ANSWER TO APRIL 16th QUESTION

A. Epicardial connection using the coronary sinus should be evaluated for participation in clockwise perimitral atrial flutter.

Explanation

The atrial flutter in April 16th Question has a cycle length of ≈242 ms. The electroanatomic map shows mapped points with relative activation times spanning almost the entirety of the cycle length (-122 ms to +111 ms). The activation sequence is consistent with clockwise perimitral atrial flutter.

The pacing maneuver from the coronary sinus (CS) 9,10 at 6 o'clock around mitral annulus shows evidence of fusion on coronary sinus electrograms, concealed entrainment, and the local post-pacing interval equaling the tachycardia cycle length (≈242 ms). These findings confirm the mechanism to be macroreentry and indicate the proximal CS site to be part of the reentry circuit. [1] This would be consistent with a perimitral left atrial flutter. The pacing maneuver from the endocardial lateral mitral isthmus shows, a post-pacing interval (281 ms), i.e. ≈40 ms longer than the tachycardia cycle length, and a difference in the stimulus-to-atrial electrograms during pacing versus local electrogram-to-rest of atrial electrograms during tachycardia. This indicates the local fractionated endocardial lateral mitral isthmus site to be outside the reentry circuit.

In presence of an endocardial mitral isthmus block, a perimitral flutter can propagate using the epicardial coronary sinus muscle. [2,3] After excluding the endocardial mitral annular tissue's participation in the reentry circuit entrainment maneuver was performed from epicardial lateral mitral isthmus within the coronary sinus (CS 1,2) as shown in Figure 1 (answer option A). After consolidation of the previously performed endocardial lateral mitral isthmus linear ablation, ablation lesions were delivered on the corresponding epicardial aspect in the coronary sinus (Figure 2) with termination and non-inducibility of the flutter, with no clinical recurrence during 6 months of follow-up.

Option B to exit the left atrium and entrain from the cavotricuspid isthmus is incorrect because this is clearly a left atrial flutter with on a short (≈40 ms) difference between the post-pacing interval and tachycardia cycle length with entrainment from the endocardial lateral mitral isthmus, and establishment of the CS 9,10 electrogram at 6 o'clock location around the mitral annulus to participate in the reentry circuit.

Option C is incorrect because early-meets-late is an artificial consequence of the chosen window-of-interest setting preceding and following the fiducial reference electrogram. [4] Changing the window-of-interest with

relation to the reference electrogram will change the colors assigned for the local activation time in all parts of the mapped chamber, without changing the sequence of activation. In this example of the flutter circuit around the mitral annulus, successful ablation can be performed at any location around the mitral annulus, so long as the ablation line can be anchored at both ends to anatomic or functional boundaries to completely transect the path of the flutter circuit. [5] Ablation along the early-meets-late stripe from the mitral annulus to the wide area circumferential ablation around the right pulmonary veins will successfully eliminate the flutter but is not advisable. Ablation along the septum carries an unnecessary risk of injury to the conduction system. Further, this is not the most efficient site and will require a new long line of ablation across the septum with difficult catheter contact and risk of an incomplete line and proarrhythmia.

Option D is incorrect because, as discussed before, based on the entrainment responses this is a macroreentrant mechanism and not a focal microreentrant tachycardia. Further, as discussed above the early or red area in a macroreentrant circuit is an illusion created by the chosen mapping window-of-interest. Macroreentry is a continuous circuit with every site in the circuit having an earlier preceding site with no defined earliest site.

Even though the electrogram at CS 9,10 is part of the reentrant circuit, focal ablation at this site will not eliminate the flutter (option E). Ablation would have to target both the endocardial left atrial and epicardial coronary sinus muscle in this location and a long linear ablation performed from the mitral annulus to the right or left wide area circumferential pulmonary vein ablation lines to preclude conduction across and completely transect the left atrial floor. [5]

REFERENCES

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Figure 1. **Entrainment from distal coronary sinus.** This tracing shows concealed entrainment form coronary sinus (CS) 1,2 with post-pacing interval equal to tachycardia cycle length.

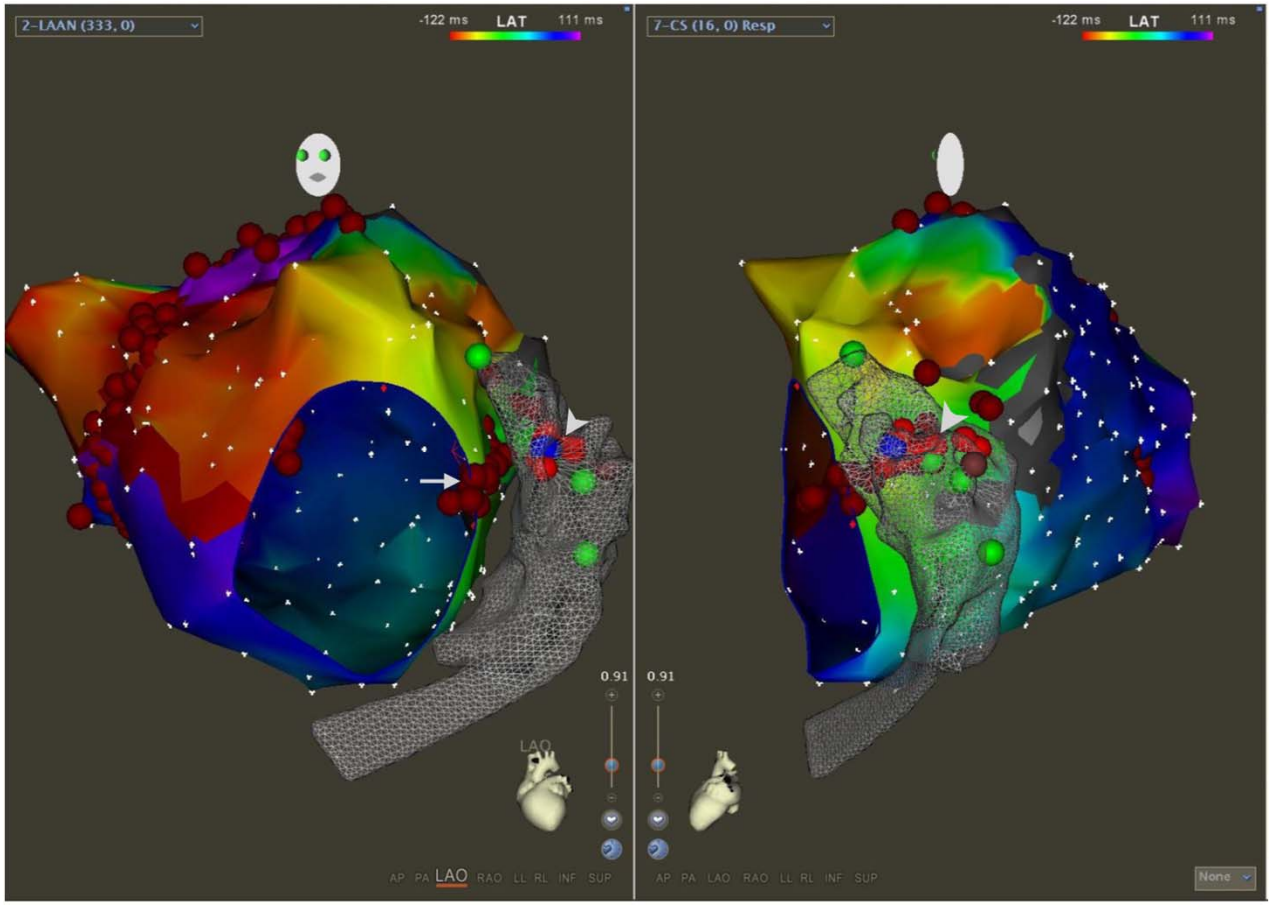

Figure 2. **Electroanatomic activation map of the atrial flutter.** Left anterior oblique (LAO) and left posterior oblique views are shown. The light green balls are sites of perfect entrainment from the coronary sinus. The arrow points to the empirical endocardial lateral mitral isthmus linear ablation points. The arrowhead shows the epicardial linear ablation in the coronary sinus opposite the endocardial line. The atrial flutter terminated at the dark blue ball and was subsequently not-inducible. Bidirectional conduction block was confirmed pacing from both sides of the ablation line.