

Heterogeneous tissue injury after AF ablation defined by LGE MRI

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Introduction:

Cardiac MRI sequences including late gadolinium enhancement (LGE) and dark blood T2 weighted turbo spin echo (T2w TSE) have been used to help define acute and chronic injury after atrial fibrillation ablation. Injury immediately post ablation is seen as bright signal enhancement on T2w TSE consistent with tissue inflammation and edema. LGE weeks to months post ablation injury shows the resulting fibrotic remodeling process and has been useful in guiding repeat procedures by identifying viable tissue gaps and incomplete pulmonary vein isolation. Here we show heterogeneous left atrial (LA) tissue injury immediately post ablation with non-enhancing regions on LGE imaging. These imaging findings have not previously been described and may be useful to further define tissue injury caused by RF energy delivery and help predict late scarring.

Theory and Methods:

From June 2009 to November 2009, fifty patients underwent PVI and debulking of the septal and posterior walls under EAM guidance (CARTO, Biosense Webster). After the conclusion of ablation procedure, each patient was transported to 3 Tesla MR scanner (Verio, Siemens Healthcare). Time interval between the conclusion of ablation procedure and imaging was less than an hour. The imaging protocol has been developed and optimized for imaging at 3T to rule out procedure complications and to assess the extent of injury to the left atrial wall.

High resolution LGE images of the LA were acquired about 15 minutes after contrast agent injection (0.1 mmol/kg, Multihance (Bracco Diagnostic Inc., Princeton, NJ)) using a 3D respiratory navigated, inversion recovery prepared GRE pulse sequence with TR/TE=3.1/1.4 ms, flip angle of 13°, bandwidth=710 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=83.3%, partial Fourier acquisition: 80% in phase-encoding direction and 90% in slice-encoding direction, GRAPPA with R=2 in phase encoding direction. An inversion pulse was applied every heartbeat and fat saturation was applied immediately before data acquisition. Data acquisition was limited to 15% of the RR cycle and was performed during LA diastole. To preserve magnetization preparation in the image volume, the navigator was acquired immediately after the data acquisition block. Typical scan time for LGE study was 4-8 minutes depending on patient heart rate and respiration pattern.

Results:

Imaging immediately post ablation with LGE often shows dark, non-enhancing regions of ablated tissue (Figure 1, A1-A3). These non-enhancing regions are seen along with enhancing regions and help define different tissue injury in the acute setting. The early, dark, non-enhancing regions are seen to enhance on LGE imaging three months later confirming tissue injury and fibrosis (Figure 1, B1-B3). Mixed LA tissue injury is also seen on a gross pathology specimen from a pig immediately after ablation injury (Figure 2).

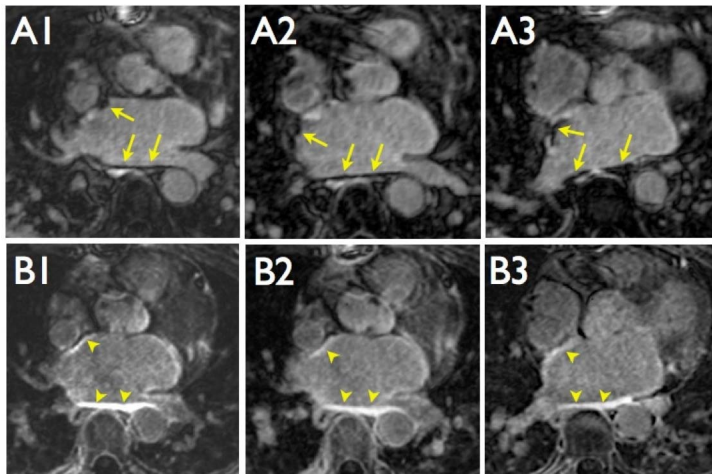


Figure 1. Upper panels (A1-A3) show LGE images immediately post ablation with dark regions of no contrast enhancement in tissue that received RF energy (yellow arrows). Bottom panels (B1-B3) show LGE images 3 months after ablation in the same patient with contrast enhancement now seen in the regions that previously showed little or no Gd uptake (yellow arrowheads).

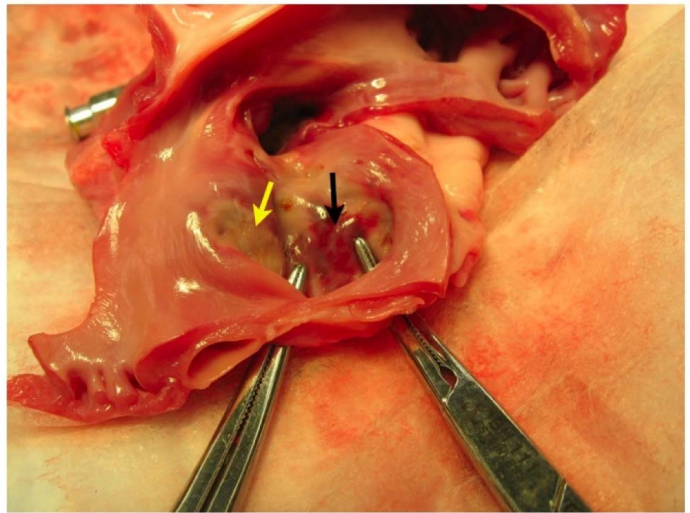


Figure 2. Gross pathology specimen of the left atrium of a pig immediately after RF ablation procedure. Heterogeneous tissue injury is seen with (black arrow) and without (yellow arrow) hemorrhage.

Discussion and Conclusion:

LGE imaging helps define heterogeneous tissue injury post ablation. Non-enhanced ablated tissue may represent a no-reflow phenomenon or hemorrhage and appears to predict late scarring.

Acknowledgments:

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References: [1] Peters D, et al. *Radiology* 2007;243:690-5. [2] McGann CJ, et al. *JACC* 2008;52:1263-71. [3] Vijayakumar S, et al. *SCMR* 2009. [4] Knowles BR et al. *ISMRM* 2009, 487. [5] Peters DC et al. *ISMRM* 2009, 4433.