

Left Pulmonary Veins Isolation: The Cornerstone in Noninvasive Evaluation of Substrate Modification After Catheter Ablation of Paroxysmal Atrial Fibrillation

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Background. Pulmonary vein isolation (PVI) is the cornerstone of the paroxysmal atrial fibrillation (pAF) treatment and P-waves analysis is vastly employed to assess any atrial substrate modifications (ASM) provoked by PVI. However, whether left (LPVI) and right PVI (RPVI) affect equally the ASM remains unexplored. Clarifying this issue would assist in the further understanding of the impact of PVI on the AF mechanisms.

Methods. Five-minute lead II recordings of 40 pAF patients undergoing PVI for the first time were recruited. Recordings were extracted before PVI (B), after LPVI (L) and after RPVI (R) at 1 kHz sampling frequency. P-waves were detected and signal-averaged features of duration, amplitude and area were calculated. Heart-rate fluctuations were mitigated for duration and area ($HR_{Duration}$, HR_{area}). Results were compared between each transition (B-L: LPVI, L-R: RPVI) and between the variations that each transition provoked on the features with non-parametric tests.

Results. After LPVI, P-wave showed lower duration (B: 120 ms, L: 104 ms, $\Delta_{B-L} : -13.3\%$, $p = 0.001$) and amplitude (B: 0.428 mV, L: 0.354 mV, $\Delta_{B-L} : -17.29\%$, $p = 0.055$). Duration (R: 106.5 ms, $\Delta_{L-R} : +2.40\%$, $p = 0.558$) and amplitude (R: 0.374 mV, $\Delta_{L-R} : +5.65\%$, $p = 0.319$) got slightly but not statistically increased after RPVI. Heart-rate fluctuation mitigation mostly preserved these trends but lost statistical power ($HR_{Duration}$: $\Delta_{B-L} : -10.54\%$, $p = 0.141$, $\Delta_{L-R} : -5.52\%$, $p = 0.740$). When compared the effect of each PVI transition on the features' variation, LPVI showed a significantly higher effect on duration than RPVI ($p < 0.0001$). The remaining results showed insignificant values ($p > 0.05$).

Conclusions. Variations observed in P-wave features after PVI stem principally from the LPVI, which contributes significantly to the ASM. Studies focusing on ASM observation should implement and prioritize the analysis of LPVI recordings.