Catheter ablation of accessory pathways near the coronary sinus: Value of defining coronary arterial anatomy

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BACKGROUND Accessory pathways can lie near or within the coronary sinus (CS). Radiofrequency catheter ablation of accessory pathways is a well-established treatment option, but this procedure can cause damage to adjacent coronary arteries.

OBJECTIVE The purpose of this study was to evaluate the anatomic relationship between the coronary arteries and the CS.

METHODS Retrospective data of patients who underwent catheter ablation of supraventricular tachycardia between June 2011 and August 2013 was reviewed. In addition, detailed analysis of coronary computed tomographic angiography (CTA) data from 50 patients was performed.

RESULTS Between June 2011 and August 2013, 427 patients underwent catheter ablation of supraventricular tachycardia, of whom 105 (age 28 ± 17 years, 60% male) had accessory pathway–mediated tachycardia. Of these, 23 patients had accessory pathways near the CS, and 60% (N = 14) underwent concurrent coronary angiography. In 4 patients, the posterolateral (inferolateral) branch (PLA) of the right coronary artery was in close proximity to the CS, and 2 patients (18%) had stenosis of the PLA at the site of ablation. On CTA at their closest proximity, the PLA was 1.9 ± 1.3 mm and the left circumflex artery (LCx) was 2.0 ± 0.8 mm from the body of the CS, in right and left coronary artery–dominant patients, respectively. CS ostium and PLA were 3.6 ± 1.9 mm apart. In left-dominant patients, LCx and CS ostium were 3.8 ± 1.2 mm apart.

CONCLUSION The PLA and LCx are in close proximity to the anteroinferior aspect of the CS ostium and proximal CS. The relationship of the CS and coronary arteries should be evaluated before ablation at these sites.

KEYWORDS Catheter ablation; Coronary sinus; Coronary artery stenosis; Coronary artery injury

ABBREVIATIONS **CA** = coronary artery; **CS** = coronary sinus; **CTA** = computed tomographic angiography; **LCx** = left circumflex artery; **PDA** = posterior descending (inferior interventricular) coronary artery; **PLA** = posterolateral (inferolateral) ventricular arterial branch of the right coronary artery; **RCA** = right coronary artery

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Introduction

Accessory pathways are a common cause of supraventricular tachycardia. Approximately 19%–33% of accessory pathways can lie near or within the coronary sinus (CS) ostium, proximal CS, or CS diverticulum,[1–3] often referred to as inferior paraseptal (and previously posteroseptal) accessory pathways.[4] Although accessory pathway–mediated AV reentrant tachycardia can be managed pharmacologically, radiofrequency catheter ablation has become a well-established treatment option for these patients. However, ablation of accessory pathways from within the CS may lead to collateral damage to nearby coronary arteries (CAs) because of the anatomic proximity of these structures. In many patients, the posterolateral (inferolateral) ventricular branch (PLA) of the right coronary artery (RCA) and the left circumflex artery (LCx) run inferiorly and in close proximity to the CS. The CS can run above the left atrioventricular groove and the attachment of the left atrium to the left ventricle. As a result, in right-dominant patients. the RCA and, in particular, the PLA run along its anteroinferior aspect (Figure 1).[5] In left-dominant patients, the LCx often runs deep and, occasionally, superior to the CS.[5] Use of radiofrequency catheter ablation within the CS has been reported to cause damage to these arteries in the form of CA stenosis or complete occlusion.[1,6–15] The risk of CA injury appears to be related to the distance from the CAs at the site of ablation.[1]

The purpose of this study was evaluate the precise anatomic relationship of the CAs to the CS in patients undergoing catheter ablation of accessory pathways near the CS as well as in patients referred for coronary computed tomographic angiography (CTA).

Methods

Retrospective analysis of patient data was approved by the University of California Los Angeles Institutional Review Board.

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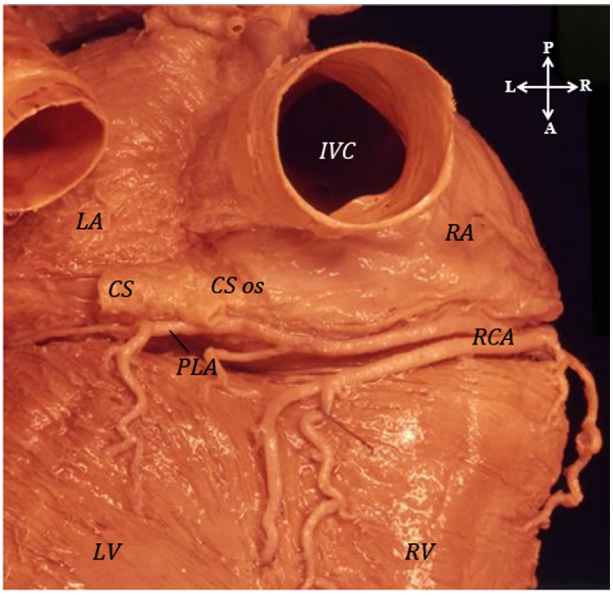

Figure 1 Relationship of the branches of the right coronary artery to the coronary sinus ostium. The mid to distal coronary sinus (CS) has been removed. IVC = inferior vena cava; LA = left atrium; LV = left ventricle; PLA = posterolateral (inferolateral) ventricular arterial branch of the right coronary artery; RA = right atrium; RCA = right coronary artery; RV = right ventricle. (Reproduced with permission from Wallace A. McAlpine Collection. UCLA Cardiac Arrhythmia Center).

Study cohorts

Cohort 1

Between June 2011 and August 2013, 427 patients underwent catheter ablation of supraventricular tachycardia at University of California, Los Angeles Medical Center. Data from patients (n = 105) who were found to have accessory pathway–mediated tachycardia were reviewed. Electrophysiologic findings, including site of ablation and proximity of the CAs to the preferred ablation site at the time of ablation, as well as acute outcome after catheter ablation in patients with accessory pathways near or within the CS (inferior paraseptal) were noted.

Cohort 2

Data from patients (n = 50) who were referred for coronary CTA were analyzed. CTA had been obtained as part of the workup for CA disease or angina, or before cardiac surgery. Using a Siemens Sensation 64 scanner (Siemens Medical Solutions USA, Malvern, PA), axial images through the lower thoracic region were obtained with a slice thickness of 0.75 mm. Coronary angiograms were acquired during administration of 80 mL of Omnipaque 350 followed by 50 mL of saline. Postprocessing, maximum intensity projection was performed on the Siemens Syngo scanner workstation and on the Vitrea 3-dimensional processing workstation (Vital Images, Minnetonka, MN).

The distance between the CS and nearby major CAs was measured on the inferior surface of the heart, at the CS ostium, and at the point of its nearest proximity to the CAs by 2 separate observers. Other measurements obtained were the distance for which the 2 vessels ran along each other and how far the point of nearest proximity was from the CS ostium (Figure 2).

Results

Cohort 1

A total of 105 of 427 patients were identified as having accessory pathway–mediated supraventricular tachycardia (Table 1). In 23 cases (21.9%), the accessory pathway was located near the CS (inferior paraseptal). Patient characteristics are listed in Table 1. Sixty percent of these patients (n = 14) had concurrent coronary angiography at the time of electrophysiologic study. Of these patients, 4 had CAs near the CS (<5 mm), leading to deferral of ablation in 2 patients. One patient had a CA very close to the site of ablation in the CS; however, the decision was made to proceed with ablation given the patient's severe symptoms (syncope with bodily injury). This led to the anticipated acute occlusion of the posterior (inferior) left ventricular artery (Figure 2). The patient underwent successful percutaneous coronary angioplasty and stenting postablation. In the second patient, coronary angiography showed occlusion of this artery at the site of a previous attempt at catheter ablation of the accessory pathway. In the 10 remaining patients, CAs were noted to be >5 mm away from the CS at desired sites of ablation. These patients underwent successful ablation of accessory pathways without injury to the CAs.

Cohort 2

Patient characteristics for 50 patients who underwent coronary CTA are listed in Table 2. In right-dominant (N = 42) and co-dominant patients (N = 2), the PLA was most often the artery running in close proximity to the CS. At its closest segment, the PLA was an average of 1.9 ± 1.3 mm (mean ± SD) from the CS and ran along the CS for a distance of 7.7 ± 4.3 mm (mean ± SD) (Figure 3 and Table 3). In 1 patient, the posterior descending (inferior interventricular) coronary artery (PDA) was a distance of 0.8 mm from the CS. In right-dominant patients, the point of closest proximity of the CS to the PLA occurred 12.7 ± 6.4 mm (mean ± SD) away from the CS ostium (into the body of the CS). The separation between the anteroinferior aspect of the CS ostium and PLA was 3.6 ± 1.9 mm (mean ± SD) Table 3.

In left-dominant patients, the LCx was the artery in closest proximity to the CS, running an average of 2.0 ± 0.8 mm (mean ± SD) from the inferior aspect of the proximal CS for a distance of 10.8 ± 7.4 mm (mean ± SD) (Figure 4). The sites of closest proximity often extended further into the CS and occurred 15.6 ± 6.1 mm (mean ± SD) from the CS ostium. The LCx and the anteroinferior aspect of the CS ostium were separated by a distance of 3.8 ± 1.2 mm (mean ± SD) Table 3.

Discussion

Major findings

The major findings of this study are as follows:

1. In right-dominant patients, the PLA runs <2 mm from the proximal CS, whereas in left-dominant patients, the LCX runs <2 mm from the CS.