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CASE REPORT: EDITOR'S HIGHLIGHTS

Use of Adenosine to Release an Entrapped Catheter During Ablation of Premature Ventricular Complexes



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ABSTRACT

Catheter entrapment is a rare complication during catheter ablation that may require surgical intervention. Use of adenosine to prolong diastole can be a safe and effective strategy to free the catheter and avoid significant morbidity. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:610-3) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

A 74-year-old male presented for an elective catheter ablation of premature ventricular complexes (PVCs).

MEDICAL HISTORY

The patient had a history of atrial fibrillation, transient ischemic attack, and rheumatic heart disease, and had undergone bioprosthetic mitral valve

replacement with a single-vessel coronary artery bypass grafting and Maze procedure in 2009. Recently, he was found to have a reduction in left ventricular ejection fraction to 35% to 40% and an elevated bioprosthetic valve gradient (peak gradient: 15 mm Hg; mean gradient: 9 mm Hg) in the setting of new typical atrial flutter and 11% PVC burden noted on a cardiac monitor.

DIFFERENTIAL DIAGNOSIS

The most likely causes for the newly reduced ejection fraction in this patient included the progression of coronary artery disease, an arrhythmia-induced cardiomyopathy from atrial flutter, or the moderate burden of PVCs. He underwent a successful catheter ablation of cavotricuspid isthmus-dependent atrial flutter. A coronary angiogram showed a patent graft and nonobstructive coronary artery disease. A repeat echocardiogram following atrial flutter ablation showed persistently depressed cardiac function. After

LEARNING OBJECTIVES

- To be aware of the potential complication of catheter entrapment during ablation, particularly when a prosthetic valve is present, and be knowledgeable about its potential sequelae.
- To understand the mechanism by which adenosine can possibly help free an entrapped catheter, thereby helping to avoid significant morbidity.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

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discussion with the patient, a decision was made to proceed with PVC ablation.

INVESTIGATIONS

The patient had frequent clinical PVCs with a right bundle branch block morphology, inferior axis, and positive pre-cordial concordance that suggested an origin in the basal anterior left ventricle (Figure 1). A decapolar catheter in the great cardiac vein revealed the earliest PVC signal near 1 o'clock on the mitral annulus. An irrigated 4-mm mapping and ablation catheter (Thermocool SMARTOUCH SF, Biosense-Webster, Diamond Bar, California) was advanced into the coronary sinus, and the earliest bipolar signal was recorded 30 ms pre-QRS on the surface electrocardiogram (Figure 2). Radiofrequency ablation with 20 W was attempted without suppression of PVCs because rising impedance limited radiofrequency delivery. A decision was made to proceed with endocardial mapping via retrograde approach from the right femoral artery. Careful mapping was performed along the mitral annulus opposite to the earliest site seen in the coronary sinus. Catheter manipulation was challenging in this region. An excessive torque was built in the catheter wedged between the prosthetic valve apparatus and large papillary muscle, and clockwise rotation pushed the catheter towards the septum. With counterclockwise rotation to bring the catheter back to anterior mitral annulus, the catheter suddenly became entrapped (Figure 3, Video 1).

MANAGEMENT

Under fluoroscopy, the operator attempted to release the catheter with clockwise or counterclockwise rotation, catheter advancement, or traction without success. Advancement of the catheter revealed a hinge point approximately 2 cm from the catheter tip. An intracardiac echocardiogram confirmed that catheter maneuvers did not affect the function and motion of the prosthetic mitral valve, which suggested the catheter was entangled in patient's native chordal structures. The patient remained hemodynamically stable (Video 1). Cardiothoracic surgery was contacted to stand by in case the catheter could not be freed. A 12 mg bolus of adenosine was given without achieving atrioventricular block. A bolus of 18 mg was administered that resulted in 5 s of asystole, and the entrapped catheter was successfully withdrawn; visual inspection confirmed it to be intact. An intracardiac echocardiogram showed unchanged valve motion and function. The procedure was concluded, and the patient was observed overnight with no apparent sequelae.

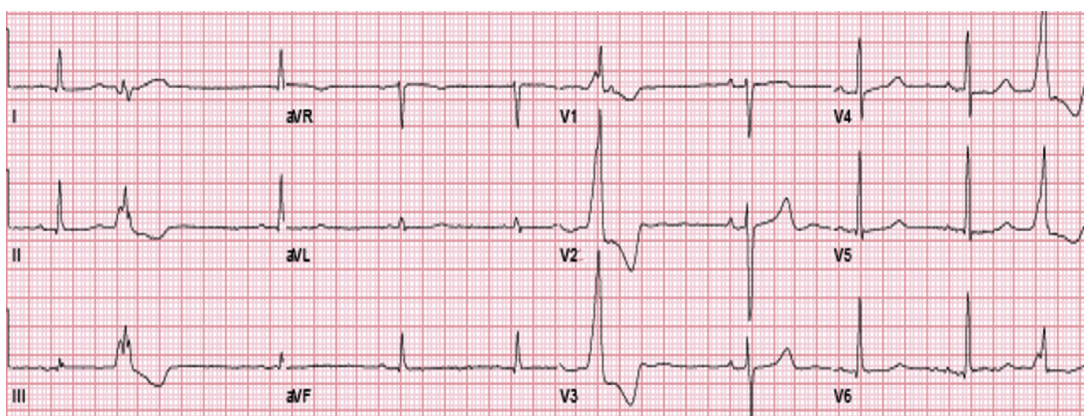
DISCUSSION

Our case describes a rare complication of an ablation catheter entrapment during PVC ablation in a patient with prosthetic heart valve. Ablation in patients with prosthetic valves carries additional risk of complications (1). Catheter entrapment in either a native or prosthetic mitral valve is a life-threatening complication that is not widely appreciated (2,3).

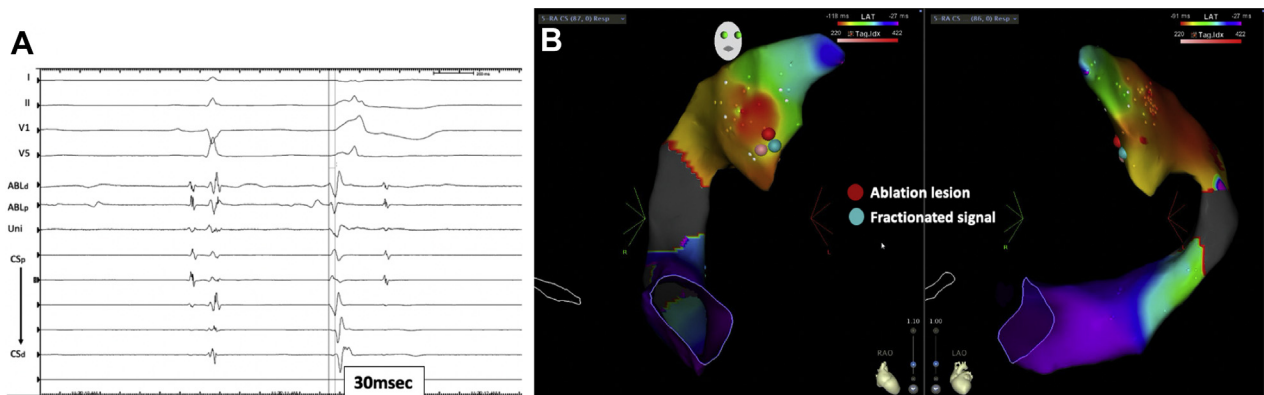
ABBREVIATION AND ACRONYM

PVC = premature ventricular complex

FIGURE 1 Clinical Premature Ventricular Complex



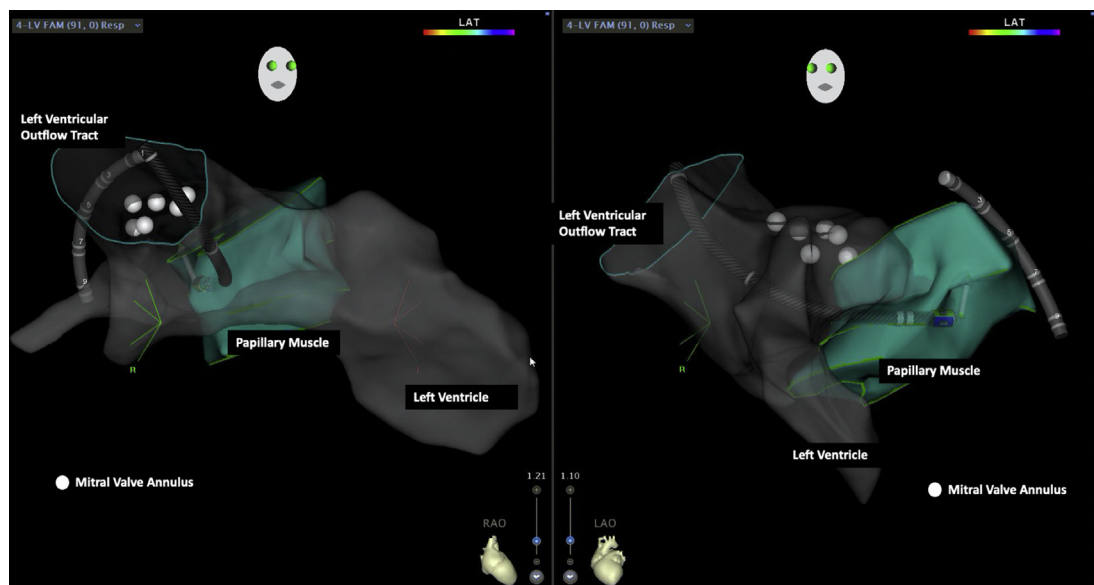
Left bundle branch block morphology with inferior axis and positive pre-cordial concordance suggests likely origin of premature ventricular complex in the anterior basal left ventricle.

FIGURE 2 Mapping of Premature Ventricular Complexes From Coronary Sinus

(A) Mapping within the coronary sinus revealed an earliest signal (30 ms pre-QRS on surface electrocardiogram) near 1 o'clock on the mitral annulus. (B) Ablation within the coronary sinus was limited due to rising impedance.

The incidence of catheter entrapment is likely under-reported, because adverse event reporting to regulatory agents or industry is completely voluntary. In a single-center review over 2 years, the incidence of catheter entrapment was estimated at 0.9% (95% confidence interval: 0.2% to 2.5%) (4). It was first reported during a left-sided accessory pathway

ablation via retrograde approach (2). Recently, cases have involved multipolar catheters, such as the Lasso (Biosense Webster) or PentaRay (Biosense Webster) during pulmonary vein isolation (4,5). Most of the reported cases required open-heart surgery to free the catheter or to replace the damaged valve after catheter retrieval (2-4).

FIGURE 3 Catheter Position at time of Entrapment

While mapping the endocardial left ventricle along the mitral annulus with the ablation catheter, the catheter became entrapped and did not release with rotational or backward traction or advancement. With catheter advancement, a hinge point approximately 2 cm off the catheter tip was visible.

Some cases reported successful release of the catheter with catheter manipulation or using other sheaths to provide support (4,5). Catheter entrapment in a tilting disc or bileaflet prosthesis can be particularly calamitous because any pulling may result in either complete closure of the valve with acute hemodynamic compromise or shearing of the catheter (6,7). Some cases have required a complex percutaneous extraction technique to snare the body or parts of the fractured catheters (6-9).

Using adenosine or rapid ventricular pacing has been described as an alternative strategy to release a catheter by removing tension from the mitral valve apparatus and/or chordae and freeing the catheter tip (4,6,7). However, no case has reported a success using this strategy. Mehta et al. (7) attempted an adenosine bolus that resulted in 10 s of asystole when the ablation catheter was entrapped inside Medtronic-Hall (Medtronic, Inc., Minneapolis, Minnesota) prosthetic valve; however, the traction on the catheter pulled the valve closed and ultimately required a complex extraction (7). Meanwhile, in our patient with a bioprosthetic valve, the catheter was entrapped in the subvalvular apparatus, and the administration of adenosine with transient asystole allowed a successful release of the catheter without the need for an extraction or surgical intervention. This simple maneuver is not widely appreciated and can prevent the need for emergent cardiac surgery in cases of catheter entrapment in the subvalvular apparatus in patients with prosthetic valves.

FOLLOW-UP

Transthoracic echocardiography after the case showed stable function of the prosthetic mitral valve and unchanged left ventricular function. The patient reported no symptoms. Repeat outpatient cardiac monitoring showed unchanged PVC burden; metoprolol was increased.

CONCLUSIONS

Catheter entrapment is a rare but serious complication during catheter ablation, particularly in patients with prosthetic heart valves. Catheter entrapment can lead to acute valvular regurgitation or stenosis with hemodynamic compromise, valve disc embolization, thrombosis, or stroke (2,10). When catheter manipulations fail to free an entrapped catheter, an adenosine bolus to induce a prolonged diastole can be a safe and effective strategy to prevent significant morbidity or escalation of intervention.

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KEY WORDS catheter ablation, complications, heart valve prosthesis

APPENDIX For a supplemental video, please see the online version of this paper.