Adenosine can improve the intra-atrial conduction block along the mitral annulus during accessory pathway ablation

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A 10-year-old boy with a supraventricular tachycardia was referred for catheter ablation. An electrophysiologic study revealed a left lateral concealed accessory pathway (AP). A few radiofrequency (RF) applications targeting the AP resulted in an inadvertent intra-atrial conduction block at the mitral isthmus without any damage to the AP. Adenosine was then administered during left ventricular pacing. Soon after that, the conduction at the mitral isthmus recovered partially, and that change disappeared soon. Those findings suggested that the administration of adenosine may transiently recover the conduction at the mitral isthmus damaged by RF ablation.

Keywords Adenosine; Accessory pathway; Mitral isthmus; Conduction block; Radiofrequency catheter ablation

It has been reported that an intra-atrial conduction block between the infero-lateral mitral annulus and left inferior pulmonary vein (mitral isthmus) can occur during radiofrequency (RF) ablation of left lateral accessory pathways (APs).1 However, the detailed electrophysiological characteristics of the mitral isthmus associated with that conduction block remain unknown. We report the use of adenosine in a case with inadvertent mitral isthmus conduction block during RF ablation of a left lateral AP.

Case report

A 10-year-old boy with a documented narrow QRS complex tachycardia underwent an electrophysiologic study and RF catheter ablation. At baseline, the 12-lead electrocardiograms exhibited no pre-excitation (Figure 1). Programmed atrial stimulation induced a supraventricular tachycardia with the earliest atrial activation in the distal coronary sinus (CS) (Figures 1 and 2). A definite diagnosis of an atrioventricular reciprocating tachycardia was obtained by entrainment pacing from the right ventricle. A few RF applications were delivered using a 7-French, 4 mm tip ablation catheter around the most distal CS electrode pair during the tachycardia (Figure 2). During the RF application, an increase in the local VA interval at the CS recording sites with a change in the retrograde atrial activation sequence suddenly occurred without any change in the tachycardia cycle length or VA interval in the His bundle (HB) region (Figure 2). The earliest retrograde atrial activation was recorded from the HB region and the atrial activation sequence within the CS was from proximal to distal. For the purpose of evaluating the elimination of the target AP and existence of a second AP, 6 mg of adenosine was administered in a bolus form during right ventricular pacing. Soon after that, a prolongation of the VA interval at the HB region and within the CS, and a reversal of the atrial activation sequence at the distal CS electrode pairs suddenly occurred (Figure 3). At that time, the VA interval recorded from the ablation catheter positioned on the lateral side of the first RF lesion never changed. Those changes in the atrial activation disappeared soon. Six milligrams of adenosine was then administered during left ventricular pacing in the same manner as that during right ventricular pacing. Soon after that, a reversal in the atrial activation sequence on the distal CS electrode pairs suddenly occurred, however, no prolongation in the VA interval was observed within the CS (Figure 3). The cause of the reversal in the atrial activation sequence on the distal CS electrode pairs was explained by the shortening of the interval between the pacing stimulus and local atrial potential. Those changes in the atrial activations again disappeared soon. Finally, a successful ablation of the AP was achieved on the distal side of the first RF lesion. After that, the administration of the same dose of adenosine as before the successful ablation demonstrated VA dissociation during right ventricular pacing.
Discussion

In this case, an intra-atrial conduction block at the mitral isthmus occurred during RF ablation of a left lateral AP as previously reported. Following the administration of adenosine, the conduction at that site transiently recovered. It has been reported that adenosine can transiently or permanently re-establish left atrial-pulmonary vein conduction in
the acute phase after successful pulmonary vein isolation. However, to the best of our knowledge, this is the first report demonstrating that adenosine could also improve the intra-atrial conduction at the mitral isthmus which was damaged during the RF ablation of a left lateral AP. The mechanism underlying that phenomenon is still unclear. Some speculations below may be proposed. At the atrial level, adenosine causes cell hyperpolarization and a reduction in both the action potential duration and refractoriness. Since functional intra-atrial conduction block can be achieved even in the presence of a stunned atrial myocardium surviving at the mitral isthmus, due to a partial cell membrane depolarization and refractoriness prolongation produced by the thermal injury, adenosine may render that myocardium transiently or permanently excitable and, thus, the intra-atrial conduction at the mitral isthmus may be re-established. An alternative explanation of that phenomenon may be electrotonic conduction over an unexcitable gap in the RF lesions, which may be facilitated by the same effect of adenosine as that on the atrial myocardium.

This case may provide a clinical implication for adenosine. Conduction block at the mitral isthmus may be targeted during the catheter ablation of atrial fibrillation and left atrial flutter. It has been recently reported that in pulmonary vein ablation, the use of additional RF applications to eliminate transient pulmonary vein reconnections induced by an adenosine injection leads to a reduction in the atrial fibrillation recurrence after pulmonary vein isolation, most likely due to the minimization of the subsequent pulmonary vein reconnection. Therefore, adenosine may also be useful for completing permanent conduction block during the catheter ablation of the mitral isthmus.

Conflict of interest: none declared.

References