Patients with Histologically Abnormal Left Atrial Myocardium Demonstrate Greater Left Atrial Late Gadolinium Enhancement

J. L. Shaw[1], S. N. Hong-Zohlman[1], R. C. Hagberg[1], B. R. Knowles[1], W. J. Manning[1,2], and D. C. Peters[1]
[1]Cardiology, Beth Israel Deaconess Medical Center, Boston, MA, United States, [2]Radiology, Beth Israel Deaconess Medical Center

Introduction: Detection of the arrhythmic substrate in patients with atrial fibrillation (AF) is important and the presence of pre-existing scar may predict recurrence for patients undergoing pulmonary vein (PV) isolation (1,2). While the gold standard for detecting fibrosis is histology (3), voltage mapping is a standard clinical tool (4), in which low voltage indicates fibrosis. Recently, late gadolinium enhancement (LGE) cardiovascular magnetic resonance (CMR)(5) has also been used to detect fibrosis in the left atrium (LA)(1,2). Pre-existing scar in AF patients may be less apparent than scar resulting from an infarction or ablation, having only partial enhancement. Here we sought to compare the enhancement patterns of healthy subjects and AF patients prior to minimally invasive maze (a surgical procedure to isolate PVs). For the pre-maze patients, resection of the LA appendage (LAA) provided a histological sample of the LA.

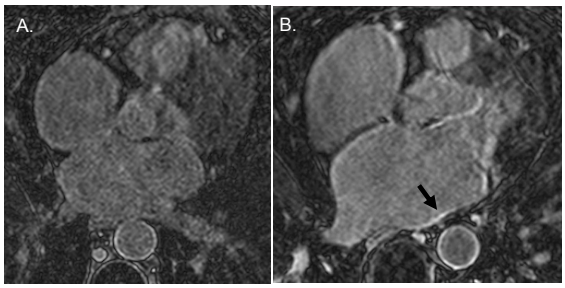

Figure 1: LA LGE image pre-maze in patients with unremarkable (A) and fibrotic (B) LAA myocardium. The LA wall CNR (vs. blood) was measured. Note subtle enhancement of the posterior wall in B), and enlarged LA size.

Methods: The LA in 9 healthy young subjects (controls) and 13 pre-maze patients were imaged with a 3D LGE sequence (6), 15-25 minutes after injection of 0.2mmol/kg Gd-DTPA. The blood-wall contrast-to-noise ratio (CNR) in the LA posterior wall (LA PW), left inferior PV (LIPV) ostia, right inferior PV (RIPV) ostia, and in the region of brightest enhancement on the LA wall ("bright point"- LA BP) was measured by a blinded observer. Blood pool signal was measured using a large region of interest, with noise measured in the air-space adjacent to the anterior wall. In patients undergoing minimally invasive maze, the LAA was resected and a sample was sent for histological analysis using gross inspection and hematoxylin and eosin stain. Differences were tested using a paired two-tailed t-test without Bonferroni correction.

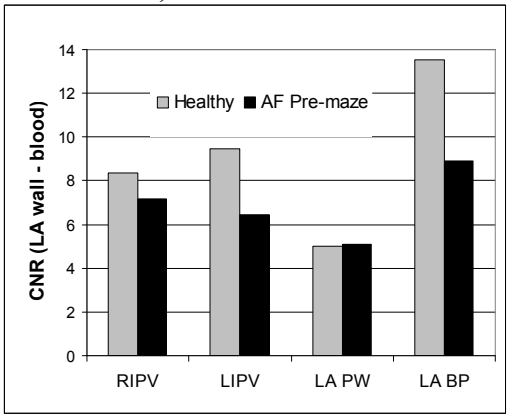

Figure 2: Comparison of LA wall enhancement between pre-maze AF patients and healthy controls. P=NS, except for LABP (p=0.04).

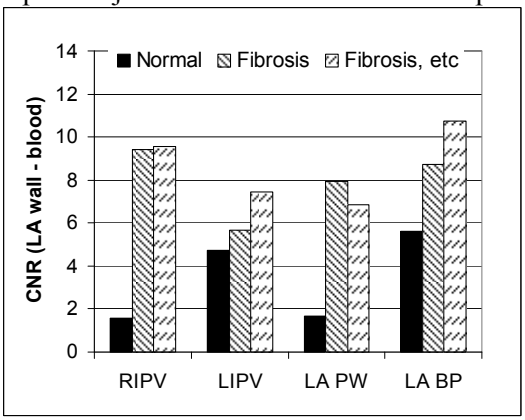

Figure 3: CNR comparison for pre-maze patients with and without abnormal histological findings. Fibrosis, etc = fibrosis, hypertrophy or fibroadipose tissue.

Results: Figure 1 compares LA images from pre-maze subjects with (A) and without (B) LAA fibrosis. CNRs were similar in pre-maze patients and healthy controls, except for LA BP CNR (p=0.04), which was higher in controls (Figure 2). By histology, 4 pre-maze patients were determined to have fibrosis, 5 additional patients had other non-normal findings (myocyte hypertrophy or fibroadipose tissue), and 4 patients had unremarkable normal myocardium. The LA PW CNR trended higher (p=0.06) in patients with LAA fibrosis (N=4) by histology, compared to patients without (N=9). The RIPV (p=0.003), LA PW (p=0.006), and LA BP (p=0.04) CNRs were all higher in patients with abnormal findings (N=9) vs. those with normal myocardium (N=4) (Figure 3).

Discussion and Conclusions: The increased CNR of LA BP in controls was unexpected, and must be further analyzed. Our study correlated CMR LGE findings with histology, and demonstrated significantly greater wall enhancement, everywhere except the LIPV, in patients with abnormal histological LAA myocardial findings, vs. patients with normal myocardium. **References:** 1. Mahnkopf et al. Heart Rhythm 2010 7:1475-1481 2. Oakes et al Circ 2009; 119:1758. 3. Steiner I, Virchows Arch 2006; 449:88-95. 4. Verma et al. JACC 2005; 45:285-292. 5. Simonetti et al. Radiology 2001;218:215-223. 6. Peters et al. Radiology 2007; 243:690-695.