Multislice multiecho T2* MRI for detection of the distribution of hepatic iron overload.

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Introduction: Precise and effective measurements of iron overload in the liver, where iron deposition seems to be primarily noticeable [1], are important for the early diagnosis, treatment and follow-up of thalassemia patients. Measurement of liver iron concentration in a small part of a needle biopsy is currently considered the gold standard for this purpose and is taken as representative of the mean iron concentration in the whole liver [2]. However, a few studies involving multiple biopsies have shown a heterogeneity in liver iron deposition [3]. The goals of our study were to set up a MRI acquisition technique for the detection of the iron burden in the whole liver and to detect potential preferential patterns of iron deposit.

Materials and methods: One hundred and one thalassemia major patients (48 males, mean age 29.7 ± 7.8 years) enrolled in the MIOT (Myocardial Iron Overload in Thalassemia) network [4] underwent MRI. Five transverse slices through the liver were obtained by a T2* gradient-echo multiecho sequence [5]. T2* measurement was performed with a custom-written software program (HIPPO-MIOT IFC-CNR®). A region of interest (ROI) was defined in each of the eight functionally independent segments in which the liver can be divided, according to Couinaud [6]. The mean hepatic T2* value was obtained by averaging all segmental values. One-way repeated measures ANOVA was used to evaluate if there was a significant difference between segmental T2* values. The percentage of deviation of the segmental T2* values from the mean hepatic T2* value was assessed for each subject as the ratio of the difference between the segmental and the mean values to the mean value, multiplied by 100. The coefficient of variation (CoV) of each patient was calculated as the SD of the absolute values of the percentage of deviations of his segmental T2* values.

Results: The mean T2* segmental values ranged from 7.8 ms (segment VII) to 10.5 ms (segment I). A significant difference in the segmental T2* values was detected (P<0.0001). Specifically, the mean T2* values over the segments VI and VIII were significantly lower than the mean T2* values over the other segments (figure 1A). The mean hepatic T2* value was 9.6 ± 9.6 ms. The percentage of deviation of the segments from the mean global hepatic T2* mean ranged from -10.8% (segment VII) to 1.2% (segment IV) (figure 1B). In figure 1C the CoV of all the patients (diamond-shaped markers) was plotted versus the global T2* values.

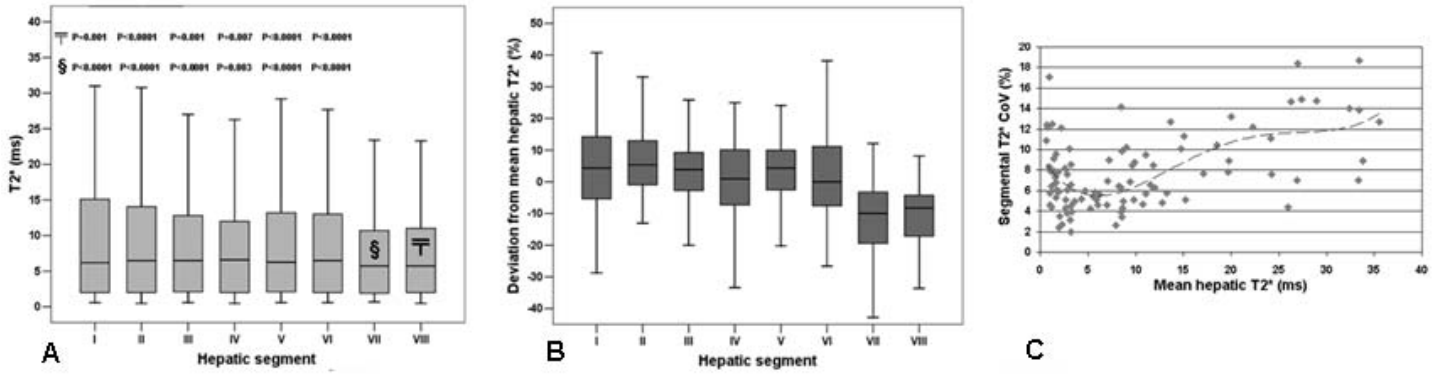

Figure 1: Segmental T2 variability (A). Percentage deviation of the segments from the mean pancreatic T2* value (B). T2* values heterogeneity assessed by the CoV (C).*

Discussion and Conclusions:. The significant segmental variability may represent true heterogeneous iron density or may be explained taking into account T2* measurement errors and susceptibility artefacts. As shown in Figure 1C, the segmental CoV is small at low T2* values and similar to the expected variation due to measurement errors [5]. The relative high CoV at very low T2* values (< 5 ms) may be explained by the lack of precision in T2* assessment at these T2* levels due to the inadequate minimum TE. The CoV significantly increased in borderline patients or in patients without iron overload. This finding can be likely explained by susceptibility artefacts which are nearly additive in the R2* (1/T2*) space and could be originated from several sources such as air-tissue interfaces. The fact that segments VII and VIII are close to the right lung base and with the air contained inside may suggest that the significant T2* reduction in these segments could be artefactual. In conclusion, T2* variations in liver are low and likely due to the artefacts effects and measurement variability.

References: [1] Noetzli LJ et al. Blood 2008;112(7):2973-2978. [2] Overmoyer BA et al. Arch Pathol Lab Med 1987;111(6):549-554. [3] Ambu R et al. J Hepatol 1995;23(5):544-549.l [4] Meloni A et al. Int J Med Inform 2009;78(8):503-512. [5] Positano V et al. Magn Reson Imaging 2009;27(2):188-197. [6] Couinaud C. Masson, Paris, 1957