Transition between different types of biatrial tachycardia during catheter ablation: Implication for ablation strategy

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Introduction

Biatrial tachycardia (BiAT) is an atypical form of atrial tachycardia (AT), which contains both the right and left atria and 2 distinct interatrial connections in the circuit. BiAT is most frequently observed in patients with a history of open heart surgery[1] or catheter ablation for atrial fibrillation.[2] BiATs are classified into 3 types in terms of tachycardia circuits: a circuit containing mitral and tricuspid annuli (type 1), that containing the right atrial septum and mitral annulus (type 2), and that containing the right and left septa (type 3).[3] However, factors that determine which type of BiAT occurs remain unclear.

Case report

An 82-year-old woman was referred for catheter ablation for AT. Four years prior, the patient underwent aortic valve replacement surgery for aortic valve stenosis. Since the patient had a history of paroxysmal atrial fibrillation, pulmonary vein isolation with cryoablation was also performed during the surgery.

The voltage map created during sinus rhythm showed extensive low-voltage area throughout the left atrium. No reconnection was observed on pulmonary vein isolation. Left atrial posterior wall isolation was performed empirically to prevent roof-dependent AT, and linear ablation was performed on the cavotricuspid isthmus to prevent peritricuspid AT. Thereafter, an AT (AT1) with a tachycardia cycle length (TCL) of 280 ms was induced by atrial burst pacing. The activation map revealed block lines on the anterior wall and anteroseptum of the left atrium and a localized-reentrant AT propagated through 2 gaps between the block lines (Figure 1A). We ablated the gap on the anteroseptum and connected the ablation line to the isolation line for the right pulmonary veins (Figure 1B). The AT1 was terminated during ablation; however, another AT (AT2) with a TCL of 310 ms was induced by atrial burst pacing. In the left atrial map, the AT2 showed a centrifugal pattern from the basal anteroseptum (ie, the connection site of the Bachmann bundle). Activation then propagated downward on the ventricular side of the septum and in a clockwise direction on the mitral annulus, resulting in the collision of the 2 activation wavefronts on the inferoseptum. The right atrium was mapped as we suspected that the AT2 was a BiAT. The right atrial map showed the activation of the right atrial septum in the upward direction from the coronary sinus ostium (Figure 2A). The block line on the cavotricuspid isthmus was not reconnected. Entrainment pacing showed a postpacing interval (PPI) similar to the TCL at the left atrial anteroseptum, ventricular side of the left atrial septum, proximal coronary sinus, and right atrial septum. The mitral annulus was considered

KEY TEACHING POINTS

- Since biatrial tachycardias (BiATs) usually occur based on an electrical obstacle located in the septum, ablation to the septum may provide a substrate for BiATs.
- BiATs are classified into 3 types in terms of tachycardia circuits: a circuit containing mitral and tricuspid annuli (type 1), that containing the right atrial septum and mitral annulus (type 2), and that containing the right and left septa (type 3).
- The ablation strategy for BiATs is interrupting the tachycardia circuit by ablating an anatomical isthmus or interatrial connection; however, creating a conduction block in an anatomical isthmus may give rise to a transition to another type of BiAT.

KEYWORDS Biatrial tachycardia; Catheter ablation; Bachmann bundle; Coronary sinus; Mitral isthmus line
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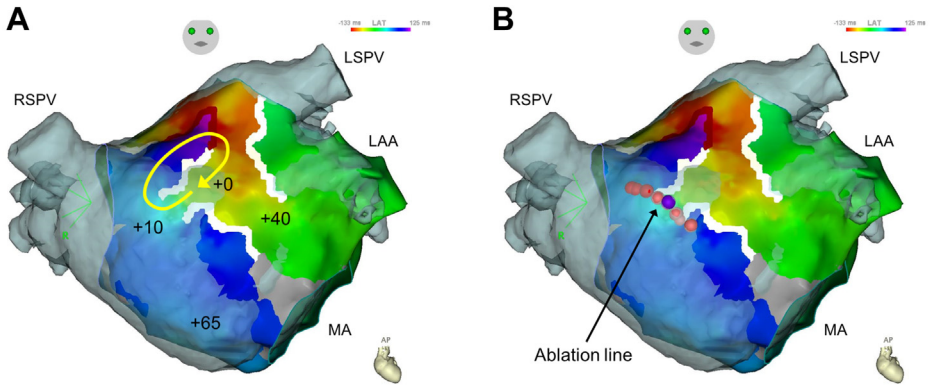

Figure 1 The localized-reentrant atrial tachycardia (AT) on the anteroseptum of the left atrium. **A:** The activation map of the localized-reentrant AT. Block lines (*white lines*) were observed on the anterior wall and anteroseptum of the left atrium, and a localized-reentrant AT propagated through 2 gaps between the block lines in the clockwise direction. The numbers on the map show the postpacing interval after entrainment pacing minus the tachycardia cycle length. **B:** The ablation line for the localized-reentrant AT. A purple tag indicates the ablation site where the AT was terminated. LAA = left atrial appendage; LSPV = left superior pulmonary vein; MA = mitral annulus: RSPV = right superior pulmonary vein.

out of the circuit, as entrainment pacing from the lateral mitral annulus antidromically captured the coronary sinus and showed a PPI longer than the TCL. Therefore, the AT2 was diagnosed as the BiAT containing the right and left atrial septa in the circuit (type 3). The earlier ablation lesion on the left atrial anteroseptum was extended toward the mitral annulus to complete an anteroseptal mitral line (Figure 2B). Then, the AT2 transitioned to AT3 with a TCL of 330 ms. The activation map showed the counterclockwise activation of the mitral annulus and upward activation of the right atrial septum (Figure 3A). The entrainment pacing demonstrated that the PPI was similar to the TCL throughout the mitral annulus, coronary sinus, and right atrial septum. Therefore, the AT3 was diagnosed as the BiAT containing the right atrial septum and mitral annulus in the circuit (type 2). The AT3 was terminated during linear ablation of the lateral mitral isthmus. Finally, a complete block line was created on the lateral mitral isthmus. Although the activation of the left atrial appendage was delayed after ablation, the left atrial appendage was not electrically isolated (Figure 3B). No AT was inducible after the procedure. No recurrence of any atrial tachyarrhythmias was observed and no antiarrhythmic drugs were taken during the 15-month follow-up. Anticoagulation therapy was continued after the procedure, and no thromboembolic event occurred.

Discussion

BiATs usually occur based on an electrical obstacle located in the septum. In this case, the incomplete block line created on the anteroseptum of the left atrium may have provided the substrate for the septal-type BiAT (type 3). Furthermore, the extension of the block line toward the mitral annulus rendered the anteroseptal block line complete and consequently hindered the downward activation on the ventricular side of the left atrial septum. As a result, the clockwise activation of the mitral annulus became the dominant circuit, giving rise to the transition to the BiAT with the circuit containing the mitral annulus (type 2). Theoretically, the incomplete and complete block line on the septum can cause

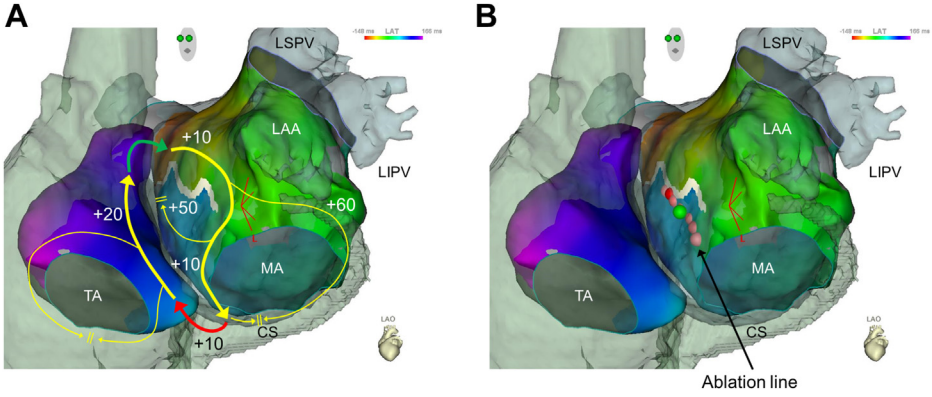

Figure 2 Biatrial tachycardia (BiAT) that contains the right and left atrial septum in the circuit (type 3). **A:** The activation map of the BiAT. Activation through the Bachmann bundle (*green arrow*) arose from the basal anteroseptum of the left atrium and propagated downward on the ventricular side of the septum. The activation was conducted to the inferoseptum of the right atrium through the coronary sinus (*red arrow*) and propagated upward on the right atrial septum. **B:** The ablation line for the BiAT. The green tag indicates the ablation site where the BiAT transitioned to another BiAT. CS = coronary sinus; TA = tricuspid annulus. Other abbreviations as in Figure 1.

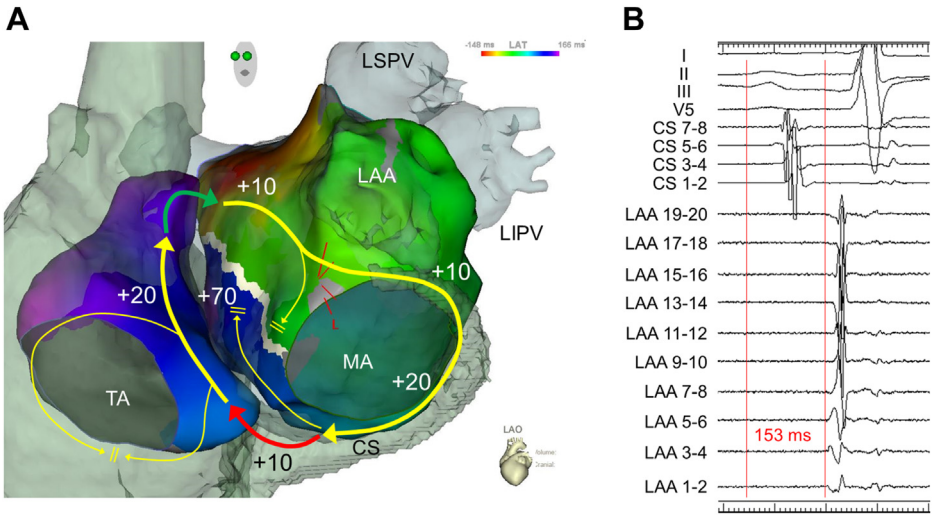

Figure 3 Biatrial tachycardia (BiAT) that contains the right atrial septum and the mitral annulus in the circuit (type 2) and a tracing recorded after ablation. **A:** The activation map of the BiAT. The activation through the Bachmann bundle (*green arrow*) propagated around the mitral annulus in the clockwise direction and conducted to the right atrium through the coronary sinus (*red arrow*). **B:** The tracing after linear ablation on the lateral mitral isthmus. The interval between the onset of P wave and left atrial appendage potential was 153 ms. Abbreviations as in Figure 2.

type 3 BiAT and type 2 BiAT, respectively. However, to the best of our knowledge, this is the first case report that proved this theory through the direct transition from type 3 BiAT to type 2 BiAT during linear ablation on the left atrial anteroseptum.

The findings observed in this case provide critical insights for considering ablation strategy of BiATs. Firstly, when ablation of localized-reentrant ATs is performed on the anterior wall or septum, ablation lines should be designed in a manner where ablation to the septum is avoided as much as possible. In this case, the occurrence of BiATs could have been avoided if the gap on the anterior wall was ablated instead of that on the anteroseptum. Secondly, the creation of the complete block line on the septum may not be the appropriate strategy for ablating type 3 BiATs. In some previous reports,[3,4] to treat BiATs, ablation was performed targeting the connection site of the Bachmann bundle to the atria. In this case, the complete block line was created on the anteroseptum instead of ablating the Bachmann bundle connection because we were concerned about the recurrence of the BiAT as a result of the reconnection of the Bachmann bundle[4]; however, this strategy cannot prevent type 2 BiAT. Thirdly, the complete block line was added on the lateral mitral isthmus to ablate the type 2 BiAT; however, this ablation strategy may cause electrical isolation of the left atrial appendage. Since the interatrial conduction through the Bachmann bundle was preserved, we decided to create the lateral mitral isthmus line even though the block line had already been created on the left atrial anteroseptum. However, a delay in the activation of the left atrial appendage occurred after ablation, suggesting Bachmann bundle damage. The left atrial appendage would be electrically isolated when the conduction through the Bachmann bundle is disrupted owing to atrial remodeling.

The transition between different types of BiATs is theoretically possible but has not been fully described. The importance of the appropriate ablation design for the prevention and treatment of BiATs should be highlighted.

References

1. Namdar M, Gentil-Baron P, Sunthorn H, Burri H, Shah D. Postmitral valve replacement biatrial, septal macroreentrant atrial tachycardia developing after perimitral flutter ablation. Circ Arrhythm Electrophysiol 2014;7:171–174.
2. Mikhaylov EN, Mitrofanova LB, Vander MA, et al. Biatrial tachycardia following linear anterior wall ablation for the perimitral reentry: incidence and electrophysiological evaluations. J Cardiovasc Electrophysiol 2015;26:28–35.
3. Kitamura T, Martin R, Denis A, et al. Characteristics of single-loop macroreentrant biatrial tachycardia diagnosed by ultrahigh-resolution mapping system. Circ Arrhythm Electrophysiol 2018;11:e005558.
4. Kusa S, Hachiya H, Iesaka Y. Biatrial tachycardia occurring after mitral/tricuspid valve repair using a superior transseptal approach: where is the optimal ablation site? J Cardiovasc Electrophysiol 2019;30:1154–1155.