Case Report

A Bridging Vein Connecting Left Atrium and Coronary Sinus: Coronary Computed Tomography Angiography Findings

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Introduction

Until recent years, coronary venous system imaging was overshadowed by coronary artery imaging.[1] However, in recent times, the significance of coronary venous system imaging has risen markedly, particularly due to its pivotal role in diverse interventional cardiology procedures.[2] These interventions encompass a spectrum of tasks, including left ventricular pacing, mapping and ablation of arrhythmias, and retrograde cardioplegia. These procedures are facilitated by utilizing the potential of the coronary sinus (CS). As a result, comprehending the anatomy and anomalies of the CS holds paramount importance, and coronary computed tomography (CT) angiography has proven invaluable for achieving this objective.[3]

In this case report, we present an extraordinary cardiac venous anomaly: a bridging vein connecting the left atrium to the CS with non-specific chest pain. We believe that this case serves as an illustrative example for understanding rarely observed cardiac venous vascular anomalies, while also making a valuable contribution to the existing literature through the utilization of clear and direct coronary CT angiography images.

Case presentation

A 55-year-old male presented to the cardiology department with non-specific chest pain. He had a medical history of hypertension for 9 years and type 2 diabetes mellitus for 6 years. His biochemical test results were within normal limits, and the chest X-ray revealed no abnormalities. The electrocardiogram showed a slow R-wave progression in the precordial leads from V1 to V3. Transthoracic echocardiography indicated normal left ventricular function with an ejection fraction of 62%. Due to his family history of cardiac ischemic disease and non-specific chest pain, he was referred for coronary CT angiography to assess the coronary arteries.

Keywords

Coronary Sinus; Computed Tomography Angiography; Heart Atria

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Manuscript received December 1, 2023; revised December 18, 2023; accepted January 26, 2024
Editor responsible for the review: Marcelo Dantas Tavares de Melo

DOI: https://doi.org/10.36660/abcimg.20230111i

For coronary CT angiography, a 256-slice General Electric Revolution™ CT scanner was utilized. Non-obstructive atherosclerotic calcified plaques were identified in the middle segment of the left anterior descending artery and the proximal segment of the circumflex artery. Additionally, enlargement of the CS was observed, with a diameter reaching 12 mm before its opening into the right atrium. A bridging vein, measuring 2.5 mm in diameter, was identified connecting the left atrium to the enlarged CS (Figures 1 and 2).

Discussion

The CS is the central venous structure of the heart, and it provides most of its venous return. Positioned within the left atrioventricular groove, the CS opens into the right atrium.[1] Left ventricular pacing, mapping and ablation of arrhythmias, and retrograde cardioplegia procedures are facilitated through the use of the CS.[2] For this reason, it is crucial to understand its anatomy, variations, and anomalies. In 1966, Mantini et al. classified CS anomalies into the following 4 groups:[4]

I. Enlargement of the CS
   A. Without left-to-right shunt into the CS
   B. With left-to-right shunt into the CS
II. Absence of CS
III. Atresia of the right atrial CS ostium
IV. Hypoplasia of the CS

In our patient, we identified a bridging vein connecting the CS and the left atrium, which was consistent with the subtype B enlargement of the CS.

Anomalies of the CS are receiving increasing attention due to their relevance in interventional cardiac procedures and their connection to other congenital heart abnormalities,[3] despite the fact that many of these anomalies are clinically insignificant, as observed in our patient. In symptomatic patients, the clinical manifestation will differ based on the occurrence of arrhythmia and the extent and direction of shunting. If there is no increased pressure in the right heart or stenosis at the CS ostium, blood will primarily move from the left atrium through the CS into the right atrium. This forms a left-to-right shunt, as observed in our case during coronary CT angiography. When right-sided pressure increases due to conditions such as right-sided valve issues and pulmonary hypertension, there is a possibility for the direction of the shunt to be reversed. Even after isolating the pulmonary veins, atrial fibrillation can continue, potentially indicating that the arrhythmia's origin might be attributed to the suspected interaction between the CS and the left atrium.[5,6]

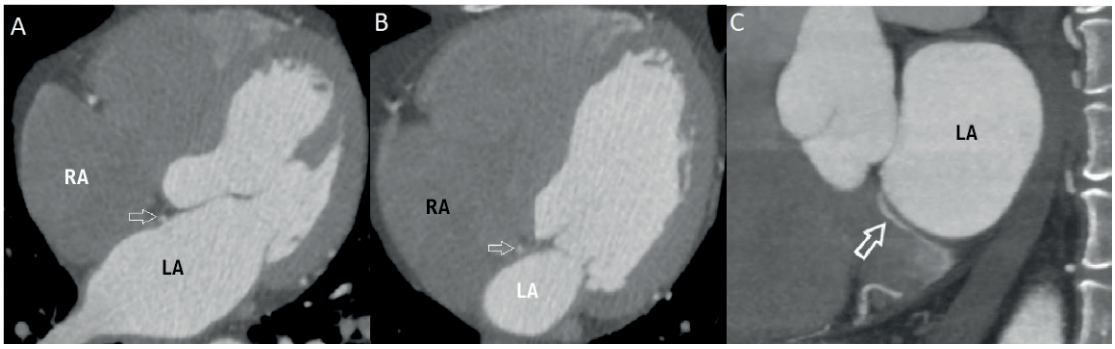

Figure 1 – *Coronary computed tomography angiography. Four chamber views (A, B) and sagittal view (C) showing a bridging vein with a 2.5 mm diameter (arrow) connecting the left atrium and coronary sinus. LA: left atrium; RA: right atrium.*

Coronary CT angiography has emerged as a highly effective option for visualizing cardiac vasculature, particularly owing to recent advancements in spatial, temporal, and contrast resolution.[7] In the context of CS anomalies, these can be successfully detected during the delayed phase of coronary CT angiography, as was observed in our patient's case. Cardiac MRI stands as an additional non-invasive technique for diagnosing cardiac anomalies, without the need for contrast agents or exposure to ionizing radiation. Furthermore, both transthoracic and transesophageal echocardiography serve as valuable tools to identify enlarged CS; however, they are operator-dependent and are limited in their ability to provide intricate details of the cardiac venous vasculature. While an alternative option for imaging the CS involves a CS venogram, its utilization is hindered by its invasive nature and challenges in execution, particularly when dealing with the presence of Thebesian valve at the CS ostium. Consequently, this method has found more application for therapeutic rather than diagnostic purposes.[5,8]

An unroofed CS refers to a communication between the CS and the left atrium, arising from the partial or complete absence of the roof of the CS, and this condition is typically accompanied by other cardiac anomalies.[9] Differentiating between a CS-to-left atrium shunt via a bridging vein and an unroofed CS is mainly accomplished through coronary CT angiography and cardiac MRI. The latter distinction is significant as unroofed CS cases usually require surgical intervention.

In conclusion, many patients with CS anomalies are typically asymptomatic and may not require intervention, similar to our patient's case. As previously mentioned, awareness of CS anomalies holds significant importance in various interventional cardiac procedures, such as electrophysiological studies and ablation for arrhythmias, ventricular pacing, and the management of high-flow shunting in coronary bypass graft surgery.[5,10]

Author Contributions

Conception and design of the research, writing of the manuscript and critical revision of the manuscript for intellectual content: Şahin S, Özbülbül NI; analysis and interpretation of the data: Şahin S.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

Figure 2 – *Coronary computed tomography angiography. Volume-rendered image depicting an enlarged coronary sinus (opaque arrow) with a 12 mm diameter, connected to the left atrium via a bridging vein (transparent arrow). LA: left atrium.*

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