Correlation Between Left Atrial Volume Changes And Percentage Scar Measured 3-months Post RF Ablation

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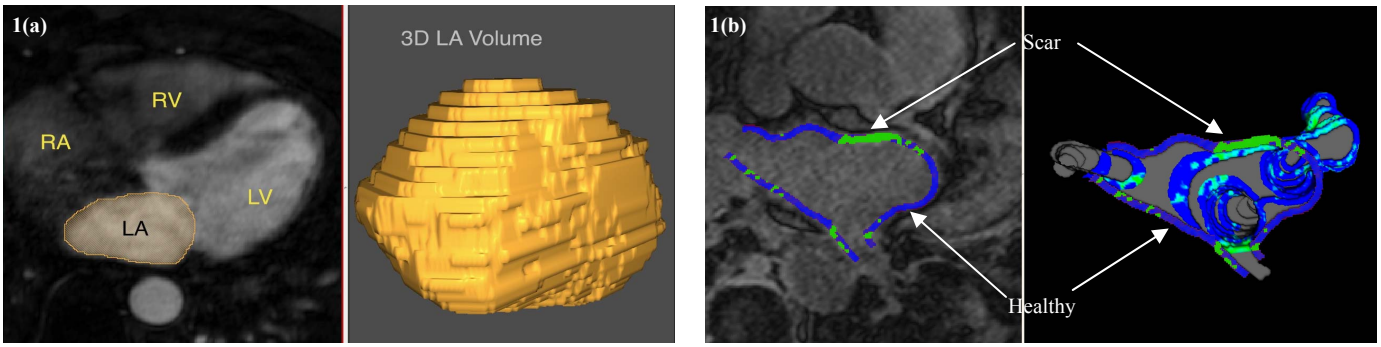
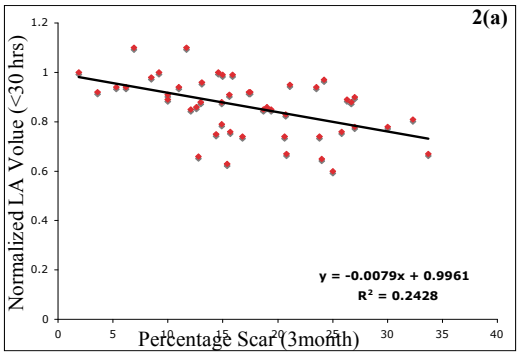
Introduction: Recent studies have demonstrated the usefulness of Cardiovascular Magnetic Resonance (CMR) imaging in the management of patients with cardiac arrhythmia. CMR imaging allows an accurate assessment of various characteristics of cardiac chambers [1]. Significant changes in left atrium (LA) volumes have previously been documented in patients who have undergone radiofrequency (RF) ablation therapy for treatment of atrial fibrillation (AF) [2,3]. Recently, it was shown that high-resolution 3D Late Gadolinium Enhancement (LGE) imaging can visualize post-ablation scar [4,5] in the AF patients treated using RF ablation. The aim of this study was to assess correlation between change in LA volume after RF ablation therapy and the amount of scar formed 3 months post ablation.

Methods: 53 AF patients underwent CMR evaluation before, immediately after (< 30 hours) RF ablation therapy, and 3 months post ablation. All patients were imaged on a 3T Siemens Verio scanner (Siemens Healthcare, Erlangen, Germany). 3D high-resolution MR angiography (MRA) and LGE-MRI of LA were performed in each of these studies. The scan parameters for the MRA acquisition were as follows: TE/TR = 1.3/3.0; flip angle = 23°; bandwidth=800 Hz/pixel, voxel size: 1.25x1.25x2.5; GRAPPA with R=2; contrast dose of 0.1mmol/kg of Multihance (Bracco Diagnostic Inc., Princeton, NJ). LGE images of LA were acquired about 15 minutes after contrast agent injection using a 3D respiratory navigated, inversion recovery prepared GRE pulse sequence with TR/TE=1.4/3.1 ms, flip angle of 14°, bandwidth=750 Hz/pixel, FOV=400x400x110 mm, matrix size=320x320x44, 9% oversampling in slice encoding direction, voxel size=1.25x1.25x2.5 mm, phase encoding direction: left to right, fractional readout=87.5%, partial Fourier acquisition: 87.5% in phase-encoding direction and 90% in slice-encoding direction, GRAPPA with R=2 in phase encoding direction. Inversion pulse was applied every heart beat and fat saturation was applied immediately before data acquisition. Data acquisition was limited to 15% of RR cycle and was performed during LA diastole. To preserve magnetization preparation in image volume, navigator was acquired immediately after data acquisition block.

LA volume and amount of scar were evaluated using a custom software program Corview. The software includes tools for segmentation and analysis of MRA and LGE images as shown in Figure 1. The MRA segmentations were used to compute the volume of the LA. Data from MRA acquired at the following time-points were used – pre-ablation, immediately post ablation (from 45 minutes post ablation to 30 hours post ablation) and 3 months post ablation. The volumes of the LA at these time points were normalized to the volumes measured pre-ablation. To evaluate amount of scar, LA wall was segmented using LGE images acquired 3 months post ablation. Then, the intensity distribution of LA wall voxels was analyzed to find scar voxels. Percentage of scar was computed as a ratio between the number of scar voxels and the total number of LA wall voxels.





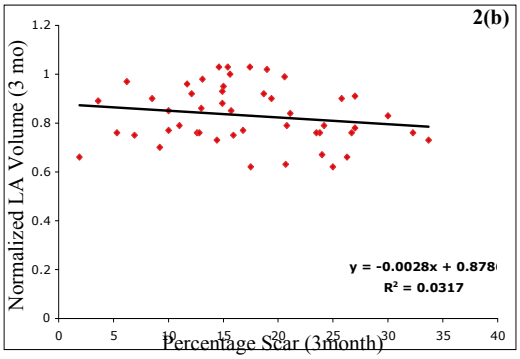


Figure 1. Segmentation and analysis of (**a**) MRA and (**b**) LGE images using Corview software.
Figure 2. **(a)** Correlation between normalized LA volume <30 hrs post ablation and scar percentage **(b)** Correlation between normalized LA volume 3-months post ablation and percentage scar.

Results: Normalized LA volumes immediately (<30 hours) and 3-months post ablation and amount of scar at 3 months post ablation were estimated using the Corview software to be 0.86 ± 0.12; 0.83 ± 0.18; and 17.2% ± 7.5% respectively. Figures 2(a) and (b) show the correlation between the percent scar and normalized LA volume <30 hours and at 3 months post ablation, respectively. It can be seen that there is weak correlation between the scar percentage and normalized volume. The correlation is higher for volumes measured < 30 hours post ablation.

Conclusion/Discussion: Changes in LA volume after RF ablation procedure for AF treatment have been reported in previous studies [2-3]. It was shown that reduction in LA volume correlates with success of the procedure. Post-ablation changes in LA volume may be attributed to a number of factors: reverse remodeling of LA after restoration of sinus rhythm and reduction in AF burden or amount of LA scar tissue. In this study, acute (< 30 hours) and 3-months post-ablation changes in LA volume and amount of LA scar tissue at 3 months after the procedure were evaluated. Analysis of these data demonstrates a weak correlation between LA volume change post procedure and the percentage of scar. This result indicates that reverse remodeling of LA after restoration of sinus rhythm and reduction in AF burden may be the main cause for the observed reduction in LA volume for patients who have successful ablation procedure.

References: 1) Bellenger N, et al., *European Heart Journal* 2000;21:1387-96. 2) Jeevanantham V, et al., *Am J Cardiol* 2010;105 :1317-26. 3) Yoshida K, et al., *J Interv Card Electrophysiol* 2011;32:155-61. 4) Peters D, et al., *Radiology* 2007;243:690-5. 5) McGann CJ, et al., *JACC* 2008; 52:1263-71.

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