COMPLEX CASE STUDY

Iatrogenic Atrial Standstill?

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Introduction

Although the initial clinical description of atrial standstill was published in the 1940s, over the past 60 years there have only been scattered reports of this rare clinical entity.1–4 In many cases, the development of atrial standstill is a late finding associated with progressive diseases such as amyloidosis, inflammatory myocarditis, or myocardial dystrophy.1–4 We report a case of a patient who had undergone several prior cardiac procedures in which a region of the right atrium was electrically isolated from the remainder of the atria that led to apparent atrial and ventricular standstill on the surface electrocardiogram. The case also highlights the complexities and fluidity of management decisions in patients with atrial fibrillation.

Case report

A 69-year-old man with a history of recurrent atrial fibrillation was referred to our institution for electrophysiologic study and radiofrequency catheter ablation. Five years ago he underwent electrophysiologic study and radiofrequency catheter ablation for drug-refractory symptomatic persistent atrial fibrillation using a wide area circumferential ablation (including a cavotricuspid isthmus line) at an outside institution. Two years ago he developed recurrent persistent atrial fibrillation, and because of accompanying significant mitral regurgitation, he underwent mitral valve replacement, tricuspid valve repair (with annuloplasty ring), and an epicardial "mini-Maze" procedure using radiofrequency energy at a second outside medical center. Six months ago persistent atrial fibrillation recurred despite amiodarone therapy, and the patient had an unsuccessful external cardioversion. On initial evaluation at our medical center, he complained of profound fatigue for the past 6 months despite adequate rate control. He was fully anticoagulated and treated with carvedilol 6.25 mg twice daily (his amiodarone had been stopped 6 months ago). He was referred for electrophysiologic study and possible repeat radiofrequency catheter ablation.

During electrophysiologic study, decapolar catheters were placed in the coronary sinus and lateral wall of the right atrium and a 20-pole catheter placed in the left atrium (Figure 1). Baseline electrograms recorded during atrial fibrillation are shown in Figure 2a. Irregular low-amplitude signals consistent with atrial fibrillation were recorded in the coronary sinus and the anterolateral portion of the right atrium, but electrodes in the posterolateral right atrial electrograms were unaffected, with a similar rate and morphology as his baseline.

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Figure 1: Fluoroscopy of baseline catheter position in the right anterior oblique and left anterior oblique planes.
Figure 2: (a) Electrograms obtained at baseline show atrial fibrillation in the coronary sinus (CS) electrodes and the anterolateral portion of the right atrium (T4,T5). Absence of electrograms suggestive of scar is noted in the mid-lateral right atrium (T3), and slow regular activity is observed in the posterolateral portion of the right atrium (T1, T2). (b) Initial electrograms obtained after internal cardioversion. Idioventricular rhythm with retrograde atrial activity recorded in the CS and superior right atrium. Continued dissociated slow activity that is unchanged from baseline is recorded in the posterolateral right atrium. (c) Sudden cessation of idioventricular rhythm with continued atrial activity in the posterolateral right atrium that does not result in a P wave inscribed on the surface electrocardiogram. (d) Pacing from the coronary sinus restores ventricular activation via intrinsic atrioventricular conduction.
recordings (Figure 2b). Subsequently, the idioventricular rhythm stopped, resulting in apparent atrial and ventricular asystole with no cardiac activity recorded by surface electrocardiogram, although atrial activity in the posterolateral right atrium was unchanged (Figure 2c). Hemodynamic collapse was prevented by pacing from the coronary sinus (Figure 2d). During pacing, mapping of the atria revealed electrograms with normal amplitude and morphology except at the posterior left atrium near the pulmonary vein antral region and the lateral right atrium (T4).

The patient was observed overnight with continued temporary atrial pacing. Despite withdrawal of his beta-blocker, no spontaneous atrial activity was observed, and the patient underwent permanent pacemaker implantation. Intracardiac mapping identified an atrial pacing site with adequate pacing parameters far enough from the isolated region in the posterolateral wall so that “spurious” sensing did not occur. An active fixation atrial lead was placed in the right atrial appendage region (Figure 3). On follow-up, the patient has been dependent on atrial pacing with intrinsic atrioventricular conduction (Figure 3) and has not had recurrent atrial fibrillation confirmed by interrogation of pacemaker diagnostics. In addition, his fatigue and exertional dyspnea have resolved.

Discussion

This case demonstrates an example of partial electrical standstill with an electrically isolated region in the posterolateral right atrium, with slow pacemaker activity and no spontaneous pacemaker activity from the remainder of the atria. It is not known whether the prior cardiac procedures contributed to the development of this condition, but it is interesting that electrograms recorded from the rest of the atria during pacing demonstrated normal amplitude and morphology, suggesting that a more generalized atrial myopathic process was not present. Permanent pacing may be required in approximately 20% of patients after a traditional “cut-and-sew” Cox Maze III surgery and occasionally after radiofrequency “mini-Maze” surgeries.6,7 Permanent pacing is not commonly required after catheter-based ablation procedures for atrial fibrillation.8

This case also illustrates several important management issues that may arise in treating patients with atrial fibrillation. First, in patients who have failed external cardioversion, internal cardioversion is an important option for restoring sinus rhythm.5 Although initially described in the late 1980s using high energy (200–300 J) with an electrode in the right atrium used as the cathode and a back patch as the anode, internal cardioversion is
now usually performed with low energies (1–30 J) using multipolar catheters placed in the coronary sinus and lateral right atrium, with the right atrial catheter configured as the cathode.\textsuperscript{5,9–11} In patients in which sinus rhythm still cannot be restored despite usual internal cardioversion protocols, intravenous ibutilide or alteration of the waveform may facilitate internal cardioversion.\textsuperscript{12,13}

Second, the case demonstrates the importance of a baseline electrophysiologic evaluation of patients with atrial fibrillation. Several studies have found that approximately 5–10% of patients referred for ablation of atrial fibrillation will have supraventricular tachycardia, and importantly, a simple ablation strategy targeting the mechanism of supraventricular tachycardia is effective in suppressing atrial fibrillation in 80–90% of cases.\textsuperscript{14,15} As illustrated in this case, baseline evaluation may also be important in patients who have undergone prior cardiac procedures to evaluate location, extent, and electrophysiologic consequences of atrial scar tissue.

Third, sinus node dysfunction is relatively common in patients with atrial fibrillation, and in the presence of symptomatic bradycardia, requires placement of a permanent pacemaker. This case illustrates the inherent unreliability of idiopathic ventricular rhythms. Special consideration for placement of the atrial lead was required in this case to prevent sensing of atrial activity from the isolated area and to allow intrinsic atrioventricular conduction.

In summary, we present a case report in which prior cardiac procedures may have contributed to the development of partial atrial standstill and which also illustrates the complex decision process that may be required for the treatment of atrial fibrillation.

References