

Bone marrow T2* values in healthy subjects: reproducibility and normal values

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Introduction. Multiecho T2* MRI is a well-established technique for iron overload assessment in the heart, liver and pancreas [1,2] but there are no reports concerning the bone marrow, which is one of the first organs in which iron accumulates [3]. As starting point, we used the data of healthy subject to assess for the first time the reproducibility of the MRI technique for measuring bone marrow T2* values and we established the lower limits of normal, necessary to interpret the T2* data in the iron-overloaded population.

Methods. Thirty-five healthy subjects (21 men and 14 women, 19-52 years old, mean age 29.60 ± 8.53 years) underwent MRI exam (1.5T GE Signa/Excite HD, Milwaukee, WI, USA). One transverse slice through the lumbar bone marrow (first or second vertebra) was obtained by the same T2* gradient-echo multiecho sequence used in clinical practice for the liver [4]. T2* measurement was performed with a previously validated software program (HIPPO-MIOT®). For each patient two different types of regions of interest (ROI) were defined: a standard circular ROI (circular_ROI) and a manually drawn ROI covering all the visible vertebral body (global_ROI). Each image was analyzed by two different operators. The lower limit of normal for the T2* value was calculated as mean minus 2 standard deviations.

Results. The circular_ROI T2* values and the global_ROI T2* values were absolutely comparable (Table below).

	T2* values	Paired t-test		Regression Analysis			Bland Altman		CoV (%)
		Mean Values (ms)	P	Slope	Intercept (ms)	R-squared	Mean diff (ms)	Limits (ms)	
Operator 1	Circular_ROI vs global_ROI	16.51 ± 2.64 vs 16.52 ± 2.60	0.958	0.943 ± 0.065	0.938 ± 1.088	0.864	- 0.009	From - 1.9 to 1.9	4.15
Operator 2	Circular_ROI vs global_ROI	16.59 ± 2.58 vs 16.56 ± 2.58	0.857	0.902 ± 0.075	1.654 ± 1.250	0.816	0.034	From - 2.2 to 2.3	4.77

Regardless by the type of the ROI, the inter-operator reproducibility was really good (Table below).

		Paired t-test		Regression Analysis			Bland Altman		CoV (%)
		Mean Values (ms)	P	Slope	Intercept (Hz)	R-squared	Mean diff (ms)	Limits (ms)	
Circular ROI	Operator 1 vs Operator 2	16.51 ± 2.64 vs 16.59 ± 2.58	0.642	0.952 ± 0.066	0.723 ± 1.114	0.862	- 0.078	From - 2.0 to 1.9	4.18
Global ROI	Operator 1 vs Operator 2	16.52 ± 2.60 vs 16.56 ± 2.58	0.666	0.993 ± 0.032	0.079 ± 0.535	0.967	- 0.035	From - 0.96 to 0.89	2.00

We took as reference the bone marrow T2* values evaluated in the circular ROI by the operator 1. Bone marrow T2* values were not correlated with age (Spearman R= 0.095; P=0.586) but were significantly lower in males than in females (see Figure). Because of the gender-difference, the limits of normal were evaluated separately for males and females (Table below).

	Bone marrow T2* (mean \pm SD)	Lower limits of normal for bone marrow T2*
Males	15.33 ± 2.21 ms	10.9 ms
Females	18.28 ± 2.26 ms	13.8 ms

Conclusions. Bone marrow T2* measurements are feasible, reproducible, non-time-consuming and can be limited to a circular ROI. Bone marrow T2* values in healthy subjects are independent of age but are different between the sexes, so gender-specific lower limits of normal should be used.

References. [1] Pepe A et al. JMRI 2006; 23:662-8. [2] Wood JC. Curr Opin Hematol 2007; 14:183-90. [3] Gabutti V et al. Prog Clin Biol Res 1989;309:35-41. [4] Meloni A et al. JMRI 2011;33:348-55.

