Arrhythmias - Catheter Ablation of Arrhythmias

Optimum timing to assess ablation lesions with Late Gadolinium Enhancement MRI

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Background

Late gadolinium enhancement MRI (LGE-MRI) is increasingly used to detect native as well as ablation-induced atrial fibrosis in the context of atrial fibrillation (AF). However, cardiac fibrotic tissue including ablation lesions is subject to sustained remodeling, and neither the development of ablation-induced fibrosis over time nor the capability of LGE-MRI to detect it at different stages of scar formation have been defined. We sought to define the long-term development of ablation-induced atrial fibrosis and to validate LGE-MRI for the assessment of ablation lesions at different time points.

Methods

Patients with first-time AF ablation and an early follow-up LGE-MRI (3 months post ablation) and a late follow-up LGE-MRI (>12 months post ablation) were included. LGE-MRI data were postprocessed for quantification of fibrotic tissue using the ADAS 3D software. In the majority of patients high-density electroanatomical mapping (EAM), performed in a repeat procedure served as a reference.

Results

22 consecutive patients fulfilling the inclusion criteria were analysed retrospectively. In the LGE-MRI 3 months post ablation an average of 91.7 ± 7.0% of the ablation lines" circumference displayed late gadolinium enhancement (LGE) reflecting ablation-induced fibrosis, whereas in the late follow-up LGE-MRI, at a median of 28 months post ablation, only 62.8 ± 25.0% of the ablation lines" circumference was covered by LGE ($p < 0.0001$) (see figure for representative examples and individual development of LGE coverage over time). This decrease of LGE coverage of the ablation lines was also reflected by an increase in the median number of LGE-MRI-predicted gaps per circumferential ablation line from 4 (3 months) to 10 (28 months). These data may suggest a decrease of ablation-induced fibrosis over time. However, EAM subsequent to the late follow-up LGE-MRI, which was performed in 18 of the 22 patients, indicates that it was not ablation-induced fibrosis that decreased over time, but rather the capability of LGE-MRI to detect it. In 95% of the pulmonary vein segments in which the late follow-up LGE-MRI (28 months) indicated a disappearance of local ablation-induced fibrosis, EAM demonstrated durable lesions consistent with the 3-months LGE-MRI. In line with this observation, the overall agreement of EAM at the repeat procedures with the 3-months LGE-MRI regarding the prediction of ablation-induced fibrosis and functional gaps was good (K 0.74; $p< 0.0001$, positive predictive value 93%), whereas the agreement with the LGE-MRI at 28-months was only weak (K 0.29; $p < 0.0001$, positive predictive value 63%).

Conclusions

Our results indicate that while ablation-induced atrial fibrosis appears to remain rather constant over time, LGE-MRI loses some of its capability to detect it. Thus, LGE-MRI 3 months post ablation may be more accurate in the detection of durable ablation lesions than LGE-MRI at later time points more than 12 months after ablation.

Abstract Figure