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Coronary Artery Disease in Patient with An Anomalous Origin of Right Coronary Artery

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ABSTRACT

Coronary artery disease (CAD) remains a leading cause of mortality and morbidity in developed countries. CAD is a pathological process characterized by the accumulation of atherosclerotic plaques in the epicardial arteries, both obstructive and non-obstructive. This study aims to investigate rare cases of anomalous right coronary artery arising from the left main coronary artery and its clinical implications for coronary artery disease (CAD). The research methodology involved clinical examinations, echocardiography, diagnostic coronary angiography, and computed tomography angiography (CCTA) to obtain a comprehensive understanding of this case. The research findings indicate severe stenosis in the proximal-mid left main coronary artery (LAD) and an anomalous origin of the right coronary artery (RCA) leading to lower-level stenosis. Percutaneous coronary intervention (PCI) on the proximal-mid LAD lesion resulted in significant improvement in the patient's condition. The implications of this research underscore the importance of a deep understanding of coronary artery anatomical variations for accurate diagnosis and appropriate management of CAD patients, especially in rare cases like this.

Keywords: Coronary artery disease, CAD, Anomaly Origin Of The Right Coronary Artery, Patient.

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INTRODUCTION

Coronary artery disease (CAD) remains the leading cause of mortality and morbidity in developed countries (Nakano et al., 2022). CAD is a pathological process characterized by atherosclerotic plaque accumulation in the epicardial arteries, whether obstructive or non-obstructive (Sechtem et al., 2020). This process can be modified by lifestyle adjustments, pharmacological therapies, and invasive interventions designed to achieve disease stabilization or regression (Knuuti et al., 2020).

Anomalous origin of the right coronary artery is uncommon, with a reported incidence of 0,26% (Shaban et al., 2022). An anomalous origin of the right coronary artery is usually asymptomatic (Villa et al., 2016). It is mostly found incidentally on an invasive diagnostic angiogram (Rawala et al., 2019). The incidence of an anomalous right coronary artery originating from the left coronary sinus on coronary angiography is 0.019% to 0.49%. Often, patients present with sudden death or myocardial ischemia (Hong et al., 2013). Most patients remain asymptomatic and have no ischemic symptoms or findings on resting or stress electrocardiography (ECG); therefore, they are diagnosed only on coronary imaging (Narayanan et al., 2016).

We report a case of a 69-year-old man admitted with complaints of chest pain who underwent catheterization for diagnosis of coronary artery disease, The catheterization revealed severe stenosis at the left anterior descending artery and detected an anomalous right coronary artery arising from the left coronary cusp.

Case Presentation

A 69-year-old man was admitted to the hospital for a diagnostic evaluation of chest pain. Six months before admission, he complained of chest pain, with a tight chest pain of strong intensity, lasting

for 10 minutes, and no radiating pain. Chest pain was aggravated by activity and relieved by rest. He has no complaints of shortness of breath, but he has limitations in normal activity. He had no history of smoking, diabetes, hypertension or dyslipidemia. There was no family history of coronary artery disease (CAD). Then, he was evaluated at the Cardiology Department. Clinical examination was normal. Initial ECG showed sinus rhythm, normal axis, heart rate 82 beats per minute (Figure 1). Echocardiography revealed normal left ventricular (LV) function (ejection fraction 68,9%), LV segmental hypokinetic in the apical septal wall, with diastolic dysfunction grade I, suggestive ischemic heart disease.

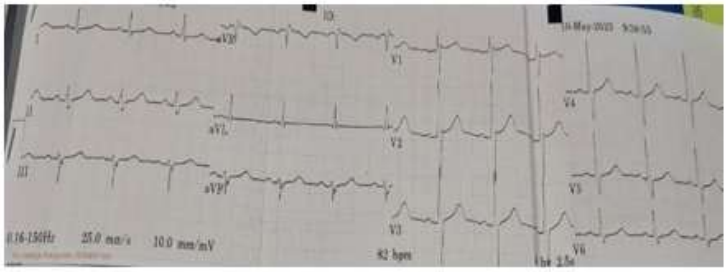

Figure 1. Electrocardiography showed sinus rhythm, normal axis, heart rate 82 beats per minute

Then, the patient was referred for invasive coronary angiography or diagnostic coronary angiography (DCA). The DCA (on February 1st, 2023) revealed a left main coronary artery (LMCA) free of obstructions, left anterior descending artery (LAD) was stenosis up to 80% at proximal-mid, left circumflex artery (LCx) was stenosis up to 30% at distal. The right coronary artery (RCA) cannot be evaluated due to suspicion of high posterior ostial RCA. Repeated attempts to cannulate the RCA were not successful (Figure 2). A nonselective injection into the left coronary sinus with a pigtail catheter demonstrated an anomalous RCA arising from the left sinus. In order to confirm the anomalous origin and course of RCA, the patient was then referred to a higher hospital for coronary CT angiography (CCTA).

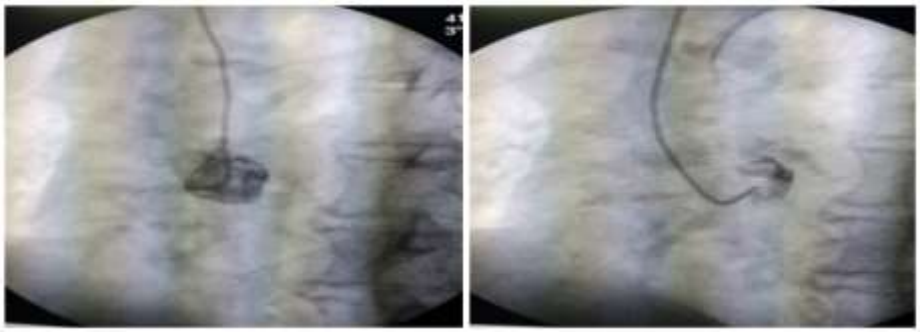

Figure 2. The right coronary artery cannot be evaluated due to suspicious of high posterior ostial RCA

The CCTA (on March 07th, 2023) reported calcified plaque with minimal stenosis 20% at distal LM to ostial LAD, multiple mixed plaque with moderate stenosis 40-50% at ostial-proximal LAD, multiple calcified plaque with severe stenosis 80-90% at proximal-mid LAD, calcified plaque with minimal stenosis 30% at proximal LCx, stenosis 40% at distal LCx, and small ostial RCA diameter causing 20-30% stenosis, anomaly origin of RCA, RCA arises from left coronary cusp. Multiple spotty calcifications at Proximal-Mid RCA without luminal stenosis. Anomaly origin of right coronary artery (anomaly coronary artery origin from opposite or ACAOS) (Figure 3). Then, the patient was scheduled to get a primary coronary intervention (PCI).

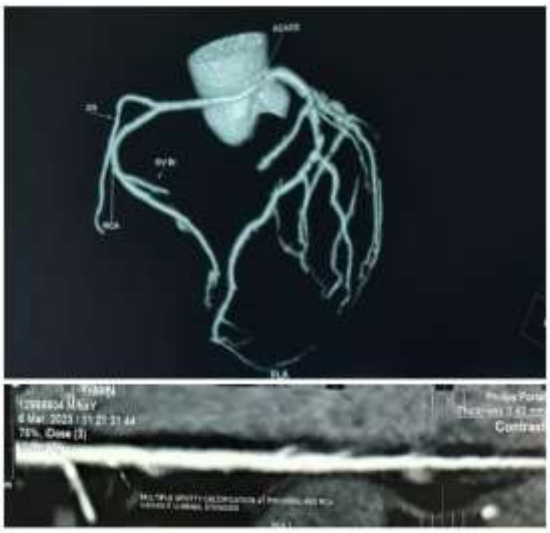

Figure 3. Anomalous origin of RCA. (A) RCA arises from the left coronary cusp. (B) Small ostial RCA diameter causing 20-30% stenosis

The initial examination (on May 10th, 2023) showed blood pressure of 130/90 mmHg, heart rate of 76 beats per minute, respiratory rate of 20 breaths per minute, temperature of 36 Celsius, and oxygen saturation of 98% when breathing ambient air. No abnormalities were found during the examination of the heart, lungs, or abdomen. The ECG showed sinus rhythm, normal axis, and a heart rate of 76 beats per minute. Chest X-ray and initial laboratory results showed no other abnormalities.

Cardiac catheterization later revealed LAD stenosis of 20% at proximal, up to 85% at proximal-mid, and up to 30% at distal. LMCA was normal, LCx was normal, and RCA was not cannulated. The percutaneous coronary intervention was carried out, and the proximal-mid LAD lesion was stented with a drug-eluting stent (DES). The final angiography showed a good result. No residual stenosis. TIMI 3 flowed to the distal LAD (Figure 4).

The patient was given therapy with clopidogrel 75 mg 1-0-0, nitroglycerin 1x2.5 mg, aspirin 100 mg 1-0-0, and atorvastatin 20 mg 0-0-1. On the third day, the patient was discharged from the hospital.

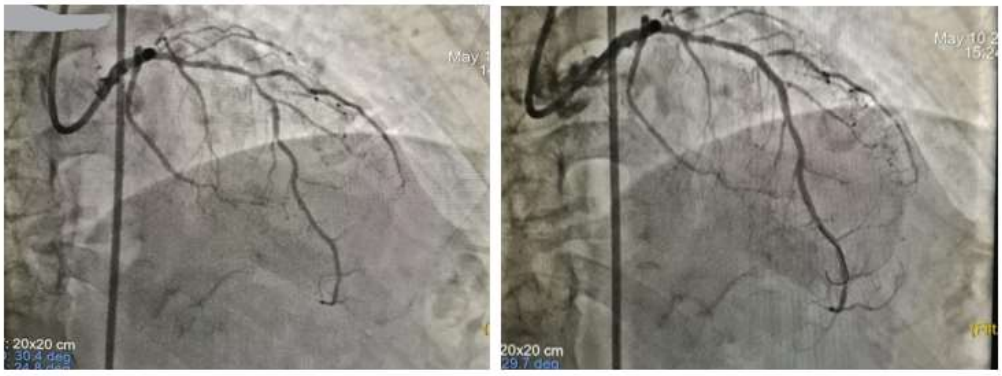

Figure 4. Cardiac catheterization showed A. Stenosis up to 85% at proximal-mid LAD. B. After PCI at proximal-mid LAD lesion, the final angiography showed a good result

This study aimed to investigate rare cases of right coronary artery anomalies arising from the cusp of the left coronary and their clinical impact on coronary artery disease (CAD). Thus, this study is expected to provide deeper insights into the treatment and prognosis of patients with this rare type of coronary artery anomaly. In terms of benefits, the results of this study can provide valuable information for medical practitioners in identifying and managing similar cases more effectively. In addition, a better understanding of the relationship between coronary artery anomalies and CAD can help in the development of more sophisticated diagnostic and intervention strategies for the disease.

METHOD

The research methodology involved clinical examinations, echocardiography, diagnostic coronary angiography, and computed tomography angiography (CCTA) to obtain a comprehensive understanding of this case.

RESULTS AND DISCUSSION

Coronary artery disease (CAD) is a pathological process characterized by atherosclerotic plaque accumulation in the epicardial arteries, whether obstructive or non-obstructive (Nakano et al., 2022). The disease can have long, stable periods. However, it can also become unstable at any time, typically due to an acute atherothrombotic event caused by plaque rupture or erosion. Invasive coronary angiography has long been the gold standard for diagnosing CAD (Knuuti et al., 2020).

In this case, the patient has typical chest pain, which is aggravated by exercise and relieved by rest. Later, the chest pain occurs more frequently and is not relieved by rest. So, the patient is scheduled to get diagnostic coronary angiography (DCA) to diagnose CAD. The first DCA revealed severe stenosis at proximal-mid LAD and suspicion of high posterior ostial RCA. Then the CCTA showed stenosis 80-90% at proximal-mid LAD and anomaly origin of RCA, RCA arises from left coronary cusp.

Coronary artery anomalies (CAAs) are characterized by an abnormality in the course or origin of three main coronary arteries. The origin of the left main coronary artery or left ascending artery (LAD) from the right sinus of Valsalva or right coronary artery (RCA) from the left sinus of Valsava is referred to as the anomalous aortic origin of a coronary artery (AAOCA) (Bigler et al., 2021). There are four most common coronary anomalies: right coronary artery (RCA) arises from the left coronary sinus, left coronary artery (LCA) originates from the right coronary sinus, or LCA or RCA arises from the non-coronary sinus. Of course, 14 CAAs can be classified as CAAs of origin and termination (Table 1) (Gentile et al., 2021).

Table 1. Classification of Coronary Artery Anomalies (CAAs) 5

Simplified Nomenclature of CAAs		
Type of anomaly	**Variant**	**Subvariants**
Anomalies of origin	Anomalous pulmonary origin of the coro- varies	Origin of the left main coronary artery from the pulmonary artery
		Origin of the right coronary artery from the pulmonary artery
		Origin of the circumflex coronary artery from the pulmonary artery
		Origin of left and right coronary arteries from the pulmonary artery
	Anomalous aortic origin of the coronaries	Origin of the left main coronary artery from the right aortic sinus of Valsalva
		Origin of the right coronary artery from the left aortic sinus of Valsalva
		Origin of left anterior descending coronary artery from the right aortic sinus of Valsalva
		Origin of left anterior descending coronary artery from the right coronary artery
		Origin of the circumflex coronary artery from the right aortic sinus of Valsalva
		Origin of the circumflex coronary artery from the right coronary artery
		Single coronary artery
		Inverted coronary arteries
		Others
	Congenital atresia of the left main artery	

Simplified Nomenclature of CAAs		
Type of anomaly	**Variant**	**Subvariants**
Anomalies of course	Myocardial (or coronary) bridging	Symptomatic Asymptomatic
	Coronary aneurysm	Congenital Acquired
Anomalies of termination	Coronary arteriovenous fistula	Congenital Acquired
	Coronary stenosis	Congenital Acquired

Various diagnostic techniques can be used to investigate coronary anatomy and to assess the presence of high-risk features. CCTA is currently considered the gold standard, and cardiac magnetic resonance (CMR) is becoming an alternative (De Filippo & Capasso, 2016). CCTA is currently the favored imaging modality to diagnose anomalous right coronary artery (ARCA) due to its higher spatial resolution (Surhonne et al., 2016).

Invasive coronary angiography (ICA) was considered the most important and definite tool to identify and classify CAAs. During coronary angiography, two clues should raise suspicion of a coronary anomaly: (1) the 'unperfused myocardium' sign, a myocardial region that is not supplied by any visualized vessel; and (2) the 'aortic root' sign, a vessel that appears to cross the aorta and the pulmonary artery at the level of the aortic root on ventriculography or proximal root injection in the right anterior oblique (RAO) projection, which is seen with most anomalies with an ectopic origin from the contra-lateral sinus (Ali et al., 2011). There are challenges when performing angiography in patients with CAA. There may be difficulty in locating and engaging the ostium of the artery. In addition, determining the precise course of the artery may be difficult. CT angiography (CTA) is increasingly employed in these circumstances to provide accurate anatomical information on origin and course (Angelini & Monge, 2013).

Multidetector CCTA offers numerous advantages, making it the gold standard for studying CAAs. CCTA offers a detailed characterization of the anatomic clues associated with high-risk CAAs, allows visualization of the surrounding cardiac and non-cardiac structures and their relative 3-dimensional relations, and is more widely applicable for population studies (Gentile et al., 2021). The origin and course of abnormal coronary arteries can be visualized with a three-dimensional anatomical display using axial reconstructions from multidetector CTA. Some authors advocate using CT as the first-line investigation when CAA is suspected, as the exact position and course of the anomalous artery can be viewed about the aortic root and pulmonary artery (Shaban et al., 2022).

The treatment of ARCA is often controversial. Surgery is recommended in symptomatic patients, and conservative management in asymptomatic patients (Rawala et al., 2019). Treatment options include observation with medical therapy, percutaneous intervention (stenting), or surgery (Vora et al., 2021). Significant atherosclerotic CAD in association with coronary artery anomalies has been reported in 26–60% of cases. Symptomatic patients with associated significant CAD may be treated with routine interventions such as percutaneous coronary intervention (PCI) or coronary artery bypass grafting (Surhonne et al., 2016).

In our case, the DCA revealed stenosis up to 80% at proximal-mid LAD, and the RCA cannot be evaluated due to suspicion of high posterior ostial RCA. The CCTA showed an anomaly in the origin of RCA; RCA arises from the left coronary cusp. This congenital anomaly was an incidental finding since the patient's initial clinical presentation was suggestive of significant coronary obstructive disease of the LAD. The proximal-mid LAD segment had a severe stenosis; therefore, blood flow to all distal branches was jeopardized. Coronary flow to the distal LAD was significantly improved after percutaneous coronary intervention and stenting of the proximal-mid LAD lesion. We decided to do

conservative management for the anomalous origin of RCA because it is not clinically significant, and CAD more often causes ischemia than the anomaly.

CONCLUSION

The conclusions of this study suggest that a deeper understanding of coronary artery anatomical variations, especially in rare cases such as right coronary artery anomalies arising from the cusp of the left coronary crest, is essential for determining the appropriate approach in cardiac intervention. In these cases, PCI in severe stenosis of the mid-proximal LAD produces good results in patient management. The implication of this study is the need to emphasize the careful evaluation of the anatomical structure of the heart before intervening, so as to help avoid complications and improve the effectiveness of treatment. As a suggestion for future research, further studies involving a number of cases are needed to evaluate optimal diagnosis and management strategies in patients with rare coronary artery anomalies.

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