

Correlation of left atrial transport function and bipolar voltage maps in patients with atrial fibrillation

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Background: Bipolar voltage mapping is a widely accepted approach to identify areas of arrhythmogenic substrate in patients undergoing atrial fibrillation (AF) ablation.

However, until now little is known about the correlation of left atrial (LA) bipolar voltage distribution and LA transport function.

Purpose: To study the impact of LA low voltage zones on LA transport function.

Methods: 107 consecutive patients referred for ablation of symptomatic AF (34 paroxysmal, 73 persistent AF) were prospectively enrolled. Each patient underwent cardiac magnetic resonance imaging (CMR) within 24 hours prior to the ablation procedure. 59 patients were in sinus rhythm (SR) and 48 in AF. LA phasic indexed volumes and ejection fractions were calculated using biplane area length formula. In addition, LA phasic strains and strain rates were analyzed using dedicated tissue tracking software (Figure 1A&B).

LA bipolar voltage mapping was performed prior to beginning of ablation in SR, using a 3-dimensional mapping system, and low voltage zones (LVZ) were defined as areas of bipolar voltage <0.5mV.

Results: LVZ were present in 47 patients. The area of LVZ was 14.6cm² (5.3-34.0). For patients in AF at the time of CMR, only elevated minimal and maximal LA volume indices ($p = 0.001$ and $p = 0.002$ respectively) but no LA functional parameter was predictive for the occurrence of LVZ. In contrast to patients in SR, all LA phasic volumes (endsystolic, pre atrial contraction and enddiastolic LA volume indices) and LA function parameters (passive, active and total ejection fraction, reservoir, conduit and booster pump strains and strain rates) were predictive for the occurrence of LVZ. After clustered multivariate logistic regression, only impaired total LA ejection fraction and LA booster pump strain rate was still predictive for occurrence of LVZ (OR 0.842, 95% CI 0.772-0.918, $p < 0.001$ and OR 0.954, 95% CI 0.931-0.978, $p < 0.001$).

In addition, Pearson correlation analysis revealed a strong link between LA booster pump functional parameters and cm² expansion of LVZ areas: LA active ejection fraction, LA booster pump strain and strain rates ($r = -0.42$, $p = 0.044$; $r = -0.47$, $p = 0.024$; $r = -0.65$, $p = 0.001$ [Figure 1C], respectively).

Conclusion: LA transport function is closely linked to the occurrence of LA low voltage zones. Furthermore LA booster pump function parameters show robust correlation to the extension of LA low voltage zones.

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