Adjustment of the Early Meets Late Module to Differentiate the Active Circuit of a Dual Loop Reentrant Atrial Tachycardia

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1 CASE

A 78-year-old woman with a history of a pulmonary vein (PV) isolation (PVI) of atrial fibrillation was referred to our institution for catheter ablation of an atrial tachycardia (AT) (Figure 1A). She had previously received an aortic valve replacement for aortic regurgitation, mitral valvuloplasty for mitral regurgitation, and left atrial appendage closure. The AT cycle length (CL) was 242 ms with a distal to proximal activation sequence in the coronary sinus (CS). After a transseptal approach, an activation map of the left atrium (LA) and PVs was created during the AT guided by the CARTO3 mapping system (Biosense Webster, Diamond Bar, CA, USA) with a multipole mapping catheter (Pentaray NAV, Biosense Webster). A left PV (LPV) reconnection was observed. The LA activation map suggested a dual loop macroreentrant AT: an LA roof dependent reentry around the LPV that descended along the LA anterior wall and ascended along the posterior wall, and an LPV gap reentry through the LPV carina (Figure 1B). Which was the active circuit of this reentrant AT?

2 DISCUSSION

Recently, the development of the 3-dimensional mapping systems has enabled the meticulous clarification of the AT circuit and has shown a sufficient diagnostic performance without entrainment pacing. Nonetheless, the differentiation of the active circuit from the passive circuit in a dual loop reentry is still challenging.1 In such complicated AT cases, entrainment pacing is useful for determining the dominant circuit. In this case, the post-pacing interval (PPI) – tachycardia CL (TCL) on the LA roof, mitral isthmus, and LPV carina was 2, 6, and 44 ms, respectively, which suggested a diagnosis of an LA roof dependent AT (Figure 2). However, an AT alteration or termination during entrainment pacing is a major concern, with a reported incidence of 3–10%.2,3 In this situation, the early meets late (EML) module, in particular, the lower threshold module, could sometimes be useful to distinguish the active circuit. The upper threshold of the EML is well known as a useful module to visualize reentrant circuits, connecting the earliest activation and latest activation of the mapping window of interest as colored in red. The lower threshold is useful for detecting conduction block between 2 adjacent mapping sites. If there is a large discrepancy in the activation times between the 2 points that cannot be explained by direct conduction, the lower threshold shows a white line between them. In this case, a setting of the upper threshold of 80% and lower threshold of 10% suggested a diagnosis of an LA roof dependent AT, and visualized a block line at the anterior and posterior aspects of the LPV carina area possibly on the previous PVI line (Figure 2). A linear ablation of the LA roof line

terminated the AT. A further increase in the value of the lower threshold revealed the location of the LPV gaps (11% for anterior gaps and 12% for posterior gaps) (Figure 3). Additional RF applications at the gaps detected by the adjustment of the lower threshold value successfully achieved the LPVI. No AT was inducible at the end of the procedure. The adjustment of the lower threshold might be advantageous to differentiate an active circuit of a dual loop reentry by detecting an activation discrepancy between the points, in particular, a confluence area of the 2 reentries. A further adjustment identified the PV gap in the same AT map. With the use of the lower threshold, both the AT circuit and PV gaps could be identified even in one activation map. Further study would be warranted to assess the diagnostic performance of this module for determining the active circuit of a dual loop reentry as compared to entrainment pacing.

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Figure legends

Figure 1

A. Twelve-lead electrocardiograms of a regular narrow QRS tachycardia.

B. The LA activation mapping of the AT with an EML upper threshold of 80% suggests a dual loop AT: LA roof-dependent AT (solid dotted line) and LPV gap reentry (solid dashed line).

LA, left atrium; AT, atrial tachycardia; LAT, local activation time; EML, early meets late; LSPV, left superior pulmonary vein; LIPV, left inferior pulmonary vein; RSPV, right superior pulmonary vein; RIPV, right inferior pulmonary vein; SUP, superior; LPO, left posterior oblique; PA, posterior-anterior

Figure 2

Intracardiac electrograms of entrainment pacing from the (A) LA roof showing a PPI – TCL of 2ms, (B) mitral isthmus showing a PPI – TCL of 44ms, and (C) LPV carina showing a PPI – TCL of 6ms. An LA roof dependent AT as an active circuit is clearly shown by the EML (80% upper and 15% lower thresholds).

LA, left atrium; EML, early meets late; CS p, coronary sinus proximal; CS d, coronary sinus distal; S, stimulus; PCL, pacing cycle length; PPI, post pacing interval; TCL, tachycardia cycle length.

Figure 3

AT activation map revealing a gap site on the previous left pulmonary vein (LPV) isolation line on the (A) anterior aspect and (B) posterior aspect of the LPV carina with lower threshold values of 11% and 12% in the early meets late module, respectively.

AT, atrial tachycardia; LPO, left posterior oblique; PA, posterior-anterior