**NAMIC: CARMA Left Atrial MRI**

###### TERMS OF USE

These image data are provided by the Comprehensive Arrhythmia Research and Management (CARMA) Center for the exclusive use of members of NA-MIC. The segmentations were produced using the Corview software, also a product of CARMA, and Seg3D, software developed and distributed by the Center for Integrative Biomedical Computing (CIBC). Support for the development of Seg3D came from the NIH/NCRR Grant 2P41 RR0112553-12. Please acknowledge CARMA, the CIBC, and the NIH when publishing any results derived with the assistance of these data. Any redistribution of these data requires permission from the CARMA Center.

You may send additional questions about this data to Josh Cates at cates@sci.utah.edu.

For more information on the CARMA Center, please visit: http://healthsciences.utah.edu/carma/

For more information on the CIBC and Seg3D software, please visit: http://www.sci.utah.edu/cibc

###### PRE and POST RADIOFREQUENCY ABLATION LGE-MRI COLLECTION

The Pre/Post Radiofrequency Ablation Late-Gadolium Enhanced (LGE-MRI) collection consists of MRI image data from patients with atrial fibrillation (AF) who have undergone radiofrequency catheter ablation for treatment of atrial fibrillation.

The "Pre" datasets are late-gadolinium enhanced images of the patient heart BEFORE undergoing RF ablation. The "Post" datasets are late-gadolinium enhanced images of the patient heart from 3 to 6 months AFTER RF ablation.

Enhancement in the left-atrial wall in the "Pre" images is hypothesized to represent fibrosis, or structural remodeling of the endocardial tissue that is correlated with the progression of AF. Enhancement in the left-atrial wall in the "Post" images is due mainly to scarring from the RF ablation.

###### LATE GADOLINIUM ENHANCED MRI ACQUISITION

LGE-MRI scans were obtained to assess both the extent of LA fibrosis pre ablation and the post ablation scarring on LA wall. LGE-MRI scans were obtained on either a 1.5 Tesla Avanto or a 3.0 Tesla Verio clinical scanner (Siemens Medical Solutions, Erlangen, Germany). The scan was acquired 15 minutes following contrast agent injection (0.1 mmol/kg, Multihance [Bracco Diagnostic Inc., Princeton, NJ]) using a 3D inversion recovery, respiration navigated, ECG-gated, gradient echo pulse sequence. Typical acquisition parameters were: free-breathing using navigator gating, a transverse imaging volume with voxel size = 1.25 × 1.25 × 2.5 mm (reconstructed to 0.625 × 0.625 × 1.25 mm), repetition time (TR)/echo time (TE) = 5.4/2.3 ms, flip angle=20 degrees, inversion time (TI) = 270 - 310 ms, and GRAPPA with R = 2 and 46 reference lines. ECG gating was used to acquire a small subset of phase encoding views during the diastolic phase of the LA cardiac cycle. The time interval between the R-peak of the ECG and the start of data acquisition was defined using the cine images of the LA. The TI value for the LGE-MRI scan was identified using a scout scan.

###### LEFT ATRIUM SEGMENTATIONS

Each dataset ("Pre" and "Post") includes manual segmentations of (1) the endocardial surface of the left atrium and (2) the left-atrial wall. The endocardial surface segmentation also includes the pulmonary vein antrum regions. The left-atrial wall segmentation excludes the pulmonary vein antrum regions, the mitral valve, and the left-atrial appendage.

The pulmonary vein antrum is an important structure for understanding AF and successful RF ablations because the tissue in this region is electrically active and similar to tissue in the LA.

The extent of the pulmonary vein antrum regions in each endocardial segmentation was estimated using the following criteria. There are three subjective guidelines followed when distinguishing between the PV antrum and the PV itself.

1. If the PV begins to branch, that is a strong indication that you are no longer in the antrum region.
2. The PV will stop narrowing and the diameter of the vein will remain more constant when you reach the PV proper.
3. On average, the PV antrum should not extend much more than about 10 mm, or roughly 3X the thickness of the LA wall.

The LGE-MRI image volumes and their associated left-atrial segmentations are stored in the NRRD (Nearly-Raw Raster Data) format, which is compatible with major medical image processing software such as 3D Slicer, Seg3D, ITKSnap, and other applications built from the Insight Toolkit ([www.itk.org](http://www.itk.org)).

**Atrial Fibrillation Ablation Outcome is Predicted by Left Atrial Remodeling on MRI**

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LA wall volumes were manually segmented by 3 trained observers from the LGE-MRI images using the Corview image processing software (Merrek Inc, Salt Lake City, UT). The MRI scans were deidentified, and observers were blinded to whether scans were performed on control subjects, patients with AF, or surgical patients. The protocol for segmentation proceeded as follows. First, the endocardial border of the LA was defined, including an extent of pulmonary vein (PV) sleeves, by manually tracing the LA–PV blood pool in each slice of the LGE-MRI volume. Next, the endocardial segmentation was morphologically dilated and then manually adjusted to create an assessment of the boundary of the epicardial LA surface. Finally, the endocardial segmentation was subtracted from the epicardial segmentation to define a wall segmentation, which was manually edited to exclude the mitral valve and PVs. Thus, the resulting LA wall segmentation included the 3D extent of both the LA wall and the antral regions of the PVs.

Quantification of LA remodeling was obtained using the methods previously described with the addition of software implemented in Corview to improve determination of MRI intensity values.Typically, enhancement values are found to be in the range of 2 to 4 SDs from the mean value. Once the threshold has been determined, the percentage of enhancement is calculated as the number of voxels in the LA wall segmentation with values above the threshold divided by the total number of voxels in the LA wall segmentation. The study patients were then assigned to 1 of 4 SRM categories based on LA wall enhancement as a percentage of the total LA wall volume, with stage I defined as <10%, stage II ≥10% to 20%, stage III ≥20% to 30%, and stage IV ≥30%. Additional details on methods for quantification of LA remodeling are provided in the Data Supplement.