

# T1ρ relaxation of the liver; a new biochemical marker of liver function in patients with diffuse liver disease

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**Target Audience:** Researchers and clinicians interested in body/liver imaging and disease

## Introduction

T1ρ mapping is one of the quantitative imaging techniques to assess biochemical properties of tissues, such as brain, articular cartilage and liver [1-3]. It has been reported that T1ρ values of the liver parenchyma is prolonged relating to the severity of liver damage using animal models [3,4]. However, it is unclear for radiologists or hepatologists whether T1ρ mapping of the liver is feasible in clinical practice. In this study, we investigated the clinical utility of T1ρ mapping for the assessment of liver function in patients with metastatic liver tumor or chronic liver diseases (CLD), such as chronic viral hepatitis, alcoholic liver damage, and nonalcoholic steatosis hepatitis.

## Materials and Methods

Fifty-three patients with metastatic liver tumor or CLD (mean = 65.2 years, age range = 35- 86 years, M:F = 35:18) were scanned on a 3 Tesla MR system (Achieva TX, 3.0T, Philips Healthcare, Best, The Netherlands) using an 32-channel torso-cardiac phased-array coil. 2D-axial T1ρ mapping was calculated from T1ρ-prepared images using the fast field echo technique. The imaging parameters were as follows: TR/TE = 4.7/2.4 ms, FOV = 360 x 360 mm, matrix = 256 x 256, slice thickness = 3 mm, time of spin lock (TSL) = 1/20/40/60 ms, spin-lock pulse frequency = 500 Hz, number of slices = 3. T1ρ map was generated on a pixel-by-pixel basis using mono-exponential decay model:  $S_{TSL} = S_0 \cdot \exp(-TSL/T1\rho)$ , where  $S_{TSL}$  is the signal intensity in T1ρ-prepared images with a certain TSL, and  $S_0$  is that with TSL = 0. T1ρ values of the liver parenchyma were calculated after regions of interest (ROIs) were drawn on maps by one radiologist. Patients' blood serum parameters, such as serum total protein level (TP), serum albumin levels (Alb), serum total bilirubin level (TB), serum direct bilirubin level (DB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), γ-glutamyl transpeptidase (γGTP) and prothrombin activity (PT% and PT-INR), were recorded not more than 1 week before or after MR imaging. The indocyanine green clearance tests (ICGs) were also performed using 0.5 mg/kg body weight Diagnogreen (Daiichi Pharmaceutical Co., Tokyo, Japan). Blood samples were collected before and 15 min after administration and retention rates at 15 min after injection (ICG-R15s) were measured (normal range, <15%). Pearson's correlation coefficients ( $r$  = simple correlation) were calculated between T1ρ value of the liver parenchyma and the blood serum parameters, including ICG-R15s. A  $p < 0.05$  was considered significant.

## Results

Table 1 shows the results of Pearson's correlation coefficients between T1ρ value of the liver parenchyma and the blood serum parameters. T1ρ value showed significant positive correlations with TB, DB and ICG-R15, and significant negative correlations with Alb and γGTP. T1ρ values of the liver parenchyma were prolonged relating to the increase of ICG-R15 which indicates a worsening of liver function (Fig. 1).

## Discussion and Conclusion

The present study showed that T1ρ values of liver parenchyma are significantly correlated with the blood serum parameters reflecting liver function. T1ρ mapping is sensitive to changes in macromolecular concentration, suggesting it may serve as a biomarker for biologic processes associated with alterations in macromolecular content [5]. In CLD, the change of T1ρ value of the liver parenchyma may be related to cholestasis, cellular injury, and inflammation in the liver [5]. T1ρ mapping has a possibility as a new biochemical marker for the assessment of liver function in patients with CLD.

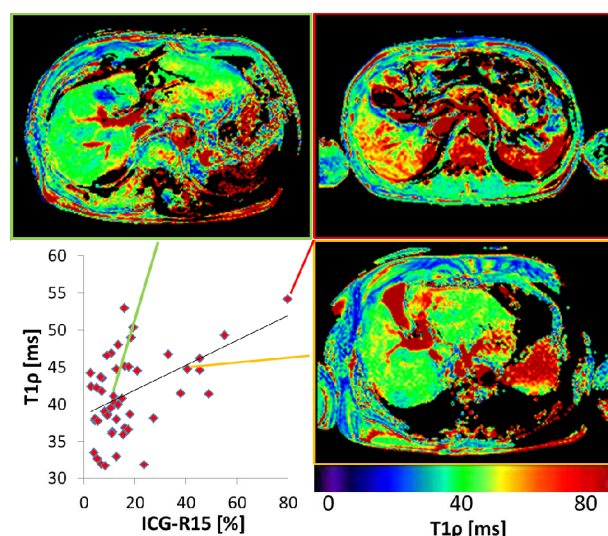
## References

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**Table 1. Results of Pearson's Correlation Coefficient between T1ρ value of the liver parenchyma and blood serum parameters**

TP	-0.099	ALT	-0.035	Glu	-0.154
Alb	-0.394**	ALP	0.144	PT-INR	0.163
TB	0.376**	γGTP	-0.290*	Plt	-0.009
DB	0.442**	Tcho	-0.070	ICG-R15	0.444**
AST	0.262	TG	-0.121		

\*\*  $p < 0.01$ , \*  $p < 0.05$



**Figure 1. Example T1ρ maps of the liver and the scatter graph.** T1ρ values of the liver parenchyma shows significant positive correlation with ICG-R15 (lower right). On T1ρ maps, T1ρ values of the liver parenchyma were prolonged with increasing ICG-R15 which indicates a worsening of liver function.