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A Rare Variant of Single Coronary Artery: Anomalous Origin of Right Coronary Artery Arising from Left Anterior Descending Artery

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Abstract: ***Background:*** *Coronary artery anomalies are identified in 0.6% to 1.55% of patients who undergo coronary angiography. Single coronary artery (SCA) is a rare coronary artery anomaly with a reported incidence between 0.024% and 0.098%. Although majority of patients with coronary artery anomalies are asymptomatic, some may present with ischemia, heart failure and sudden cardiac death, especially when they are associated with malignant course. Here we report an interesting rare case of a single coronary artery from the left coronary sinus with anomalous origin of the right coronary artery from the mid - segment of the left anterior descending coronary artery.* ***Case Summary:*** *A 59 - year - old diabetic, hypertensive, post - menopausal woman presented with exertional dyspnea of 1 week duration. ECG showed Sinus rhythm with LBBB pattern.2D echo was suggestive of dilated left ventricle with global hypokinesia and severe Left ventricular dysfunction. Coronary angiography was done after stabilisation which showed single coronary artery (LMCA) arising from left sinus of Valsalva dividing into Left anterior descending artery (LAD), non - dominant left circumflex artery (LCx) and Ramus. An anomalous Right coronary artery (RCA) was seen originating from mid portion of Left anterior descending artery (LAD) just after second diagonal and it courses anteriorly down the right atrioventricular groove. CT Coronary angiography showed Left Main coronary artery (LMCA) with normal origin was seen dividing into Left anterior descending artery (LAD), left circumflex artery (LCx) and Ramus. Left anterior descending artery (LAD), Ramus and left circumflex artery (LCx) were normal with no luminal stenosis or non - calcified lesions in any segment. Right coronary artery was seen arising from Left anterior descending artery (LAD) crossing to the right side anterior to right ventricular outflow tract and extending into atrioventricular groove and its vascular lumen and walls were normal. Patient was treated medically and was discharged in stable condition.* ***Conclusion:*** *Coronary artery anomalies (CAA) are a very rare form of congenital cardiac anomaly. Furthermore, the anomalous origin of the RCA from the LAD artery is a rare form of single coronary artery in which the anomalous RCA arises from the proximal or mid - portion of the LAD. This anomaly often has a benign course except when RCA traveling between the pulmonary artery and aorta involves surgical management.*

Keywords: Coronary artery anomalies (CAA), Single coronary artery (SCA), Right coronary artery (RCA), CT coronary Angiography (CTCA)

1. Introduction

The incidence of coronary artery anomalies (CAAs) is 1.3% and diagnosed incidentally on coronary angiography and cardiac CT.1, 2 Among these coronary anomalies, Single coronary artery is a congenital anomaly defined as a solitary coronary artery arising from a single coronary ostium in the aortic trunk and supplying the whole heart. Incidence of single coronary artery (SCA) is rare, reported between 0.024% and 0.098% of the population.3The RCA originating from the left anterior descending (LAD) artery is an extremely rare variant of single coronary artery anomaly. In such cases, RCA originates from proximal or mid - portion of the LAD artery. So far only 40 cases have been reported in which the RCA originates from LAD and only 15 cases where the RCA originates from the mid - portion of the LAD artery.4Most of these anomalies have no clinical significance. However, when right coronary artery (RCA) travels between the pulmonary artery and aorta, it is associated with profound ischemia and sudden cardiac death due to mechanical compression.5

2. Case Details

A 59 - year - old diabetic, hypertensive, post - menopausal woman presented with exertional dyspnea of 1 week duration, which was initially class II NYHA progressing to NYHA class IV. Patient was treated with antiplatelets, antihypertensives, diuretics and antidiabetic medication. ECG at presentation was suggestive of Sinus rhythm with Left bundle branch block (LBBB).2D echocardiography was suggestive of dilated Left ventricle, global hypokinesia of left ventricle with severe left ventricular dysfunction, trivial Mitral regurgitation and tricuspid regurgitation. Coronary angiography was done after stabilisation which showed single coronary artery (LMCA) arising from left sinus of Valsalva dividing into Left anterior descending artery (LAD), non - dominant left circumflex artery (LCx) and Ramus. An anomalous Right coronary artery (RCA) was seen originating from mid portion of Left anterior descending artery (LAD) just after second diagonal and it courses anteriorly down the right atrioventricular groove. Aortic root injection confirmed the absence of RCA stump or any other vessel originating from right coronary sinus. CT coronary angiography (CTCA) showed a single coronary ostium from left coronary cusp (LCC) with the absence of any coronary artery origin from right coronary cusp ostium. Left Main coronary artery (LMCA) with normal origin was seen dividing into Left anterior descending artery (LAD), left circumflex artery (LCx) and Ramus. Left anterior descending artery (LAD), Ramus and left circumflex artery (LCx) were normal with no luminal stenosis or non -

calcified lesions in any segment. Right coronary artery was seen arising from Left anterior descending artery (LAD) crossing to the right side anterior to right ventricular outflow tract and extending into atrioventricular groove and its vascular lumen and walls were normal. The calcium score was 27 (AJ 130) and was in the 70th percentileof patient's age group. She was managed medically and discharged in stable condition.

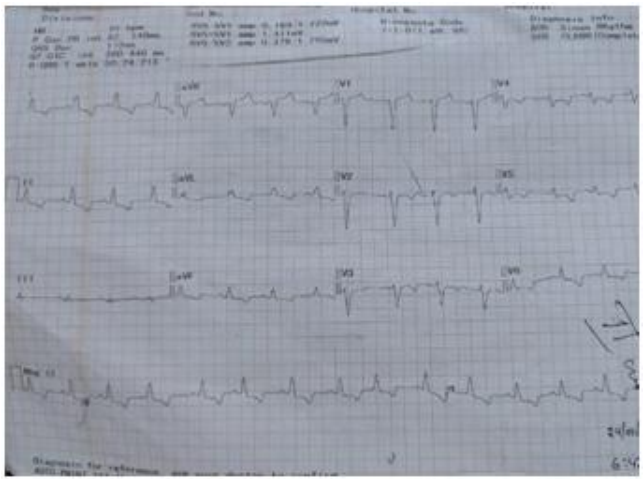

Figure 1: ECG at presentation showing sinus rhythm with rate of 90/min and LBBB

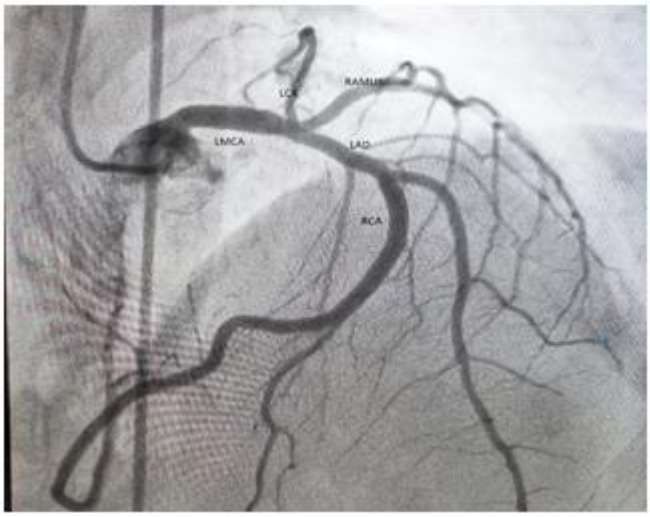

Figure 2: Coronary angiography in right anterior oblique projection with cranial angulation showing anomalous RCA arising from mid LAD

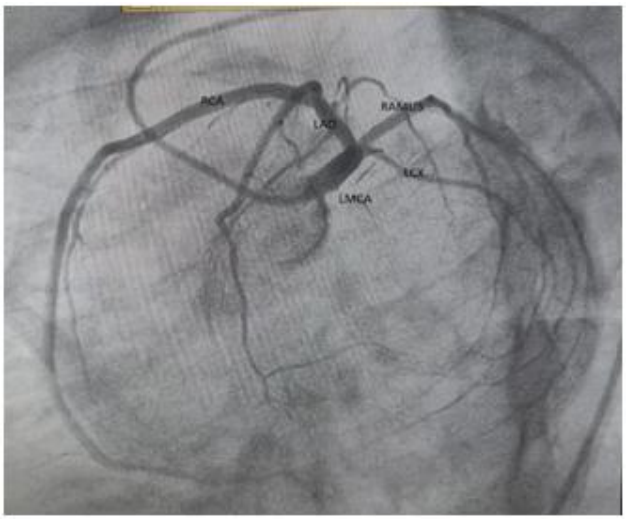

Figure 4: Coronary angiography in left anterior oblique projection with caudal angulation showing anomalous RCA arising from mid LAD

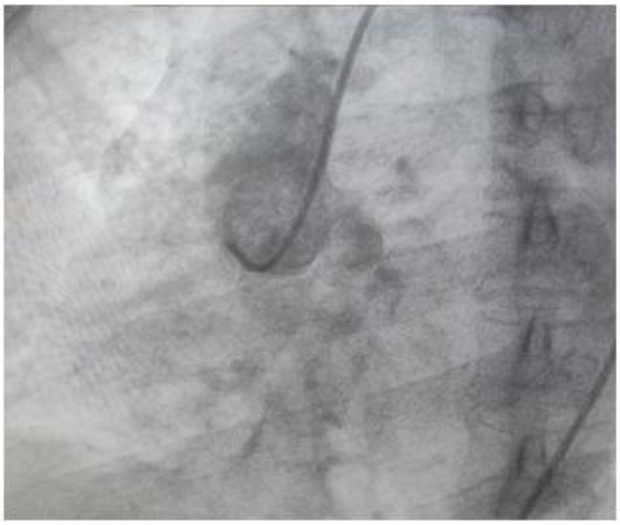

Figure 4: Coronary angiography in left anterior oblique projection with aortic root injection showing the absence of RCA or any other vessel from right coronary sinus

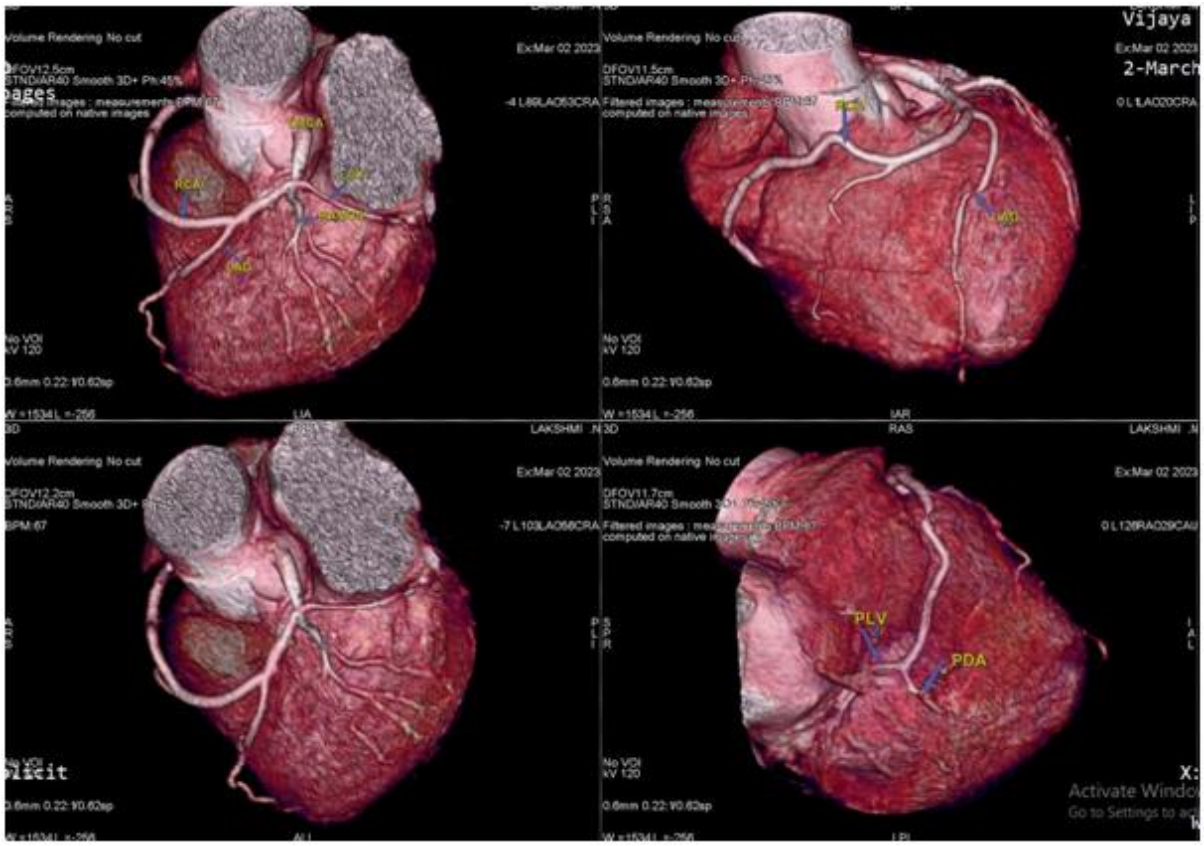

Figure 5: CT CAG showing Right coronary artery (RCA) arising from Left anterior descending artery (LAD) crossing to the right side anterior to right ventricular outflow tract and extending into atrioventricular groove.

3. Discussion

Coronary artery anomalies (CAA) are very rare and are usually detected incidentally in about 0.16 - 1.3% of patients referred for a coronary angiogram. Single coronary artery (SCA) anomaly is even rarer with an incidence of 1.1% - 8.8% of all coronary artery anomalies and only occurs in 0.024% - 0.098% of the general population.[2, 6]SCA can either be isolated or coexist with other cardiac congenital anomalies including transposition of great vessels, coronary arteriovenous fistula, tetralogy of Fallot, truncus arteriosus, interventricular septal defect, patent ductus arteriosus, bicuspid aortic valve or patent foramen ovale.[7]

Anomalous origin of RCA from LAD has been reported in literature as a very rare coronary anomaly.8Majority of cases where RCA originates from LAD has a structurally normal heart although single coronary artery is associated with other congenital anomalies such as bicuspid valve, Tetralogy of Fallot and transposition of great arteries.9 In most cases, the RCA originating from LAD is asymptomatic, usually diagnosed incidentally and has a better prognosis except if the RCA is passing between the pulmonary artery and aorta. Anamolous RCA is malignant when it courses in between great arteries. It is more prone to compression and isat higher risk to develop atherosclerosis, myocardial ischemia and sudden cardiac death even without underlying atherosclerosis.1[0]

These coronary artery anomalies can be diagnosed by different diagnostic modalities like conventional coronary angiography, coronary computed tomography angiography and cardiac MRI. Although conventional coronary angiography was considered the gold standard for assessment of the coronary artery, it is an invasive procedure and has a risk of procedure related complications.1[1] Moreover, in some cases, even with multiple projections and angiographic views, exact delineation of the anatomy of the coronary arteries in complex cases can be difficult.[12] On the contrary, coronary computed tomography angiography (CCTA) is a non - invasive diagnostic tool with high temporal and spatial resolution that has emerged as a gold standard for detection and characterization of coronary artery anomalies.[13]Most of the RCA anomalies are asymptomatic and usually do not require treatment. However, in cases of associated cardiac ischemia secondary to the anomalous artery, medical management and percutaneous intervention are needed. Treatment of the malignant type where the anomalous RCA is passing between pulmonary artery and aorta involves surgical management.6

4. Conclusion

Single coronary artery (SCA) with RCA arising from mid LAD is rare and often with benign course. Those with malignant course between great arteries are best treated surgically. Localization and adequate visualization of these coronary artery anomalies are essential for proper patient management, especially in patients undergoing complex interventional or surgical treatments of coronary and valvular diseases.

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