Mitral isthmus (MI) ablation is one of the important steps in the context of persistent atrial fibrillation ablation. However, achieving a complete transisthmus conduction block is challenging. Furthermore, incomplete conduction block can increase the risk of recurrent perimital atrial tachycardia (AT). We describe a case wherein endocardial conduction block across the MI line was established, but a residual left atrial-to-coronary sinus (LA-CS) connection served as an epicardial bypass to maintain recurrent perimital AT.

Case Reports
A 58-year-old man was admitted for catheter ablation of recurrent AT (Figure 1A) after 2 previous persistent atrial fibrillation ablation procedures involving pulmonary vein (PV) isolation and MI ablation. Baseline AT cycle length was 220 ms. A steerable decapolar catheter was inserted into the CS, and an externally irrigated ablation catheter was advanced into the LA through a transseptal puncture. Electrograms on CS 1-2 showed double potentials 74 ms apart (Figure 1B). On activation and entrainment mapping, clockwise perimital AT was diagnosed. Endocardial mapping with the ablation catheter along the previous MI line showed double potentials separated by 90 ms. The 2nd component of the double potentials corresponded to the 2nd component of the double potentials on CS 1-2. The 1st component on the ablation catheter preceded the 1st component on CS 1-2 by 16 ms (Figure 1B). The AT

Figure 1. A, Twelve-lead ECG of clinical AT. B, Mapping catheter is positioned on the MI line endocardially and records double potential spanning 90 ms (red arrows). Double potential spanning 74 ms (blue arrows) is also observed on CS 1-2. Note that the 2nd potential on the line corresponds to the 2nd potential on CS 1-2, and the 1st potential on the line precedes the 1st potential on CS 1-2 by 16 ms. RF indicates radiofrequency.
terminated immediately after radiofrequency application just distal to bipole CS 1-2. When the AT terminated, the last beat on CS 1-2 showed a small potential (red arrow, Figure 2A) that preceded the 1st potential on CS 1-2 during AT by 16 ms (Figure 1B). This small potential (red arrow, Figure 2A) was also identified after a larger sharp potential (purple arrow, Figure 2B) during sinus rhythm. Subsequent pacing maneuvers showed complete bidirectional block across the MI line. There has been no recurrence of atrial tachyarrhythmia until the last available follow-up (1 year).

Discussion
The muscle fibers of the CS wall circumferentially envelop the vein all along its length. Myocardial fibers of varying morphology extend from the CS wall to the inferior LA epimyocardium.1,2 Establishment of the transmural MI lesion is necessary to achieve complete bidirectional MI block.3 In about 70% of the patients undergoing MI linear ablation, ablation from inside the CS is required to eliminate local epicardial LA-CS connections and attain transmurality.

Recurrent perimital reentry can propagate over an endocardial or an epicardial gap in the MI linear lesion. Distinguishing local CS muscle (epicardial) potentials from far-field LA (endocardial) potentials is essential in the assessment of complete (transmural) MI block, using differential pacing technique.4 Furthermore, variable conduction in LA-CS connections resulting from extensive prior ablation procedure(s) can make the assessment of complete block more difficult. In this case, bipole CS 1-2 recorded far-field LA endocardial potentials on the MI line as a double potential, that is, a small potential (red arrow) recorded as a last potential during the termination of AT and a 2nd potential (blue arrow) just preceding it. These were preceded by a larger sharp potential (purple arrow, Figure 2A) that represented local CS musculature potential. During AT, the impulse traveled clockwise over the anterior mitral annulus endocardially. When the impulse was lateral to the previously created MI line, the small far-field potential (red arrow, Figure 2A) was also recorded on bipole CS 1-2. From there, the impulse conducted to the epicardium, generating local CS musculature potential on bipole CS 1-2 (purple arrow, Figure 2A). Subsequently, the impulse bifurcated and propagated as 2 wave fronts: One component continued epicardially to CS 9-10 and the other component reentered the endocardium over another LA-CS connection just proximal to CS 1-2, creating a 2nd far-field potential (blue arrow, Figure 2A) on bipole CS 1-2. The latter propagated toward bipole CS 9-10 endocardially. Epicardial radiofrequency application just distal to bipole CS 1-2 eliminated the connection from the LA to the CS, that is, between small far-field potential (red arrow, Figure 2A) and sharp local CS 1-2 potential (purple arrow, Figure 2A), which resulted in AT termination without inscription of sharp local CS potential. These electrophysiological findings suggest that complete endocardial linear block across the MI was present during ongoing AT before the radiofrequency application. In addition, a residual epicardial connection between the LA and the distal CS played a critical role in bypassing the endocardially blocked MI line to perpetuate the perimital AT, which was immediately terminated locally by spot epicardial ablation.

This case highlights the critical role of connections between the LA and the CS in transmirtal isthmus conduction necessary for the maintenance of perimital AT.
Elimination of such residual connections is necessary to prevent recurrent perimitral AT and achieve complete bidirectional conduction block across the MI.

Disclosures

None.

References


Key Words: perimitral atrial tachycardia ■ atrial fibrillation ■ catheter ablation ■ mitral isthmus
Recurrent Perimitral Tachycardia Using Epicardial Coronary Sinus Connection to Bypass Endocardial Conduction Block at the Mitral Isthmus
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Circ Arrhythm Electrophysiol. 2011;4:e39-e41
doi: 10.1161/CIRCEP.111.963157

The online version of this article, along with updated information and services, is located on the World Wide Web at:

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