

Cardiac MR Imaging and Technology Assessment: A randomized prospective comparison of Robotic Assisted versus Standard Catheter AF ablation

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Introduction Durable pulmonary vein lesions is integral in minimizing pulmonary vein reconnection and subsequent post-ablation recurrences. Catheter stability, tissue contact force and RF duration are determinants of lesion formation and may be operator-dependent. Remote robotic assisted navigation systems permit accurate titration of contact force while maintaining a stable catheter position. In this study, we sought to compare lesions imaged on cardiac MR created by standard versus robotic assisted catheter ablation by quantifying the amount of tissue injury with delayed enhancement (DE) and tissue edema with T2-weighted enhancement (T2) on cardiac MR.

Methods Twenty PAF patients (mean age 54 ± 15.4 years, fifteen male) undergoing their first left atrial (LA) ablation were randomized to either robotic assisted navigation (Sensei® X Robotic Catheter System, Hansen Medical, Inc) or standard navigation. 60 CMR scans were performed at three time points - pre, acute (24 hours post procedure) and chronic (beyond 3 months) [Figure1] using DE and T2 imaging sequences. 3-D LA shells were generated to quantify the percentage (%) circumferential DE and T2 enhancement around the PV antrum. (Figure 2). DE and T2 rings (DE&T2) were then overlayed to assess the combined total % encirclement. Ratios of DE/(T2&DE) was calculated to assess the proportion of acute tissue injury.

Results and Discussion On the acute CMR images, robotic ablation (Sensei® X Robotic Catheter System, Hansen Medical, Inc) resulted in a greater circumferential lesion extent as assessed by DE and T2 signal. In both groups, areas of T2 enhancement (edema) not only overlapped with areas of DE but also filled in gaps between areas of DE resulting in increased circumferential enhancement. Combination of T2 and DE conferred a higher % encirclement in the robotic series (94%) versus standard navigation (79%) achieving a statistical significance ($p=0.04$). DE percentages were higher ($77 \pm 13.1\%$) in the robotic group ($59 \pm 28.5\%$ in standard group) achieving a higher mean ratio of DE over (T2+DE) of 0.76 ± 0.18 versus 0.63 ± 0.30 in the standard group. On the chronic scans, T2 enhancement resolved to similar pre-procedural baseline amounts. Although DE chronic encirclements declined in both groups as injured tissue healed, DE encirclement remained higher in the robotic group ($62 \pm 9.9\%$ vs $55 \pm 10.7\%$). At 6 months follow-up, 6 patients in the robotic group (60%) remained AF free compared to 5 patients (50%).

Conclusion CMR imaging allowed for an in vivo comparison between standard versus robotic navigated LA ablation. Greater degree of tissue injury and a higher percentage of PV antral encirclement was observed in the robotic group. This may be a function of improved catheter stability and tissue contact force information.

Figure 1 Serial T2(left) and DE (right) CMR scans performed on a single patient following robotic navigated catheter ablation at 3 time points.

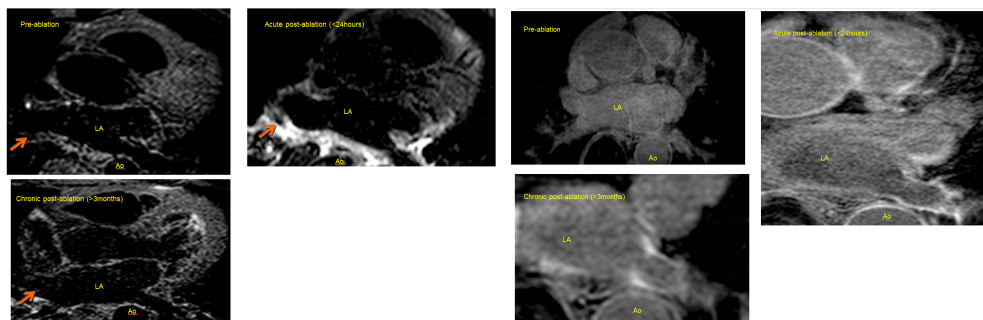


Figure 2 (left) depicts an example of a series of 3-D LA reconstructed shells (at 3 time points) in two patients to compare robotic versus standard catheter ablation. Blue represents areas of T2 signal whilst red represents DE. Greater 'islands' of red is seen in the robotic assisted LA shell. **Figure 3** (right) shows 2 sets of bar graphs outlining the mean % circumferential PV enhancement for T2, DE and combined T2&DE quantified on CMR scans at 24 hours and 3 months and beyond. An overall higher trend in signal enhancement is seen in the robotic group.

