Quantitative T2* MRI for bone marrow iron overload assessment in a large cohort of thalassemia major patients.

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Introduction. Multiecho T2* MRI is a well-established technique for cardiac and hepatic iron overload assessment [1], but there are limited data on its potential to quantify iron in organs other than the liver and heart. The aims of this study were to describe for the first time the T2* values of the bone marrow in patients with thalassemia major (TM) and to investigate the correlation between bone marrow T2* and iron deposition in myocardium, liver and spleen.

Materials and Methods. 283 TM patients (139 men and 144 women, 8-57 years old, mean age 32.25±8.28 years) enrolled in the Myocardial Iron Overload in Thalassemia (MIOT) network [2] underwent MRI (1.5T GE Signa/Excite HD, Milwaukee, WI, USA). For the measurement of iron overload, fast-gradient-echo multiecho T2* sequence was used [3]. Bone marrow T2* values were obtained on a circular regions of interest (ROI) located in the visible body of the first or second lumbar vertebra. The left ventricle was segmented into a 16-segment standardized model and the T2* value on each segment was calculated as well as the global value [3]. In the liver the T2* value was assessed in a single ROI defined in a homogeneous area of the parenchyma [4] and it was converted into liver iron concentration (LIC). Splenic T2* was estimated in a circular ROI located at the periphery of the posterior segment of splenic parenchyma.

Results. Bone marrow T2* values increased with age in a significant manner (R=0.343, P<0.0001) and were significantly lower in females than in males (Figure 1). A weak positive association was found between bone marrow and heart T2* values. Bone marrow T2* values were negatively correlated with LIC values and mean serum ferritin levels (Table 1).

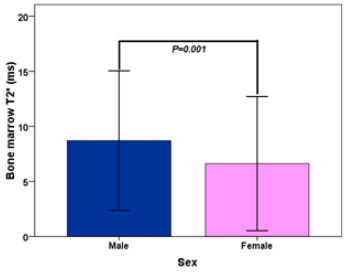

Figure 1.

Table 1.

Parameter	Mean value	Correlation with bone marrow T2* [R (P-value)]
Bone marrow T2*	8.42 ± 6.53 ms	-
Global heart T2*	30.81 ± 11.78 ms	0.143 (P=0.016)
N of segments with T2* < 20 ms	4.02 ± 5.95	-0.159 (P=0.008)
LIC	8.98 ± 11.50 mg/g dw	-0.439 (P<0.0001)
Mean serum ferritin	1547.60 ± 1672.69 ng/ml	-0.582 (P<0.0001)

166 patients (58.7%) were splenectomised and splenectomised patients showed significantly higher bone marrow T2* values than non splenectomised patients (9.78± 6.78 ms vs 4.61±3.85 ms, P<0.0001; Figure 2). The difference remained significant also correcting for the age, significantly higher in splenectomised patients. For the 87/117 patients with the spleen, the splenic T2* value was assessed (mean value: 17.54±11.76 ms). A significant correlation was detected between bone marrow and spleen T2* values (R=0.448; P<0.0001).

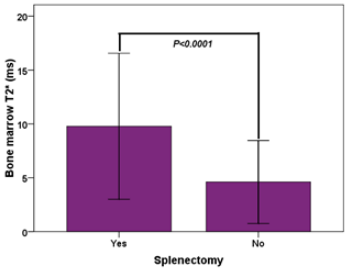

Figure 2.

Conclusions. In TM patients bone marrow T2* values increased with age. Males showed significantly higher T2* values. Gender-differences of iron deposition were have not been found in other organs, so this difference may be due to the fact that the male sex is associated with severely low bone mass [5], which can influence the T2* values. However further studies are needed to better characterize the relationship between bone marrow T2* values and bone mineral density (BMD). Bone marrow T2* values were associated with heart, liver and spleen T2* values. Our results are in agreement with that ones of Papakonstantinou et al [6], who found positive correlations between the degree of hepatic, splenic, and bone marrow siderosis, as expressed by respective R2 values. Splenectomised TM patients showed higher bone marrow T2* values. The bone marrow contains reticuloendothelial cells and, of consequence, it is among the first organs to be affected by iron overload. Splenectomy is normally performed in TM patients with hypersplenism to reduce transfusion requirements.

References. [1] Wood JC & Ghugre N. Hemoglobin 2008;32:85-96. [2] Meloni A et al. Int J Med Inform 2009;78:503-512. [4] Positano V et al. NMR Biomed 2007;20:578-90. [4] Meloni A et al. JMRI 2011;33:348-55. [5] Jensen CE et al. British Journal of Haematology 1998;103: 911-5. [6] Papakonstantinou O et al. JMRI 2009;29:853-9.