Can lesion parameters predict effective pulmonary vein isolation in very-high-power short-duration radiofrequency ablation?

I. Koev, A. Mavilakandy, A. Kotb, I. Antoun, Z. Vail, J. Barker, B. Sidhu, V. Pooranachandran, X. Li, G. Andre Ng

University of Leicester, Leicester, United Kingdom

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Background: Pulmonary vein isolation (PVI) is the cornerstone treatment for patients with atrial fibrillation (AF) refractory to medical therapy. Recent advancements have led to the development of contact-force (CF) sensing very-high-power short-duration (vHPSD) radiofrequency (RF) ablation (90W/4 seconds). Previous RF ablation utilized Ablation Index (AI) as a marker of lesion quality to guide the operator which is not utilized in QMODE+ (vHPSD) and thus, there is limited information on effective lesion formation. In this study, we evaluated the correlation between various lesion parameters to identify relationships and potential surrogate markers for effective lesion formation. Moreover, we studied the relationship between different anatomical locations on these parameters to gain further insight.

Methods: 50 consecutive AF patients (33 males, age 62.0±1.31 years, 66% paroxysmal AF) underwent first time PVI using QMODE+. All wide antral circumferential ablation (WACA) QMODE+ lesions (n=5022) were analyzed for force-time integral (FTI), impedance drop, average CF, maximum temperature attained and anatomical location. The anatomical regions assessed across both left and right WACA were posterior-superior (region 1–2), posterior-inferior (region 3–4), anterior-inferior (region 5–6), anterior-superior (region 7–8) and pulmonary vein carina (region 9). All pulmonary veins (PVs) were checked with pacing maneuvers to examine for gaps in ablation lesions and adenosine for acute pulmonary vein reconnection post-ablation.

Results: PVI was successful in all patients while a first pass isolation was observed in 26 patients (52%). A total of 5022 lesions were performed with 2461 and 2561 lesions in the left and right WACA respectively. The average CF exhibited positive correlation with maximum temperature attained and impedance drop (p<0.0001) while displaying negative correlation with FTI (p<0.0001) (Figure 1). The PV carina (region 9) of the right WACA had the smallest impedance drop (p<0.0001) while the PV carina of the left WACA exhibited the lowest average CF and temperature attained (p<0.0001) (Figure 2). The highest number of gaps or acute reconnection (12 out of 24 patients) were seen in the region of the left pulmonary vein carina (p<0.0001).

Conclusion: This is the first study that has investigated the characteristics of vHPSD ablation lesions at different regions in the left atrium. CF was positively correlated with maximum temperature and impedance drop but negatively correlated with FTI. Furthermore, ablation at both right and left PV carina demonstrates lower impedance drop and average CF which may potentially explain the greater prevalence of gaps or reconnections. This study provides detailed insight into the relationship between the anatomical region, contact force, temperature and impedance drop, and will facilitate the optimization for effective vHPSD lesion formation.