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Crossing Boundaries: A Single Coronary Artery's Journey from the Right Sinus

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Abstract

Case summary highlights a rare congenital coronary anomaly where a woman, aged 55 having diabetes as well as hypertension presented with unstable angina. Her coronary angiogram revealed Single coronary artery (SCA) originating from right coronary sinus (CS), with Left anterior descending artery (LAD) arising from Right coronary artery (RCA). Left anterior descending artery had pre-pulmonic course and showed diffuse stenosis and calcification. Off-pump coronary artery bypass grafting was performed due to significant calcification and stenosis in the coronary branches.

Keywords: Single coronary artery; Coronary artery anomalies; Pre pulmonic LAD; Coronary angiogram; Off-Pump CABG; Coronary artery disease

Introduction

SCA anomalies are rare congenital conditions, affecting between 0.024-0.066% of the general populace [1]. All of the coronary circulation in these abnormalities originates from single coronary ostium. Current case involves an SCA originating from right CS, having LAD originating from proximal RCA and following pre-pulmonic course. Few variants are still missing in Modified Lipton classification and Shinari-Roberts classification includes many of those missing ones such as this case report. We report a rare case of single coronary anomaly (not fitting into any of the Modified Lipton's classes) with Type 1 LAD and diffuse CAD, who underwent CABG (coronary artery bypass surgery).

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Case Report

The patient is a 55y/o woman with medical record of diabetes along with hypertension, had unstable angina. A coronary angiogram was performed for further evaluation; however, the LCA couldn't be visualized from left CS. It was discovered that the patient had an SCA arising from right CS. The RCA gave rise to LAD from its proximal segment, while the LCX (left circumflex artery) continued as a branch from the RCA (Figure 1).

To clarify the coronary anatomy, cardiac computed tomography (CT) was carried out, confirming the SCA's origin from right CS. The LAD had pre-pulmonic course and exhibited diffuse stenosis and calcification (Figure 2). The other coronary branches also showed significant calcification, with critical stenoses located at the origins of both the PDA (posterior descending artery) as well as OM (obtuse marginal) artery. The patient underwent off-pump CABG (Figure 1E). This case is an uncommon congenital heart condition, with a Type 1 LAD arising from RCA along with traversing the RVOT (right ventricular outflow tract).

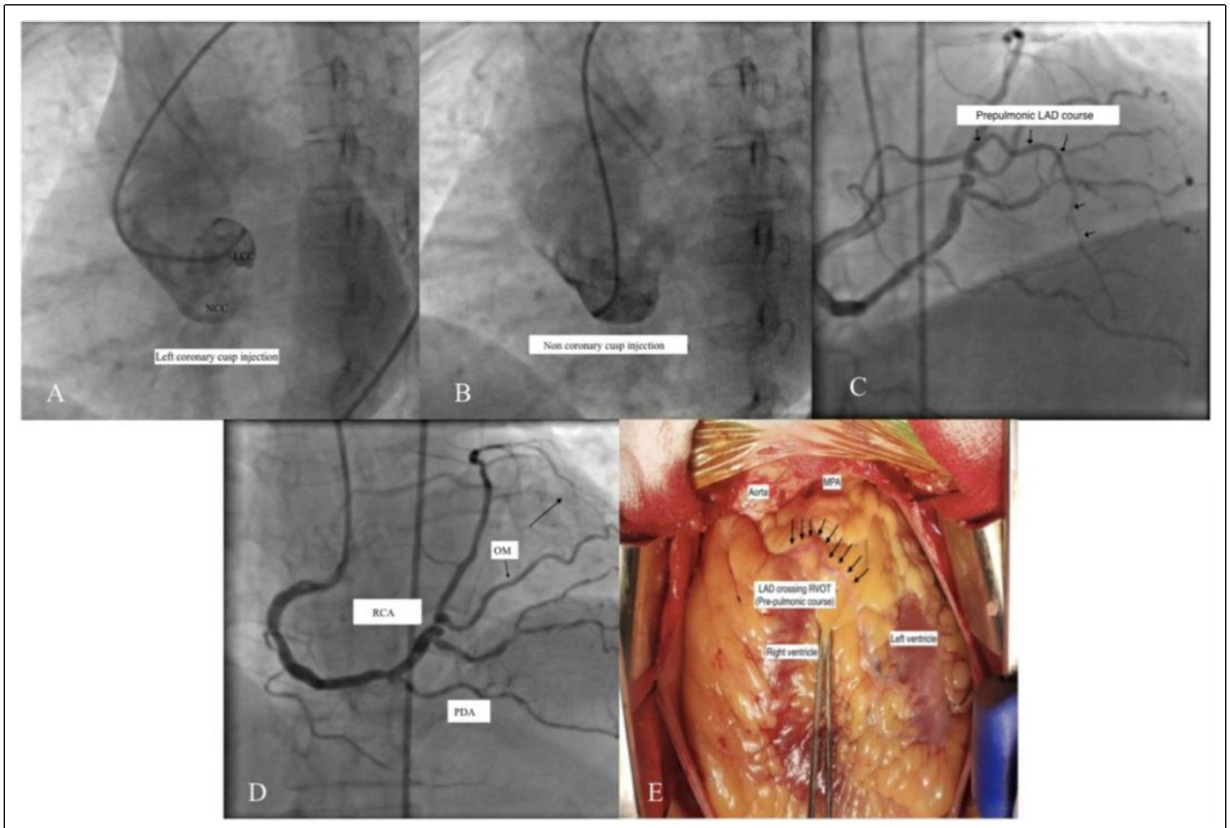

Figure 1: Panels A: (Left anterior oblique view) & **B:** (Left anterior oblique with cranial tilt) demonstrate the absence of coronary arteries originating from the left & the non-coronary sinuses. **Panels C:** (Anterior-posterior view with cranial tilt) and **D:** (Anterior-posterior view) illustrate RCA injection, revealing an SCA originating from right coronary sinus, having LAD arising from proximal segment of RCA, while the distal RCA continues as the LCX. **Panel E:** shows an intraoperative image highlighting pre-pulmonic course of Type 1 LAD. **Abbreviations: OM**- Obtuse marginal; **LCX**-Left circumflex artery; **RCA**-Right coronary artery; **LAD**-Left anterior descending artery; **MPA**- Main pulmonary artery; **PDA**- Posterior descending artery; **RVOT**- Right ventricular outflow tract.

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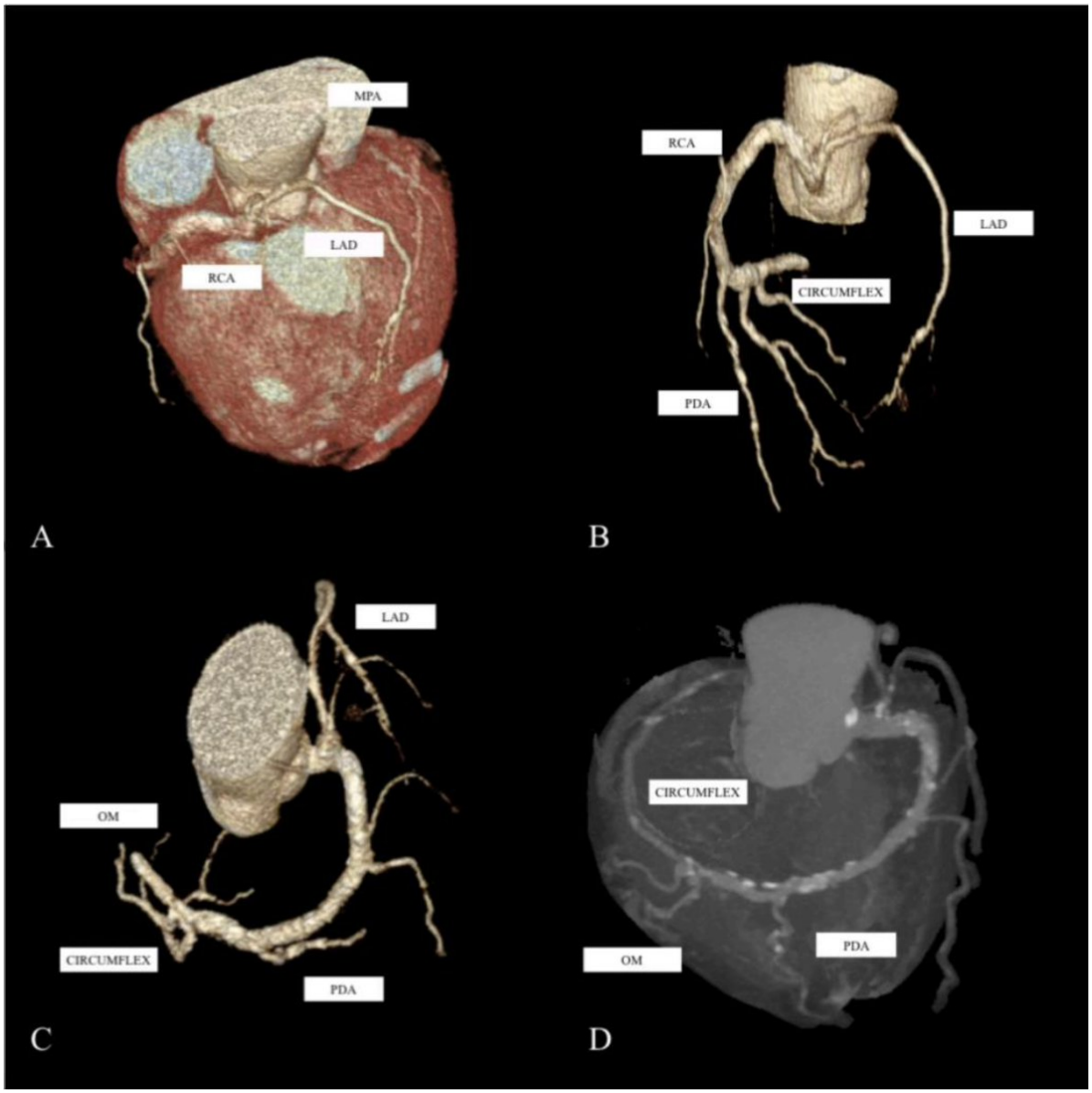

Figure 2: Panels A, B, & C: Depict the cardiac CT reconstruction, showing an SCA from right sinus with LAD branching from its proximal section, and the distal RCA continuing as LCX. **Panel D:** Illustrates diffuse calcification throughout the coronary arteries. **Abbreviations: OM**- Obtuse marginal; **LCX**- Left circumflex artery; **LAD**- Left anterior descending artery; **MPA**- Main pulmonary artery; **RCA**- Right coronary artery; **PDA**- Posterior descending artery.

The patient underwent coronary angiography, revealing absence of coronary arteries originating from left CS. Further evaluation using cardiac CT confirmed the SCA's origin from right CS. Diffuse stenosis along with calcification were present in multiple coronary branches. Off-pump CABG was performed to address the critical stenoses.

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Discussion

SCA anomalies are rare congenital abnormalities, with cases of 0.024% -0.066% in the general populace [1]. These anomalies are characterized by the entire coronary circulation originating from a single coronary ostium, often posing challenges in diagnosis and management due to their varied anatomy and associated risks. In the present case, the patient exhibited an SCA arising from right CS, with LAD originating from proximal RCA as well as following a pre-pulmonic course, while the LCX and LAD continued distally from the RCA. This anomaly underscores the complexity of evaluating such cases and the importance of precise imaging to understand coronary anatomy fully.

The type of SCA reported in this case aligns with the Lipton classification as R-I type, where an SCA arises from right CS & follows a pre-pulmonic course [2]. Sanford et al. described a similar case where the LMCA (left main coronary artery) exhibited a pre-pulmonic path, & manifested as Prinzmetal's angina [3]. This association highlights the clinical implications of such anomalies, which may lead to atypical presentations of angina and ischemic events due to altered hemodynamics and potential compression of the coronary artery throughout specific cardiac cycle phases.

In this context, the course of LAD is crucial in determining the risk associated with SCA. Gać et al. reported a case involving an interatrial course, which poses a substantial chance of unexpected cardiac mortality because of possible compression among the pulmonary artery along with the aorta [2]. Although the current case involves a pre-pulmonic course, it still presents a risk due to diffuse atherosclerotic changes noted throughout the coronary vessels. Atherosclerotic disease in SCA cases may further complicate clinical management, as diffuse calcification can exacerbate the risk of critical coronary events.

The prevalence and spectrum of SCA vary, with studies like that by Al Umairi et al. showing that different anatomical patterns can have distinct clinical outcomes [4]. For instance, a benign course of an anomalous coronary artery is linked with a lower possibility of unfavorable outcomes, whereas courses such as interatrial or intramural are linked with higher morbidity and mortality. The present case is significant not only due to its rarity but also because of the coronary artery disease observed, which required surgical intervention. The successful management using off-pump CABG reflects the importance of individualized therapeutic strategies in such complex coronary anomalies.

Cardiac computed tomography angiography (CCTA) plays a pivotal role in diagnosing and planning the treatment of SCA. Vora et al. demonstrated the use-case of CCTA in accurately delineating coronary anatomy and guiding appropriate surgical or percutaneous intervention [5]. In the reported case, CCTA confirmed the single origin of the RCA and delineated the extensive calcification in the coronary arteries, thereby assisting in surgical planning. Given the high prevalence of diffuse atherosclerosis and critical stenoses in this patient, CABG was the optimal approach to ensure myocardial revascularisation and prevent adverse cardiovascular events.

In summary, this instance of an SCA with a Type 1 LAD (originating from RCA) following a pre-pulmonic course represents a rare and challenging coronary anomaly. Accurate anatomical assessment using advanced imaging techniques such as CCTA is essential for diagnosis along with therapy. Moreover, the presence of CAD in SCAcases warrants careful consideration of therapeutic strategies, with CABG often being a suitable approach to optimize patient results. The increasing amount of material on SCA is supported by this case as well as emphasizes the diverse clinical presentations & management considerations associated with this rare congenital anomaly.

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Conclusion

This case of an SCA with a Type 1 LAD following a pre-pulmonic course represents a rare and challenging coronary anomaly. Advanced imaging techniques like CCTA are essential for precise diagnosis and treatment planning. The presence of significant CAD in SCA cases often requires individualized therapeutic strategies, with CABG being a suitable approach in this scenario.

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