Pagano et al. Journal of Cardiovascular Magnetic Resonance 2016, 18(Suppl 1):Q3
http://www.jcmr-online.com/content/18/S1/Q3

Journal of Cardiovascular Magnetic Resonance

WALKING POSTER PRESENTATION Open Access

Aging and gender effects in native T1 and extracellular volume fraction assessment using SASHA

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From 19th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 27-30 January 2016

Background

Reference values for T_1 mapping-derived extracellular volume fraction (ECV) in healthy individuals are not currently well established. Histological measurements in autopsy studies have shown decreasing ECV with healthy aging in men, however recent non-invasive measurements of ECV using different T_1 mapping techniques are inconsistent with respect to the effect of aging and gender, with a relatively wide range of values depending on the method. The goal of the current study was to characterize native T_1 and ECV as a function of age in healthy individuals (no cardiovascular risk factors or medication) with the SAturation-recovery single-SHot Acquisition (SASHA) method (Magn Reson Med. 2014 Jun; 71(6):2082-95), providing comparison to existing literature.

Methods

Well characterized healthy individuals from the Alberta HEART study (BMC Cardiovasc Disord. 2014 Jul 25;14:91) underwent CMR on a Siemens 1.5T system (Sonata, Avanto) with T_1 measurements using the SASHA pulse sequence. Imaging was performed on a mid-ventricular short-axis slice at baseline (pre-contrast) and ~15 minutes after intravenous administration of 0.15 mmol/kg gadobutrol. ECV was measured in the ventricular septum, calculated as (1-hct)*(Myocardium ΔR_1)/(Blood ΔR_1), where ΔR_1 is $1/T_1$ post - $1/T_1$ pre, and hct was the most recent hematocrit.

Results

Native T_1 and ECV measures were available from 44 individuals (60.7 ± 9.6 years, range 43-80, 15 male) free

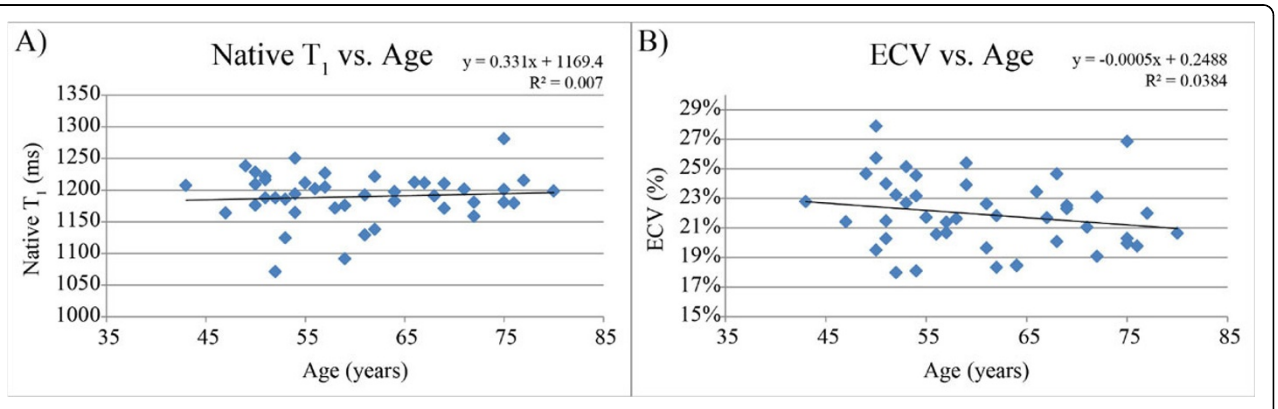

Figure 1 A) SASHA native T_1 values vs. age. B) SASHA extracellular volume fraction (ECV) vs. age.

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Table 1 Comparison of native T1 and extracellular volume fraction between methods

Study	Technique	Field Strength	n	% Female	Age (yrs)	ECV (%)	Gender Effect	Age Effect	Native T1 (ms)	Gender Effect	Age Effect
Pagano	SASHA	1.5T	44	66	61 ± 10	22 ± 2	No effect	No effect	1189 ± 38	Female>Male	No effect
Olivetti1	Histology	N/A	67	42	63 ± 11	21 ± 4	NR	Decreases1, men only2	-	-	-
Sado3	IR single-shot FLASH EQ-CMR	1.5T	81	48	43 (24-81)	25 ± 4	Female>Male	No effect	NR	NR	NR
Neilan4	Cine Look-Locker	3T	32	56	49 ± 15	28 ± 3	No effect	Increases	NR	NR	NR
Liu5	MOLLI	1.5T	235	39	65 ± 8	NR	No effect	No effect	NR	No effect	No effect
Dabir6	MOLLI	1.5T	34	NR	NR	25 ± 4	No effect	No effect	950 ± 21	No effect	No effect
Dabir6	MOLLI	3T	32	NR	NR	26 ± 4	No effect	No effect	1052 ± 23	No effect	No effect
Fontana7	ShMOLLI	1.5T	50	47	47 ± 17	27 ± 3	NR	NR	NR	NR	NR
Piechnik8	ShMOLLI	1.5T	342	51	38 ± 15	NR	NR	NR	962 ± 25	Female>Male	Decreases in women

1-Results adapted from Figure 3; Olivetti, Circ Res. 1991 Jun;68(6):1560-8
2-Olivetti, J Am Coll Cardiol. 1995 Oct;26(4):1068-79
3-Sado, Heart. 2012 Oct;98(19):1436-41
4-Neilan, JACC Cardiovasc Imaging. 2013 Jun;6(6):672-83
5-Liu, J Am Coll Cardiol. 2013 Oct 1;62(14):1280-7
6-Dabir, J Cardiovasc Magn Reson. 2014 Oct 21;16:69
7-Fontana, J Cardiovasc Magn Reson. 2012 Dec 28;14:88
8-Piechnik, J Cardiovasc Magn Reson. 2013 Jan 20;15:13
NR = Not Reported

from cardiovascular disease, diabetes, hypertension, and not on any cardiovascular medication. Average native myocardial T_1 value was 1189 ± 38 ms, which was increased in women compared to men (1201 ± 29 vs. 1167 ± 44 ms, $p < 0.05$), however did not vary significantly with age (Figure 1A; $p = 0.59$). Average ECV was 22 ± 2% (range 18-28%), and did not vary significantly with age (Figure 1B; $p = 0.20$) or gender (men: 21 ± 2% vs. women: 22 ± 2%; $p = 0.14$). SASHA ECV values were similar to a previous histology ($p > 0.05$) study. SASHA native T_1 values were higher and SASHA ECV values were lower than inversion recovery based techniques in groups free of cardiovascular risk factors (native T_1 comparisons only for 1.5T; $p < 0.05$ for all comparisons) (Table 1). Gender and age effects are noted to be different between methods (Table 1).

Conclusions

SASHA ECV values showed no dependence on age or gender and were 14-27% smaller as compared to inversion-recovery techniques, but with good general agreement to histological studies. SASHA native T_1 times are 19-20% longer than inversion-recovery techniques, and though they are longer in women, there is no age dependence. Significantly different ECVs by method reflect systematic differences in blood and myocardial T_1 values (native and post-contrast), consistent with previous reports (Kellman, J Cardiovasc Magn Reson. 2014 Jan 4;16:2). Discrepancies in the relationship between native T_1 and ECV by age and gender warrant more detailed comparison of methods as the field moves towards universal age/gender reference values.

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Published: 27 January 2016

doi:10.1186/1532-429X-18-S1-Q3
Cite this article as: Pagano *et al.*: Aging and gender effects in native T1 and extracellular volume fraction assessment using SASHA. *Journal of Cardiovascular Magnetic Resonance* 2016 **18**(Suppl 1):Q3.

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