



NONINVASIVE MONITORING OF CCl₄ INDUCED ACUTE AND CHRONIC LIVER DAMAGE IN RAT BY SINGLE QUANTUM AND TRIPLE QUANTUM FILTERED ²³Na MAGNETIC RESONANCE IMAGING

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Abstract:

In present study, single quantum (SQ) and triple quantum filtered (TQF) ²³Na magnetic resonance imaging (MRI) was used to monitor the severity and progression of CCl₄ induced acute and chronic liver damage in rat model. SQ ²³Na MRI was

proposed to measure the ^{23}Na signal intensity (SI) of total tissue sodium ions, and TQF ^{23}Na MRI was proposed to measure the SI of intracellular sodium ions. In addition, shift reagent aided ^{23}Na and ^{31}P magnetic resonance spectroscopy (MRS) was used to measure in vivo intracellular sodium concentration ($[\text{Na}+i]$), total tissue sodium concentration ($[\text{Na}+t]$) and relative extracellular space (rECS) of liver in the same model. In acute high dose CCl_4 intoxication, 24 hours after single dose of CCl_4 in 5ml per kg body weight of mixture of CCl_4 and oil in 1:1 ratio, SQ ^{23}Na SI increased by 83% and TQF ^{23}Na SI increased by 174% compared to the baseline level. According to SR-aided ^{23}Na and ^{31}P MRS, $[\text{Na}+i]$ increased by 188% and $[\text{Na}+t]$ increased by 43%. In addition, there was significant decrease in cellular energetic level, represented by ATP/Pi ratio. Histology examination showed pronounced inflammatory response in centrilobular regions, with neutrophils infiltration, fatty accumulation and swollen hepatocytes. In chronic 8-week experiment, chronic damage was induced by biweekly administration of CCl_4 in a dosage of 0.5 ml per kg body weight. From week 1 to week 6, SQ ^{23}Na SI remained relatively constant, and then increased by 15% from week 6 to week 8. TQF ^{23}Na SI progressively increased from week 1 to week 8, totally by 56%. Both SQ and TQF ^{23}Na SI showed significant difference between treated group and control at every week. SR-aided ^{23}Na and ^{31}P MRS experiment showed that, at the end of 8-week CCl_4 intoxication, both $[\text{Na}+t]$ and rECS were higher than control, by 49% and 47% respectively; however, there was no significant difference for $[\text{Na}+i]$ between two groups. Histology examination showed excessive deposition of extracellular matrix. In conclusion, SQ and TQF ^{23}Na MRI appears valuable in the functional assessment of liver in noninvasive approach, and could be a promising diagnostic modality for liver diseases in clinical area.

Description:

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