

## CASE REPORT

# Sinus arrest: A rare observation during radiofrequency ablation along the coronary sinus roof

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**Abstract**

Catheter-based radiofrequency (RF) ablation targeting segments of the cardiac conduction system and/or selected regions of myocardium is an accepted treatment for many cardiac arrhythmias. On the other hand, while purposeful extension of RF ablation to include nearby cardiac neural elements, particularly epicardial ganglionated plexi (GP), remains a subject of ongoing study, inadvertent stimulation of such structures may occur during an otherwise conventional RF ablation procedure. Thus, asystolic pauses have been observed during RF ablation of left ventricular free-wall accessory pathways, slow AV node pathways, and the left superior pulmonary vein. In this report, sinus arrest occurred within 3.3 s of RF application (40 W at 50°C) along the coronary sinus roof for treatment of an atypical “slow–slow” atrioventricular nodal reentrant tachycardia. Energy delivery was immediately terminated, but asystole persisted for 4.7 s followed by sinus bradycardia. The procedure was temporarily halted, but later was successfully resumed. Given the latency from terminating RF to return of sinus node function, the sinus arrest was likely a centrally mediated reflex vagal response. Consequently, while parasympathetic ganglia near the CS os are believed to principally innervate the AV node, not the sinus node, our observation highlights the neural cross-communications that likely exist in this region of the heart.

**KEYWORDS**

atypical AV node reentry tachycardia, radiofrequency ablation, sinus arrest

## 1 | INTRODUCTION

Catheter-based radiofrequency (RF) ablation targeting segments of the cardiac conduction system and/or selected regions of myocardium is an accepted treatment for many arrhythmias. However, more recently RF ablation targets have begun to expand beyond cardiac tissues to include nearby cardiac neural elements. In particular,

although still controversial, RF ablation techniques addressing neural ganglia situated on the epicardial surface of the heart in the vicinity of the pulmonary vein ostia, and at the junctions of cardiac chambers and great vessels have been proposed for treatment of atrial fibrillation and vasovagal syncope (Pachon et al., 2005; Rivarola et al., 2017; Sun et al., 2016). On the other hand, while the potential value of purposefully modifying cardiac ganglia remains a subject of

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ongoing study, damage to such structures may occasionally occur inadvertently and result in unanticipated consequences during an otherwise conventional RF ablation procedure.

## 2 | CASE STUDY

A 28-year-old female with no past cardiac history complained of palpitation and dizziness. Baseline 12-lead ECG (rate: 87 bpm) and echocardiogram were normal. A previously placed implantable loop recorder revealed multiple episodes of normal QRS tachycardia. Electrophysiology study was performed. An atypical "slow-slow" atrioventricular nodal reentrant tachycardia was identified, and radiofrequency (RF) ablation using a 4mm-tip catheter included lesions along the coronary sinus (CS) roof. Within 3.3 s of RF application (40 W at 50°C), abrupt asystole occurred due to sinus arrest. Energy delivery was immediately terminated, but asystole persisted for 4.7 s followed by sinus bradycardia with transient AH interval prolongation (Figure 1). Thereafter, AH prolongation promptly resolved and sinus rate gradually returned to baseline.

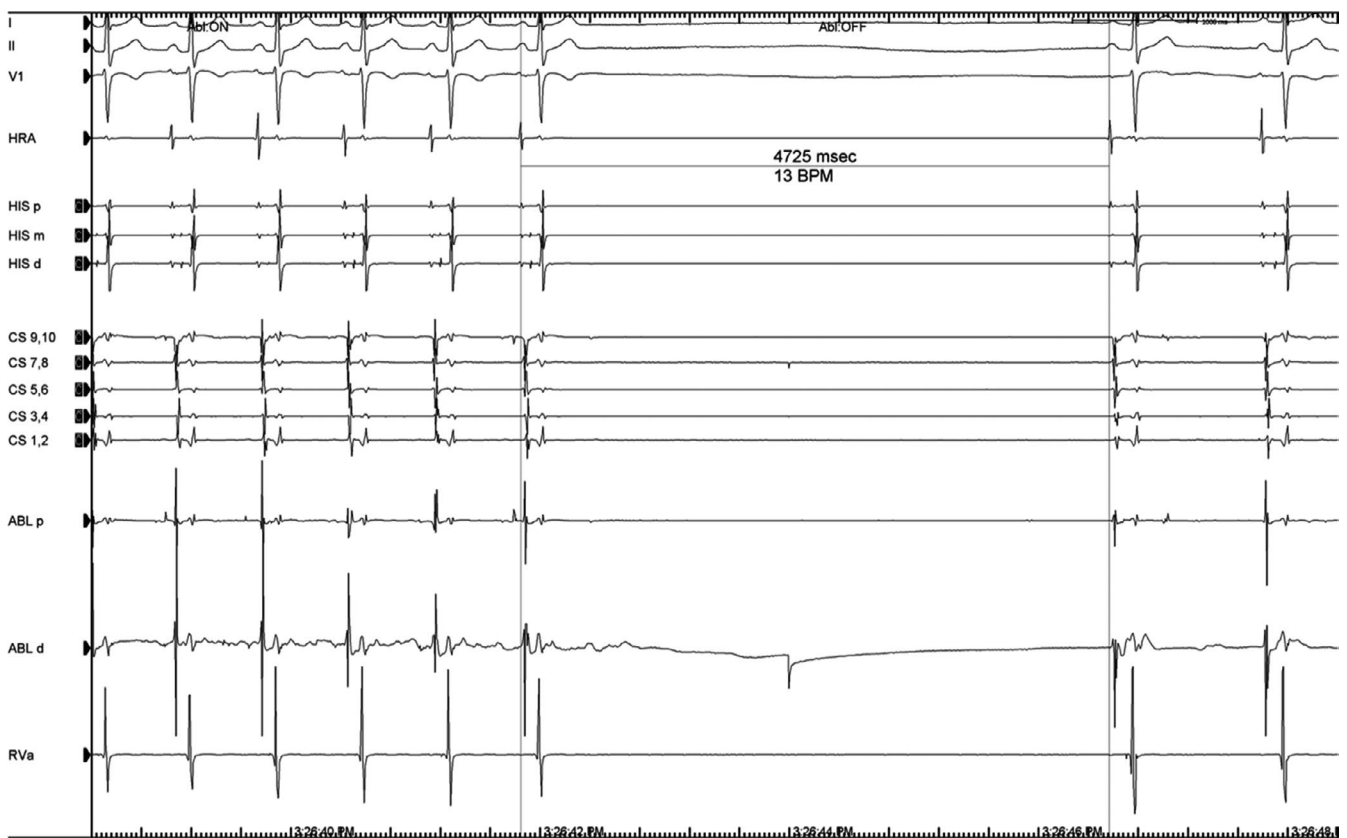
Initially, there was concern that the sinus node or cardiac conduction system had been inadvertently damaged. However, given the ablation target site well away from the sinus node (Figure 2) and absence of residual abnormality, the latter possibility seemed

unlikely and favored a parasympathetic basis for the observations. Subsequently, while cautious application of several additional lesions to nearby CS roof regions each resulted in transient moderate sinus bradycardia, pauses did not recur. After ablation, tachycardia was noninducible, and postablation AH and HV intervals were unchanged from baseline.

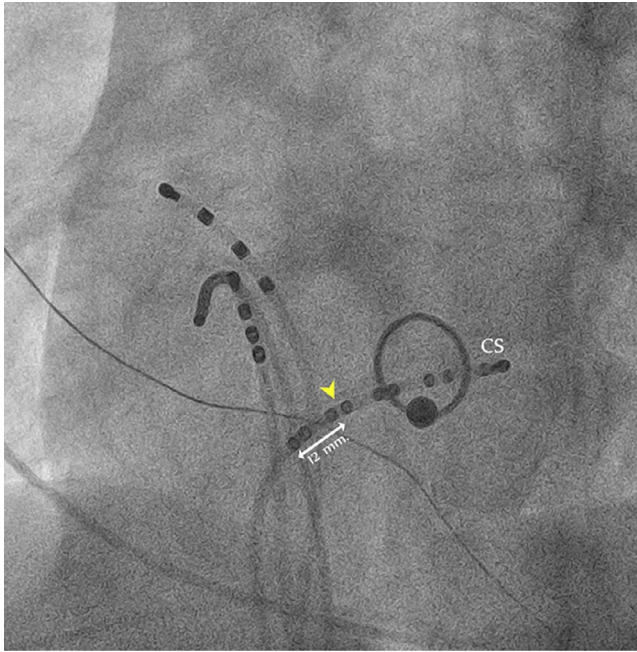
## 3 | DISCUSSION

Asystolic pauses have been observed during RF ablation at several cardiac locations, including the following: left ventricular free-wall accessory pathways, slow AV node pathways, and left superior pulmonary vein (Hu, Xu, Wang, Chen, & Yan, 2014; Rivarola et al., 2017). However, to our knowledge only one prior case report describes sinus arrest during ablation in proximity to the CS os (Schlapfer, Kappenberger, & Fromer, 1996). Most likely, in our case, given the prompt reversal of the AH prolongation and bradyarrhythmia, ablation within the proximal CS may have stimulated nearby retro-atrial neural ganglia resulting in afferent signals via nonmyelinated slow-conducting fibers (C-fibers).

The intrinsic cardiac nervous system comprises ganglionated plexi (GP) found within epicardial fat pads (Ardell & Armour, 2016; Armour, Murphy, Yuan, Macdonald, & Hopkins, 1997; Chiou, Eble,



**FIGURE 1** Intracardiac and surface ECG recording during radiofrequency ablation at the roof of the coronary sinus, showing 4.7 s sinus arrest. Sinus bradycardia was observed afterward. See text for details. HRA, high right atrium; CS, coronary sinus; ABL, ablation; RVa, right ventricular apex



**FIGURE 2** Fluoroscopic image (left anterior oblique 50-degree view) indicates the initial ablation site at the roof of coronary sinus, 12 mm from coronary sinus ostium. The ablation catheter is not shown. Yellow arrowhead indicates the ablation site. CS, coronary sinus. Left nipple ornamentation is noted (radio-opaque circle)

& Zipes, 1997; Pachon et al., 2005; Schlapfer et al., 1996; Sun et al., 2016). Most likely, in our case, given the prompt reversal of AH prolongation and bradyarrhythmia, ablation within the proximal CS may have inadvertently stimulated the nearby posteromedial left atrial (LA) ganglionic plexus on the inferior aspect of the posteromedial surface of the LA.

While ganglia near the CS os are believed to principally innervate the AV node, not the sinus node (Schlapfer et al., 1996), our observation highlights the neural cross-communications that exist in this region of the heart (Ardell & Armour, 2016; Armour et al., 1997). In addition, given the latency from initiating RF to onset of sinus arrest and from terminating RF to return of sinus node function, the sinus arrest likely incorporated a centrally mediated reflex vagal response rather than only intracardiac signaling.

In conclusion, asystole due to vagally mediated sinus arrest may occur during RF ablation along the proximal CS roof due to presumed stimulation of at least one set of ganglionated plexi that is in close proximity. In this setting, such an occurrence does not reflect damage to the cardiac conduction system, and the ablative procedure can be cautiously continued.

## CONFLICTS OF INTEREST

None of the authors have conflicts of interest to declare pertinent to the contents of this communication.

## AUTHOR CONTRIBUTIONS

Dr Nantsupawat undertook the electrophysiology procedure, obtained the Figures and drafted the manuscript. Dr Krishnappa provided critical review of the manuscript, and wrote portions of the text. Dr Benditt undertook the electrophysiology study, generated the manuscript concept, critiqued and revised the manuscript.

## ETHICAL STATEMENT

The reported study has received written consent as required by the appropriate ethics committee.

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