

## Liver function assessment using magnetic resonance imaging with gadoxetic acid administration

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### Background and Aims:

We have previously developed multiparametric magnetic resonance imaging (MRI) to assess liver fibrosis, inflammation and steatosis. However, there is no current gold standard method to assess liver function. In this study we use MRI with the contrast agent gadoxetic acid (Primovist, Gd-EOB-DTPA), which has hepatocyte-specific uptake and lowers the  $T_1$  relaxation time. The percentage reduction in liver  $T_1$  with gadoxetic acid ( $\%rT_1$ ) therefore may be a marker of liver function, with a lower value representing poorer function. Gadoxetic acid is used routinely for liver lesion evaluation. This study aims to assess the ability of MRI with gadoxetic acid to quantify liver function in comparison with standard blood parameters.

### Method:

In this prospective observational study, liver biochemical dysfunction was defined as either a bilirubin  $>21$   $\mu\text{mol/l}$  and/or an international normalised ratio  $\geq 1.2$ . Twenty-one healthy controls, 5 patients with acute liver injury and 84 patients with cirrhosis were recruited. The acute liver injury patients had liver biochemical dysfunction with no evidence or risk factors for chronic liver disease or biliary obstruction. Participants were excluded if they had contraindications to MRI or gadoxetic acid, portal vein thrombosis, transjugular intrahepatic porto-systemic shunt or primary/secondary liver cancer. All participants were assessed following a  $>4$  hours fast with liver MRI  $T_1$ -mapping pre and 20 minutes post 0.025 mmol/kg gadoxetic acid and blood tests.  $T_1$  maps were analysed by region of interest and the  $\%rT_1$  calculated as  $100 \times (T_1\text{baseline} - T_1\text{post contrast}) / T_1\text{baseline}$ .

### Results:

Of the cirrhotic patients, 44 (52%) had liver biochemical dysfunction.  $\%rT_1$  was lower in cirrhotic patients with liver biochemical dysfunction than without (48 vs 58%,  $p < 0.001$ ). Patients with acute liver injury and patients with cirrhosis and liver biochemical dysfunction had lower  $\%rT_1$  than healthy controls (39% and 48% vs 64%, respectively, both  $p < 0.001$ ). There were no significant differences between patients with compensated cirrhosis and healthy controls (58 vs 64%,  $p = 0.11$ ) or patients with liver biochemical dysfunction with and without cirrhosis (48 vs 39%,  $p = 0.15$ ).

The  $\%rT_1$  correlated ( $p < 0.001$  for all) with bilirubin ( $r = -0.58$ ), prothrombin time ( $r = -0.33$ ), albumin ( $r = 0.46$ ), Child Pugh ( $r = -0.51$ ) and MELD ( $r = -0.55$ ). The  $\%rT_1$  identified liver biochemical dysfunction with area under the receiver operator curve of 0.85 (0.77 - 0.92 95% CI). A diagnostic cut off of 55% had 0.82 sensitivity and 0.77 specificity.

### Conclusion:

The percentage reduction in liver  $T_1$  with gadoxetic acid is a promising marker of liver function that is unaffected by the degree of liver fibrosis and measures liver function in an alternative way to standard blood tests. Follow up studies should assess the use of  $\%rT_1$  alone, or in combination with blood parameters as a prognostic tool.