Optimal contact force to minimize edema volume during radiofrequency ablation

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Introduction: Radiofrequency (RF) ablation results in creation of acute edema which can lead to temporary disruption of electrical propagation. The goal of this study was to find the optimal contact force (CF) to minimize edema formation in comparison to the chronic lesion size using magnetic resonance imaging (MRI).

Methods: Forty-nine ventricular RF lesions were created by a CF sensing catheter in a canine model (n=10) with varying force for 30 s. Animals underwent T2-weighted and late gadolinium enhancement MRI (LGE-MRI) immediately and 12 weeks after ablation. Acute LGE, acute edema, and chronic LGE volume were segmented and measured (Panel A). Acute edema/LGE volume ratio (EL ratio) was used to divide the lesions into 2 groups.

Result: Acute edema volume/LGE-MRI volume ratio shows an inverse relationship with CF (Panel B). The lesions were divided into greater edema group (GE group, n=8) and smaller edema group (SE group, n=41) based on an EL ratio. When comparing the two groups, the CF and force time integral (FTI) in the GE group were significantly lower than those in the SE group (4.1 ± 4.2 vs 12.4 ± 4.9 g, p = 0.003; 390.2 ± 150.2 vs 802.8 ± 364.7 g·s, p = 0.003, respectively). Catheter power setting, tip temperature change, impedance drop, and bipolar electrogram voltage change were not significantly different. Acute LGE volume and chronic lesion depth were significantly smaller in the BE group. Moreover, ROC curve for the SE lesion group showed that the most discriminant cut-off value for FTI was 584 g·s (Panel C).

Conclusion: To minimize edema size while still forming permanent lesions, ablation should be performed with FTI > 584 g·s or CF > 12.4 g.