Visualization of a coronary sinus valve using intracardiac echocardiography


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Abstract Cannulation of the coronary sinus (CS) is sometimes difficult due to the presence of anatomical anomalies. Fluoroscopy is of limited value in visualizing these variations. This case is the first to demonstrate how intracardiac echocardiography (ICE) allows visualization of a valve, which is one of the causes of problematic cannulation of the CS. Based on information obtained by ICE an appropriate catheter could be selected.

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Introduction

The coronary sinus (CS) is of special interest to the electrophysiologist and pacemaker-implanting physician. In electrophysiology (EP) studies left sided atrio-ventricular recording is routinely done indirectly from within the CS. The left atrium or the left ventricle can also be paced via the CS.1,2 The CS can be cannulated from the jugular, subclavian or femoral vein and the insertion of electrode catheters is a routine task for experienced physicians in most of the patients.3,4 Occasionally, however, cannulation of the CS or its tributaries can be extremely difficult because of anatomical variation in its origin or course and more rarely the presence of valves. This may result in prolonged procedure and fluoroscopy times and even failure of the procedure. The aim of this report is to demonstrate the usefulness of advanced imaging techniques such as intracardiac echocardiography (ICE) in identification of the anatomical variations in such patients and how this may result in a successful procedure.

Case study

A 56-year-old man, with a 10-year history of recurrent episodes of palpitations, was referred for EP study and ablation. The patient had a history of hypertension and diabetes and had undergone kidney transplantation. He was treated with several anti-arrhythmic drugs, without reduction in symptoms.
An ECG recorded during palpitations showed a fast regular narrow QRS complex tachycardia, without visible retrograde P-waves, suggesting the presence of AV nodal reentrant tachycardia (AVNRT). An EP study was performed in a nonsedated state. Initially, two diagnostic electrode catheters were introduced into the high right atrium and onto the anterior tricuspid annulus in order to record stable atrial and His-potentials. A pacing electrode was introduced into the right ventricle. A 5 F decapolar electrode catheter (Supreme CS, Daig Corp, St Jude Medical Inc, Minnetonka, MN, USA) was inserted through the left subclavian vein and an attempt was made to advance it into the CS. The middle cardiac vein was easily cannulated several times but the distal CS could not be reached. After several failed attempts a steerable diagnostic catheter (Dynamic XT, Bard Electrophysiology, Billerica, MA, USA) was further used to cannulate the CS but without any success. An 8 French intra-cardiac echo catheter (ICE 9900, Boston Scientific Inc, San Jose, CA, USA) was then inserted through the left femoral vein using a 60 cm long vascular sheath (Boston 5662, Boston Scientific Inc, San Jose, CA, USA). As this ICE catheter provides horizontal cross-sectional images, it was placed at the level of the CS ostium. ICE showed a thin membrane located approximately 3 cm from the ostium of the CS (Fig. 1), measured by ICE. Thereafter, a diagnostic angiography catheter (Amplatz L1, Cordis Europe, Roden, The Netherlands) was introduced through the right femoral vein and positioned in the ostium of the CS and a radiographic contrast injection was performed. Retrograde filling of the CS was very limited (Fig. 2), but echocardiography showed the appearance of contrast material distal to a membranous structure in the CS. These findings led to the hypothesis that the distal portion of the CS could be reached using a very thin, non-conventional electrode catheter. Therefore a 2.5 F octapolar, diagnostic microcatheter (Pathfinder 8, Cardima Inc, Fremont, CA, USA) was chosen and successfully introduced into the CS via the angiographic catheter (Fig. 3). The diagnostic EP study confirmed the absence of accessory pathways and successful radiofrequency ablation of the slow pathway of the AV node was then performed.

Discussion

The CS opens into the right atrium between the inferior vena cava and the tricuspid valve orifice, and its ostium is guarded by an endocardial fold. This crescent shaped valve of the CS is also known

![Figure 1](https://example.com/fig1.png)

**Figure 1** Horizontal cross-sectional image as obtained with ICE. A thin membrane (arrow) is visible inside the CS approximately 3 cm from the ostium. The transducer is in the center of the image (ICE). RA: right atrium.
Figure 2  Selective angiography of the CS with the Amplatz catheter shows limited filling of the distal CS. The echocardiography catheter is the catheter closest to the ostium of the CS.

Figure 3  Successful cannulation of the CS with a very thin multipolar electrode, introduced via the diagnostic angiographic catheter.
as the Thebesian valve. The tributaries of the CS are the great, small and middle cardiac veins, the posterior vein of the left ventricle and the oblique vein of the left atrium (Marshall's vein). All except the last may potentially have valves at their orifices. In the majority of individuals the great cardiac vein has a prominent valve where the vein turns around the obtuse margin to become the CS. This valve was first described in 1706 by the French scientist R. Vieussens in his book “Nouvelles découvertes sur le coeur”. Other single or double parietal venous valves in the CS have been described. Until recently, all anatomical variants were known from post-mortem human studies only. Although there is anecdotal reference to these valves when difficulties are encountered during interventions to enter the CS, there is no study, which provides direct evidence thereof. One of the reasons is that fluoroscopy—which is an almost exclusive visual tool for guiding EP procedures—does not allow visualization of small anatomical structures. The resolution of transthoracic echocardiography is too limited to visualize these small valves and is cumbersome anyway during interventions. Transesophageal echocardiography (TEE) provides better imaging for intracardiac structure identification, but requires general anesthesia, because TEE causes significant patient discomfort during lengthy procedures. Recently ICE became available, providing excellent image accuracy and direct visualization of small anatomical structures. The case presented illustrates the limited value of fluoroscopy in visualization of important anatomical structures during EP procedures. Immediately after insertion of the ICE imaging tool, the correct diagnosis was made and the appropriate catheter was selected for the remaining part of the EP study.

In conclusion, this is the first report showing in vivo images of a valve in the CS. According to anatomical studies this valve is most likely a parietal valve. We also demonstrate that improved imaging can effectively modify the procedural strategy and therefore may improve the outcome of procedures in the CS.

References