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Introduction: Atrial fibrosis works as AF substrate because it causes conduction slowing and action potential duration shortening, which facilitate reentry. 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 and delayed enhancement MRI studies also show localized fibrosis, suggesting that fibrosis is heterogeneous process. These localized fibrotic regions have been shown to be a possible ablation target for substrate modification. The purpose of this study is to re-evaluate the bipolar voltage map 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 (100 beats per minutes) before AF ablation were analyzed. The maximum distance between 2 acquired points (interpolation) was strictly set at 5 mm. LA was divided into 7 regions including anterior, septum, roof, posterior, inferior, lateral wall, and LA appendage, and each LA region was further 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 highest voltage of each LA region and total LA was calculated. LVZ was defined as three cutoffs including <0.5mV (LVZ0.5), <1.0mV (LVZ1.0), and <1.5mV (LVZ1.5). Patients were classified into three groups according to tertiles (G1, G2 and G3). Total activation time (TAT) of the LA was defined as the time interval between the earliest activation site to the latest activation site.

Result: LVZ0.5, LVZ1.0, and LVZ1.5 appeared when the mean LA voltage decreased under 4 mV, 5 mV, and 6 mV, respectively. The extent of LVZ at each threshold had negative linear relationship with the mean LA voltage under 4 mV, 5 mV, and 6 mV (R=-0.78, -0.84, -0.81, respectively) (Figure 1). When mean voltage was calculated only in the inferior wall, where LVZs were rarely identified, there was a similar negative relationship between the mean voltage of inferior wall and LVZ0.5, LVZ1.0, and LVZ1.5. The mean voltage at anteroseptal-roof, posteroinferior, lateral, and LA appendage were significantly different in all groups (G1 to G3). TAT was negatively associated with the LA mean voltage (R = -0.70).
Conclusion: LVZ appears as the global voltage decreases under some threshold. Bipolar voltage at anteroseptal and roof region seems to be lower by nature. LA conduction time prolongs as mean voltage decreases. These data suggest that fibrotic remodeling in the LA would not be a heterogeneous process but more homogenous process, which raise a question about substrate modification strategy targeting localized fibrotic regions.