

# Novel pilot data - Cardiac MR Imaging Post Catheter Ablation: Does T2 and DE ratios matter in predicting clinical outcome?

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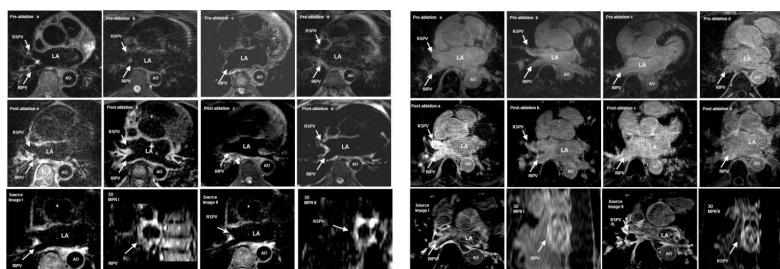
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**Background** Wide area circumferential ablation (WACA) is used to achieve pulmonary vein isolation (PVI) for the treatment of symptomatic drug refractory paroxysmal atrial fibrillation (PAF). However, PAF recurrences associated with pulmonary vein reconnection are common. We assessed firstly the hypothesis that acute PVI results from a combination of irreversible (necrosis) and reversible (interstitial edema) tissue damage at the left atrial (LA)–pulmonary vein (PV) junction as evaluated by cardiac magnetic resonance (CMR) imaging. Secondly, we proposed that given the reversible nature of edema, the higher the proportion, the higher the likelihood of recurrences arising.

**Methods** Delayed enhancement, DE (necrosis) and T2-weighted enhancement, T2 (edema) imaging sequences were performed pre and immediately post WACA in 15 patients with paroxysmal atrial fibrillation (PAF). Images were analyzed by firstly segmenting the LA from the 3D whole heart image to generate a 3D shell. These shells were next fused onto the DE and T2 source images allowing the maximum intensity projections (MIP) to be obtained on to the shells<sup>1</sup>. Quantification of the percentage (%) circumferential extent of DE and T2 lesion formation on the shells were performed.

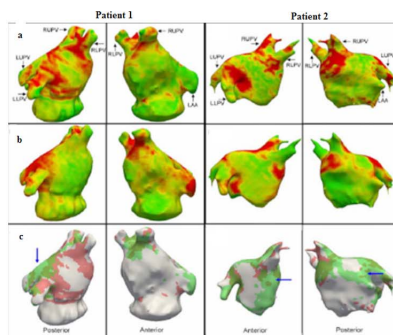
**Results** Following electrical isolation, 30 pairs of PVs (15 right, 15 left) were imaged and the percentage (%) circumferential lesion of DE, T2 and DE + T2 was quantified. Both Figure 1 and Figure 2 demonstrate DE and T2 pre and post ablation in 3 of our patients. The mean±SD percentages on the right side were 52.4±31.4 for DE, 61.6±26.7 for T2 and 77.7±23.8 for DE +T2. On the left side, the mean ± SD percentages were 63.4± 28.3 for DE, 58.1± 20.7 for T2 and 84.5±17.1 for DE +T2. Both DE and DE+T2 means were statistically significant (0.02) suggesting the contribution of T2 in completing PV antral encirclement. The clinical outcome at 6 months was then correlated to the MR findings. 8 cases free from AF (16 pairs of PV) had mean ± SD values of 70.3±22.9 for DE and 51.6±26.3 for T2. Recurrences in 7 cases (14pairs of PV) had mean ± SD values of 45.8±28.6 for DE and 69.2±16.2 for T2. Both DE and T2 means from the two groups were statistically significant (p-values of 0.02 and 0.03). Areas of T2 enhancement (edema) not only overlapped with areas of DE but also filled in gaps between areas of DE producing in combination almost circumferential lesions in all PVs (Figure 3). Both the T2 / DE ratios (p=0.001) and DE / (DE+T2) ratios (p=0.0003) calculated are represented in Figure 4.

**Conclusion** T2-weighted enhancement (edema) in combination with DE on CMR contributes to near completion of pulmonary vein encirclement leading to acute electrical isolation. In PAF recurrences, more of this ring was composed of increased T2-weighted signal than DE. This pilot data raises the hypothesis that resolution of oedema causes PV reconnection leading to recurrence of AF.

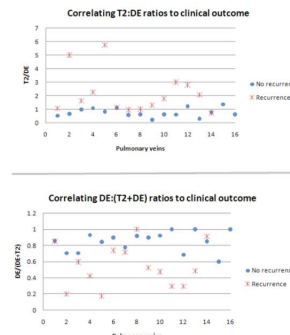


**Fig. 1:** Demonstrates a series of T2-W images of the LA and PV. The first two rows depict T2-W images pre and post catheter ablation. The third row shows both source and multi-planar reconstructed (MPR) T2-W images of the pulmonary veins

**Fig. 2:** Demonstrates the corresponding DE images of the LA and PV from Fig. 1. The first two rows depict DE images pre and post catheter ablation. The third row shows both source and multi-planar reconstructed (MPR) DE images of the pulmonary veins.



**Fig. 3:** 3D visualization of (a) DE, (b) T2 W, and (c) simultaneous overlay of both MR images for two PAF patients. The blue arrows in (c) show areas where gaps in-between DE is filled by T2.



**Fig. 4:** Scatter-plots comparing DE:T2 ratios quantified from surface shells to clinical outcome.

**Reference:** 1Knowles et al. Three-dimensional visualization of acute radiofrequency ablation lesions using MRI for the simultaneous determination of the patterns of necrosis and edema. *IEEE Transactions of Biomedical Engineering (IEEE-TBME)*. 2010;57(6):1467-1475.