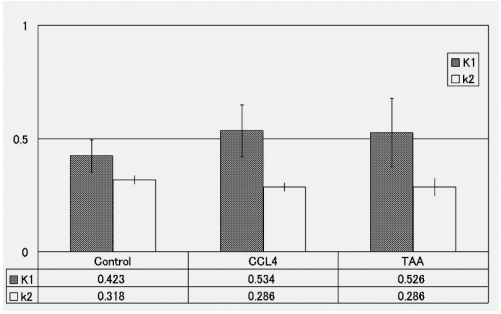

Fig. 4 Comparison of K_1 and k_2 among rat models.