Slow conduction zone as an early electrical remodeling change in patients with atrial fibrillation

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Background: The slow conduction zone (SCZ) in the left atrium (LA) detected using 3-D mapping and high-resolution imaging system has attracted attention as an arrhythmia substrate of atrial fibrillation (AF). However, the occurrence mechanism of SCZ remains unclear.
Purpose: This aim of this study is to clarify whether SCZ is related to the low voltage zone (LVZ) or the LA anatomical contact areas with other organs such as aorta or thoracic spine in patients with AF.
Methods: We studied 36 patients (21 males, 68±10 years, 14 paroxysmal AF; PAF, 17 persistent AF; PeAF, 5 long-standing persistent AF; LS-PeAF) who received catheter ablation for AF. High-density LA mapping during sinus rhythm or right atrial pacing after pulmonary vein isolation were constructed by acquiring more than 2000 endocardial points in each patient. Isochronal activation maps were created at 5-ms interval setting, and the SCZ was identified on the activation map by finding a site with isochronal crowding of ≥3 isochrones, which are calculated as ≤27 cm/s (figure). The LVZ was defined as the following; mild (<1.5 mV), moderate (<1.0 mV), and severe LA-LVZ (<0.5 mV). The LA contact areas (CoAs; ascending aorta-anterior LA, descending aorta-posterior LA, and vertebrae-posterior LA) were assessed using computed tomography.
Results: The SCZ was distributed linearly (figure), and observed in 35 of 36 patients (97.2%). The SCZ was often found in the anterior (89%), roof (64%), and septal wall (47%) of LA, and longest in patients with LS-PeAF (PAF: 56±34 mm, PeAF; 79±41 mm, LS-PeAF; 107±34mm, P=0.0351). The prevalence rate of SCZ (97.2%) was higher than LVZ (figure, mild LA-LVZ; 91.7%, moderate LA-LVZ: 66.7%, severe LA-LVZ; 25%). The 55.8% of SCZ overlapped with mild LA-LVZ, 37.6% of SCZ with moderate LA-LVZ, and 19.1% of SCZ with severe LA-LVZ. The LA CoAs were found in all patients. A total of 72 CoAs (average surface area, 7.0±4.0 cm^2) were identified. A CoA was found in each of the three representative regions, ascending aorta-anterior LA (4.1±2.0 cm^2, 36 of 36 patients, 100%), descending aorta-posterior LA (2.3±1.2 cm^2, 12 of 36 patients, 33%), and vertebrae-posterior LA (3.4±2.1 cm^2, 24 of 36 patients, 67%). However, only 22% of SCZ matched with the LA anatomical contact areas.
Conclusion: The slow conduction zone reflects LA electrical remodeling and may be a precursor finding of the low voltage zone, not LA contact areas in patients with atrial fibrillation.