Dependence of scar contrast in LGE-MRI of left atrium on time post contrast injection

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Purpose: In recent years, radio frequency (RF) ablation has become a routine therapy for the treatment of many cardiac arrhythmias. It has been shown that LGE imaging can be used to evaluate post-ablation scar [1,2] and pre-ablation remodeling of left atrium [3]. Visibility of scar depends on the time interval between injection of contrast agent and the LGE scan. **In this study, we try to determine, what time post contrast injection would give the optimal contrast between post-ablation scar and blood (CNR_{SB}) and scar and normal myocardium (CNR_{SM}).**

Methods: This study was performed retrospectively on 3-month post ablation LGE data from 52 patients (22 females, aged 65.9 ± 9.5 years), acquired on a 3T Verio scanner (Siemens Healthcare, Erlangen, Germany). All patients were injected with a full dose (0.1mmol/kg) of contrast agent (Multihance, Bracco Diagnostic Inc. Princeton, NJ). 3D LGE imaging of the whole heart was performed to identify the regions of myocardium ablated during RF ablation procedure. The parameters for the LGE scan were as follows: respiratory navigated, ECG gated, inversion recovery prepared GRE sequence with resolution=1.25x1.25x2.5 mm, TR/TE=2.9/1.4 ms, flip angle=15^o; parallel imaging R=2.The data were separated into 4 groups based on time post contrast:

a. < 20 minutes post contrast (15 patients)
b. 20-30 minutes post contrast (13 patients)
c. 30-40 minutes post contrast (12 patients)
d. >40 minutes post contrast (12 patients)

Contrast to Noise Ratio (CNR) was computed as the ratio of the difference in signal intensity over a chosen region of interest in the scar and normal myocardium or blood pool and the standard deviation of the noise observed in the blood pool. CNR was computed between scar and normal myocardium CNR_{SM} & between scar and blood CRN_{SB}. All measurementa were made using Osirix software. Figure 1 shows a representative measurement of CNR in the left atrium.

Figure 1. Typical assessment of CNR in a 3mo-post patient dataset

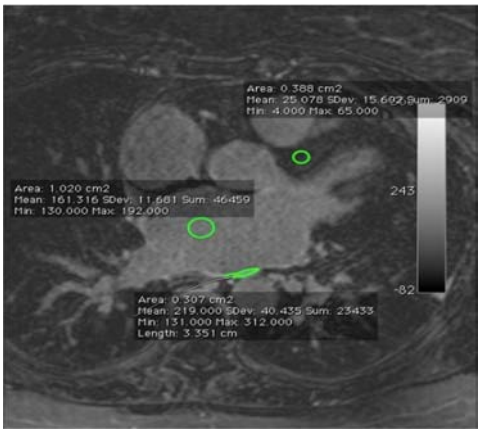

Table 1. CNR computed for each studied group

Time post contrast	CNR_{SM} (mean ± std)	CRN_{SB} (mean ± std)
15.1 ± 1.8 minutes	13.5 ± 5.1	4.0 ± 2.5
25.2 ± 4 minutes	20.3 ± 9.1	8.7 ± 4.8
34.3 ± 2.5 minutes	20.2 ± 8.8	11.3 ± 5.9
42. ± 2.8 minutes	17.3 ± 3.5	10 ± 1.9
One way ANOVA	**$p < 0.05$**	**$p < 0.0001$**

Results: It is seen from Table 1 that scar visibility as a function of CNR between scar and myocardium CNR_{SM} is statistically significantly different between the categories, more obviously if the images are acquired less than 20 minutes or more than 40 minutes past contrast injection. Scar visibility as a function of CNR between scar and blood CNR_{SB} is also statistically significantly different between the categories and is worst when images are acquired less than 20 minutes post contrast injection.

Conclusion/Discussion: In this work, we have studied 4 different subsets of patients with LGE-MR images acquired at 4 different time points after injection of contrast agent. It is interesting to note that the CNR_{SM} and CNR_{SB} are statistically significantly different between all the times post contrast injection. However from looking at Table 1, we conclude that the best quality images may be obtained in the range of 20-35 minutes post contrast injection, outside of these limits, the scar visibility drops significantly.

References: [1] Peters D.C et al. Radiology. 2007 Jun; 243(3):690-5. [2] McGann C.J. et al. JACC. 2008 Oct7; 52(15):1263-71. [3] Oakes R.S, et al. Circulation. 2009 Apr 7;119(13):1758-67.

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