Non-contrast-enhanced T1-weighted cardiac magnetic resonance identifies ablation lesion gaps with reversible conduction block after pulmonary vein isolation

Susumu Tao  
Michael Guttman  
Daniel Herzka  
Aravindan Kolandaivelu  
Tatsuya Hayashi  
Masateru Takigawa  
Yoshihide Takahashi  
Masahiko Goya  
Tetsuo Sasano  
Henry Halperin

Introduction: After pulmonary vein isolation (PVI), there can be sections of ablation lines that have reversible conduction block (gaps), and which lead to recurrence of atrial fibrillation. These gaps cannot be necrotic, and non-contrast-enhanced T1-weighted (nCE-T1w) cardiac magnetic resonance (CMR) can identify necrotic tissue in radiofrequency catheter ablation (RFCA) lesions. We aimed to determine whether nCE-T1w CMR can identify RFCA lesion gaps which are associated with PV reconnection.

Methods: RFCA was performed in 9 swine to achieve PVI. After confirming bi-directional block with electrophysiological study (EPS), CMR was performed using nCE-T1w, and contrast-enhanced imaging performed early and delayed (DCE) post-injection. Three swine were sacrificed after CMR acutely (Group A). The other 6 swine underwent EPS, CMR, and sacrifice after 8 weeks (Group B). Lesion gaps in CMR were compared with gross pathology.

Result: All PVs were successfully isolated. Lesions were detectable by nCE-T1w CMR acutely. In Group A, lesion gap widths seen in T1w correlated with pathology ($r^2=0.98$, $p<0.01$; Figure A-C). In Group B, 12 gaps (2.0±0.9 / PV) with a mean width of 3.9±2.0 mm were detected in nCE-T1w CMR acutely. Three of these 12 gaps were detected in early contrast imaging, while none were detected in DCE (Figure D-F). Chronically, PV reconnection was observed at 11 sites in 5 swine, with locations matching those of gaps seen in nCE-T1w acutely (92%; Figure G-I). There was no difference of gap width between nCE-T1w acutely and DCE chronically (3.7±2.2mm, $p=0.85$).

Conclusion: nCE-T1w CMR acutely identifies gaps in RFCA induced necrosis which are associated with locations of PV reconnection.