

# The Importance of consistent RF Spoiling for MRI based Liver Iron Content Determination with Signal Intensity Ratios – preliminary data

Arthur Peter Wunderlich<sup>1</sup>, Volker Rasche<sup>2,3</sup>, Holger Cario<sup>4</sup>, Markus Juchems<sup>1</sup>, and Meinrad Beer<sup>1</sup>

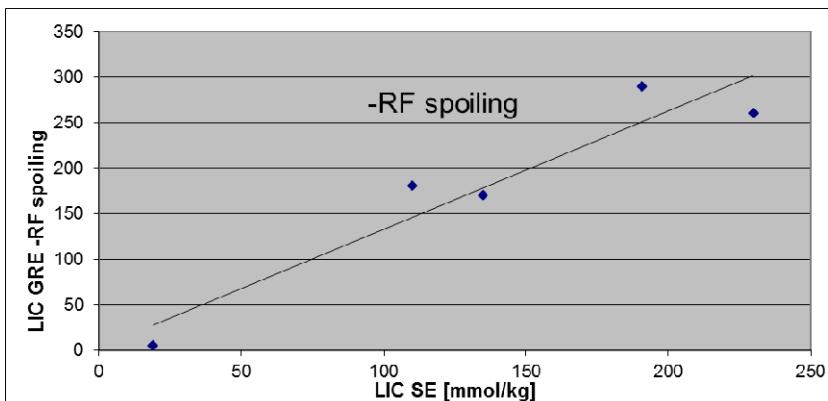
<sup>1</sup>Dept. for Diagnostic and Interventional Radiology, Univ.-Clinic Ulm, Ulm, Germany, <sup>2</sup>Experimental Cardiovascular Imaging, Univ.-Clinic Ulm, Ulm, Germany,

<sup>3</sup>Internal Medicine II, Univ.-Clinic Ulm, Ulm, Germany, <sup>4</sup>Pediatry, Univ.-Clinic Ulm, Ulm, Germany

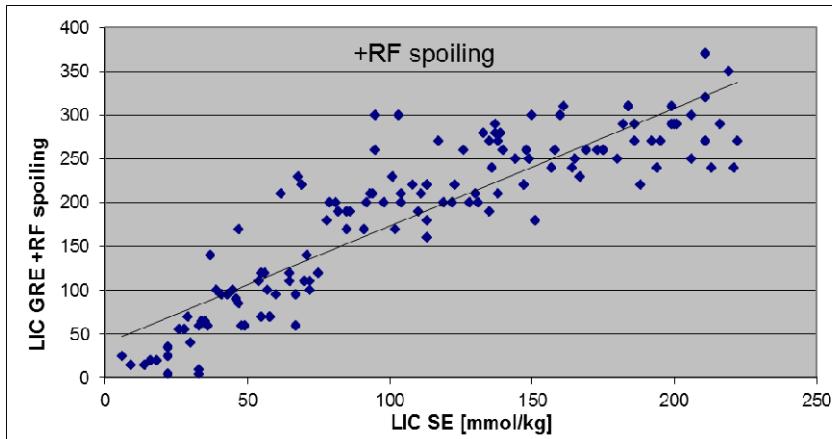
**Target Audience.** Clinicians and scientists interested in MRI based liver iron content (LIC) determination using simple data analysis.

**Purpose.** To compare Liver Iron Content (LIC) determined with the method published in [1] for GRE with and without RF spoiling.

**Methods.** 5 patients (age 12 ... 35 years, mean age 21.5 y) suspected for liver iron overload were examined by MRI to evaluate the amount of LIC. All examinations were performed at 1.5 T. Gradient echo sequences were acquired according to the protocol published by Gandon et al [1] without RF spoiling. Furthermore, examinations with spin echo (SE) were performed with a protocol proposed by St. Pierre et al. [2] and commercially analyzed (Ferriscan ®), cf. [3] and references cited there, named LIC SE in the following. For analysis of GRE data, signal values are measured in manually drawn circular regions of interest (ROIs) in vessel-free parts of the liver and in the paraspinal muscles. These values were typed in the web form provided by Gandon (<http://www.radio.univ-rennes1.fr/Sources/EN/HemoCalc15.html>) to get the LIC value, referred to LIC GRE below. This calculation is based on the ratio of liver signal and muscle reference value. Linear correlation was determined between LIC determined with both methods. The correlation line was evaluated as well as  $R^2$ . For comparison of this result, a subgroup of 136 patients scanned before with RF spoiling was analyzed accordingly. These patients were selected from the cohort published in [3] with a LIC SE not to exceed 230 mmol/kg.



**Fig. 1.** Liver iron content in mmol/kg liver dry tissue determined with Gandon's method [1] using GRE sequences without RF spoiling vs. LIC determined with SE. The solid line indicates the linear regression between both methods.



**Fig. 2.** As above, but with RF spoiling. Note the deviation from identity in the range of LIC SE below 100 mmol/kg.

**Conclusion.** Be aware of RF spoiling when working with SIR. This effect will be studied further.

**References.** 1. Y. Gandon et al.: Non-invasive assessment of hepatic iron stores by MRI. Lancet 2004; 363: 357–62

2. T. G. St. Pierre et al.: Noninvasive measurement and imaging of liver iron concentrations using proton magnetic resonance. Blood 2005; 105 (2): 855-61

3. A. Wunderlich et al.: Estimation of Liver Iron Content with different MRI methods. Proc. 17<sup>th</sup> ISMRM (2010), 4657

**Results.** LIC GRE without RF spoiling correlated reasonably with LIC SE yielding a  $R^2 = 0.89$ . For the patients scanned with RF spoiling we observed a substantial lower  $R^2 = 0.78$ . While the slope of the regression line didn't differ much, the intercept was 39 with RF spoiling compared to 3.6 without.

**Discussion.** RF spoiling was shown to play an important role when determining LIC with GRE protocols using the SIR method.

The previously scanned patients were selected with a LIC (determined with SE) not above 230 mmol/kg since that was the highest value observed in patients scanned without RF spoiling. However, the influence of RF spoiling seems to diminish at LIC above 100 mmol/kg. An explanation for this is the shortening of liver  $R2^*$  which contributes to vanishing of remaining transverse magnetization. By that, effects of additional spoiling decrease.

Even in this very limited number of patients scanned without RF spoiling yet, we are able to demonstrate a substantial difference in results. Another hint for the influence of RF spoiling on SIR results is the fact that some of our patients were scanned twice at different MR scanners. Results differed only when RF spoiling was different, otherwise results didn't deviate significantly (data not shown).

It has to be noted that nothing was mentioned about RF spoiling neither in ref. [1] nor in the corresponding website. Our results can explain why an inconsistency between LIC SE and was previously found as reported in [3] where RF spoilt GRE protocols were used.