When a multipolar catheter misses an "arm": A known complication experienced anew

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Introduction

Atrial arrhythmias are often encountered after cardiac surgery, with atrial fibrillation and atrial tachycardias (AT) being common early and late sequelae after operative mitral valve surgery. The mechanism of AT is most often macro-reentry originating from scars at the surgical access site, at insertion sites for the bypass cannulation, or around the implanted valve itself.[1] As there are different access paths for mitral valve surgery involving only the left atrium or both atria, the reentry circuit may be found in the left as well as the right atrium. Another possible mechanism for occurrence of AT in these patients may be structural myocardial changes with scar formation and volume overload in the left atrium caused by the severe mitral insufficiency.[2] As there are many possible substrates for arrhythmia, ablation of AT after mitral valve surgery is generally considered a challenging electrophysiological scenario.

Case report

A 76-year-old woman presented with symptomatic AT (atrial cycle length 240 ms). The patient did not tolerate antiarrhythmic therapy with amiodarone and was still symptomatic when taking rate-control agents such as beta-blockers and digoxin. She had previously undergone mitral valvuloplasty, tricuspid annuloplasty, and left atrial appendage closure in 2012, followed by mechanical mitral valve replacement (St. Jude Medical; 27mm) in 2018. Transthoracic echocardiography depicted severe biatrial enlargement. Left ventricular function was preserved, with an estimated systolic left ventricular function of 65%. Prior to the surgical procedure, the patient had already presented with symptomatic atrial fibrillation and paroxysmal AT. Two ablation procedures for pulmonary vein isolation (2012) and paroxysmal AT (2013) had been performed.

Clinically, the patient complained about fatigue and dyspnea attributable to the AT, which prompted the referral for a repeat catheter ablation procedure.

Owing to the previous ablation and surgical history in the presence of a severely dilated left atrium, 3-dimensional electroanatomical mapping (CARTO3 Version 7; Biosense Webster, Diamond Bar, CA) using a multipolar (PentaRay, Biosense Webster) catheter was performed. The data were merged with a preacquired contrast-enhanced cardiac computed tomography scan to serve as a 3-dimensional roadmap (Figure 1). The procedure was performed under general anesthesia and after exclusion of intracardiac clots by transesophageal echocardiography. Venous femoral puncture was performed using ultrasound guidance and a decapolar catheter was advanced in the coronary sinus as a reference. Activation mapping of the right atrium and the coronary sinus were suggestive of perimitral reentry. Double transseptal access was achieved using a radiofrequency needle (NRG; Baylis Medical, Toronto, Canada) and 2 nonsteerable sheaths (8.5F, TorFlex; Baylis Medical) were positioned in the left atrium.[3] During mapping at the anterior wall of the left atrium to identify a conduction gap close to the mechanical mitral valve prosthesis and a large anterior scar area (previous surgical access site during mitral valve surgery), 1 arm of the multipolar mapping catheter suddenly vanished (Figure 1D). The catheter was easily retracted into the sheath but the distal electrode poles of 1 of the arms had sheared off. After an initial check to rule out embolization to the head and confirmation

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KEY TEACHING POINTS

- Atrial tachycardias are a common sequela of mitral valve replacement. Profound knowledge of previous surgery and subsequent scarring is essential for successful procedure outcome.
- Novel high-resolution multipolar catheters may facilitate mapping in complex anatomic conditions but may be at risk for entrapment in mechanical valves.
- A careful risk-benefit assessment should be carried out in a case-by-case fashion.

of adequate anticoagulation, the procedure was continued until termination into stable sinus rhythm was achieved. In the subsequent waiting time, the missing element, measuring approximately 1 cm in length, was located in the left renal artery proximal to its branching level (Figure 2). Using a Simmons catheter (Performa, Merit Medical, South Jordan, Utah) and a snare (OneSnare, Merit Medical, South Jordan, Utah) via a 9F arterial femoral sheath, the thin catheter arm was extracted without further complications. The total procedural duration amounted to 293 minutes with cumulative radiation exposure of 1389.9 μGym^2 and a fluoroscopy time of 25.03 minutes. A follow-up echocardiography demonstrated normal function of the valve and the renal function remained nonimpaired.

Discussion

This case illustrates a critical incident that may occur when mapping close to mechanical valves. Entrapment of catheters in mechanical valves is a known complication in invasive electrophysiology and has been described with different catheters for many years.[4] Particularly for multipolar catheters, spline entanglement has been described by practitioners.[4–6] For the PentaRay catheter, this led to a class II recall in the United States in October 2016 by the Food and Drug Administration. In patients with prosthetic valves, use of this multipolar catheter as well as other high-resolution catheters, such as the Orion Mapping catheter (Boston Scientific) and Advisor HD Grid Mapping Catheter (Abbott

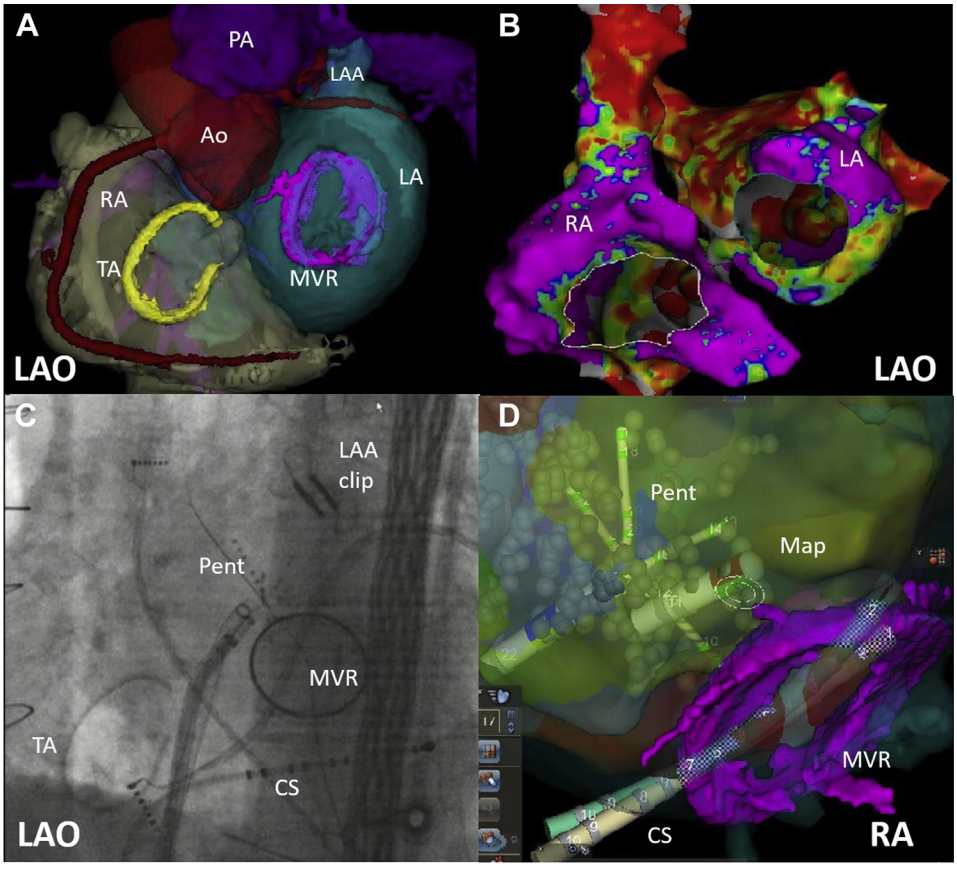

Figure 1 **A:** Three-dimensional (3D) reconstruction of a computed tomographic (CT) scan displayed in left anterior oblique (LAO) projection. The rings of the tricuspid annuloplasty (TA) and the mechanical mitral valve (MVR) are shown as well, to facilitate orientation for the operator. Note the remnant of the left atrial appendage (LAA), which is present despite surgical LAA clipping. **B:** Voltage amplitude map of the right (RA) and left atrium (LA). Note the scar area in the anterior wall of the LA corresponding to Waterston's access during surgery. **C:** Fluoroscopic image in LAO demonstrating double transseptal access and the multipolar PentaRay (Biosense Webster, Diamond Bar, CA) catheter (Pent) in the LA. **D:** 3D electroanatomical mapping of anterior superior aspect of the mitral valve in right anterior oblique (RAO) projection. Note that the Pent catheter has only 4 arms instead of the regular 5. Ao = aorta; CS = coronary sinus catheter; Map = mapping catheter; PA = pulmonary artery.

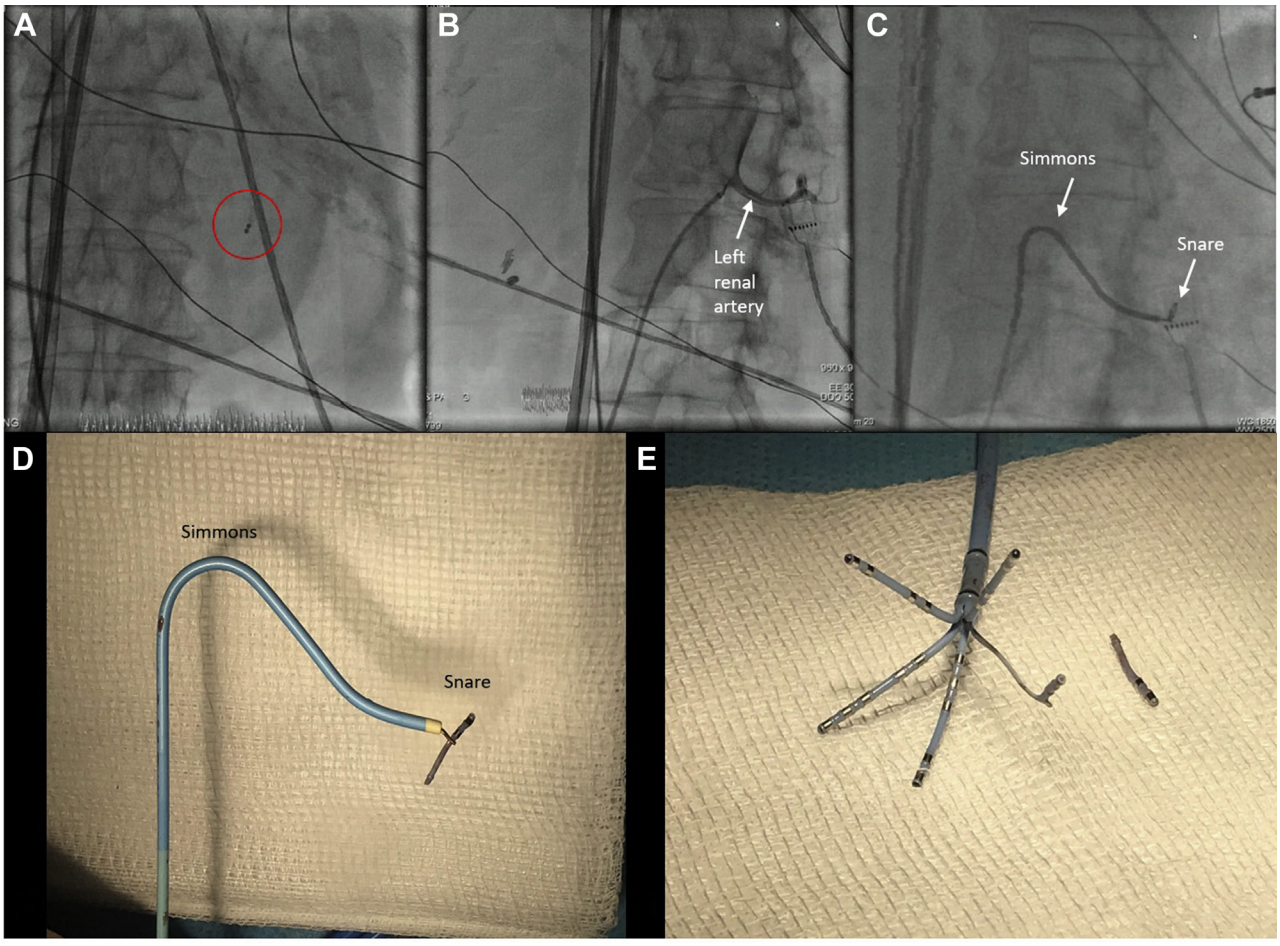

Figure 2 **A:** Localization of the thin catheter arm in the left renal artery. **B:** Semi-selective contrast injection into the left renal artery to depict the exact location of the catheter arm. **C:** Successful capture using a Simmons guide and a 5 mm snare. **D,E:** Retrieval of catheter arm with guide and snare in comparison to the rest of the multipolar catheter.

Technologies), are considered off-label. However, in clinical practice, they are used because of their characteristic to gain much information time-efficiently. This approach seems attractive in complex atrial or ventricular arrhythmias and when performing procedures in the systemic circulatory pathway to minimize risk for thrombus formation and arterial embolization. However, with these thin-armed catheters, special caution should be taken when mapping close to mechanical valves. In current literature, there are 2 other case reports where a limb of a multipolar catheter sheared off after entrapment in the mechanical mitral bileaflet valve of different manufacturers (St. Jude Medical, Carbometrics).[5,6] Fortunately, in all cases as well as in the case presented here, mitral valve function remained unimpaired and the missing electrodes could be retrieved without any further complications. To avoid this complication, alternative mapping strategies when in the area immediately adjacent to the mechanical valve should be evaluated. Mapping can be carried out with a larger-tip mapping catheter. However, mapping of a conduction gap close to a mechanical valve, even with these more robust catheters, would require extreme caution. Benefits of minimizing the risk for the illustrated complication have to be weighed against the risk for thrombus formation owing to prolonged procedure time and increased radiation exposure. To be able to handle these complications, excellent teamwork between electrophysiologists and interventional radiologists is essential. A standard of procedure to deal with these rare but relevant complications should be in place to enable safe and successful retrieval of any embolic catheter remnants in a timely fashion. This stresses the importance of creating renewed awareness that although high-resolution mapping catheters can give extensive information and are frequently used, complications may occur. A careful risk-benefit assessment should be carried out in a case-by-case fashion.

Conclusion

Novel multipolar catheters allow for fast and accurate mapping, which greatly facilitates the mapping of complex arrhythmia substrates. However, protruding slim electrode arms can get easily get entrapped and sheared off when coming too close to a mechanical valve. Retrieval of embolized

remnants should be carried out and requires teamwork and specialized equipment.

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