Non-invasive assessment of pulmonary vein isolation durability using late gadolinium enhancement MRI


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Background: Electrical reconnection of pulmonary veins (PV) is considered an important determinant of recurrent atrial fibrillation (AF) after PV isolation (PVI). However, it requires an invasive repeat procedure to assess durability of PVI. Against this background, in most centers clinically relevant AF recurrences almost automatically trigger repeat ablation procedures aiming at PV re-isolation. However, technological and procedural advances have substantially improved efficacy of catheter ablation. As a result it is increasingly common that all four PVs are found isolated in those repeat procedures. Thus, as ablation of extra-PV targets has failed to show benefit in large randomized trials, more and more often these highly invasive procedures are being performed only to confirm durable PVI. To date, late gadolinium enhancement (LGE)-MRI is the only non-invasive method to assess ablation lesions. However, its predictive value regarding PVI durability has not been systematically determined.

Purpose: Here we aim to define the ability of LGE-MRI to rule out PV reconnection and its potential to guide patient selection for repeat ablation procedures.

Methods: This study was based on our prospective registry where all patients receive a LGE-MRI before and after AF ablation. All patients that had undergone a repeat invasive procedure after an initial PVI-only ablation were included, and the ability of LGE-MRI to determine PVI durability was analysed using invasive mapping as a reference. Gradient echo MR sequences were acquired in sinus rhythm and 3D-reconstruction of left atrium and PVs performed using ADAS-3D software. LGE was quantified based on the signal intensity ratio of each voxel relative to the blood pool, applying a previously validated threshold of >1.2 to define LGE indicative of ablation-induced scarring. LGE discontinuations of >3 mm were considered indicative of PV reconnection. For validation, PVI durability was determined invasively based on local bipolar electrograms.

Results: A total of 142 patients and 284 PV pairs were analysed. LGE-MRI displayed LGE-discontinuations suggestive of PV reconnection in 210 PV pairs (74%). According to invasive mapping, LGE-MRI predicted PV reconnection with high sensitivity (89%), whereas specificity was somewhat lower (48%). Of note, a complete circumferential LGE-lesion reliably ruled out electrical reconnection of the respective PV pair with a negative predictive value of 94.5%. In the patient-based analyses 11% of the patients displayed complete LGE-lesion sets encircling all 4 PVs. None of these patients showed electrical PV reconnection in the invasive repeat procedure.

Conclusion: Although not frequently encountered, continuous LGE lesions encircling all 4 PVs reliably rule out PV reconnection. Thus, LGE-MRI has the potential to guide treatment decisions in patients with AF recurrences and may help to avoid unnecessary repeat procedures with all their associated risks and costs.