Association between Local Slow Conduction and Bipolar Voltage – an Analysis Using HD Grid Mapping Catheter in Atrial Fibrillation Patients

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Introduction: Left atrial (LA) area with reduced bipolar voltage identified during sinus rhythm (low voltage zone = LVZ) has been used as a surrogate for atrial fibrosis. LVZ is frequently localized in a specific region such as anterior wall. These localized LVZs have been shown to be a possible ablation target for substrate modification. The purpose of this study is to evaluate the relationship between local slow conduction zone (SCZ) and bipolar voltage using a newly released HD Grid mapping catheter (Abbott, USA).

Methods: Fifty patients (70 ± 10 years old, 29 males, 29 non-paroxysmal AF) who underwent high density voltage mapping and activation sequence mapping using HD Grid during sinus rhythm or high right atrium pacing before AF ablation were analyzed. The maximum distance between 2 acquired points (interpolation) was strictly set at 5 mm. LA was divided into sub-region of 10mm x 10mm. The highest bipolar voltage in each sub-region was selected as the voltage of the sub-region, and mean voltage of LA was calculated. LVZ was defined as three cutoffs: <0.5mV, <0.75mV, and <1.0mV. Local conduction was also assessed using isochronal map, and local SCZ was defined as <0.3m/s with >10mm length. Coexistence of SCZ and LVZ was defined as within 10 mm distance. Total activation time (TAT) of the LA was defined as the time interval between the earliest activation site to the latest activation site.

Result: 56%, 74%, and 91% of SCZs coexisted with LVZ defined as <0.5mV, <0.75mV, and <1.0mV, respectively. On the other hand, 89%, 89%, and 69% of LVZ defined as <0.5mV, <0.75mV, and <1.0mV coexisted with SCZs, respectively. Number of SCZs increased as mean LA voltage decreased. There was a negative linear relationship between total length of SCZ and mean LA voltage (R = –0.67). In addition, there was a negative linear relationship between mean voltage and TAT (R = –0.70), and a positive linear relationship between TAT and the total length of SCZ (R = 0.66). SCZs and LVZs were frequently identified at some specific regions like anterior, septum and around the PV antrum. Left atrial macroreentrant atrial tachycardia was induced in 10 patients after pulmonary vein isolation, in which significantly higher number and greater length of SCZs were identified compared to those without (median number of 6 Vs. 3, p<0.001, and mean length of 167±64 mm Vs. 52±43 mm, p<0.001).

Conclusion: SCZs were strongly associated with LVZs defined as <1.0mV. The number and length of SCZs increased as the global bipolar voltage decreases. LA conduction time prolongs as SCZs increases
and voltage decreases. These data suggest that conduction disturbance of the LA closely associates with global reduction of bipolar voltage, which would be caused by more homogenous fibrotic remodeling process. SCZs in the LA works as a substrate for LA macroreentrant atrial tachycardia.