

Isolated Right Ventricular Infarction Owing to Anomalous Origin of Right Coronary Artery

Role of MR and CT in Diagnosis

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Abstract: Our case report describes a very rare example of isolated right ventricular infarction in a 39-year-old patient with non-dominant anomalous right coronary artery. We took advantage of both computed tomography and magnetic resonance imaging techniques to diagnose this case. The computed tomography scan characterized the anatomy and course of the right coronary artery and cardiac magnetic resonance imaging distinguished the area of infarction to the right ventricles.

Key Words: coronary angiography, anomalous coronary artery, myocardial infarction, cardiac MRI, right ventricle infarction, multidetector CT, CT coronary angiography

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A variety of imaging modalities are available for evaluation of suspected disease of the coronary arteries and myocardium. Recent advances in the computed tomography (CT) and magnetic resonance imaging (MRI) technologies made detailed imaging of the heart possible in a variety of pathologic conditions. Isolated right ventricular (RV) infarction is rare and anomalous origin of the right coronary artery (RCA) is also rare. This case report describes a very rare example of isolated RV infarction in a patient with an anomalous origin of a nondominant RCA. A brief literature review pertaining to these issues is summarized.

CASE REPORT

A 39-year-old previously healthy Egyptian male presented with acute chest pain and dyspnea. There was no prior past or family history of ischemic heart disease. On presentation, he was hemodynamically stable with no clinical evidence of cardiac failure. His initial electrocardiogram (ECG) showed sinus rhythm with no ischemic changes but small q-waves in leads V3 and V4 suggesting a small anterior infarction. His cardiac enzymes were mildly elevated. He was treated for a non-ST segment myocardial infarction with aspirin, β -blocker, statin, intravenous heparin, and an intravenous glycoprotein IIb/IIIa inhibitor. He was taken for cardiac catheterization. Coronary angiography revealed large ectatic left coronary system without any flow obstructing lesions and demonstrated a left dominant circumflex artery giving rise to the posterior descending artery (Fig. 1). The RCA ostium was difficult to engage and had an anomalous origin. RCA angiography

revealed abrupt tapering with a proximal occlusion. Attempts were made to percutaneously intervene but a guide catheter would not engage the anomalous RCA ostium. He was taken to the cardiac care unit in stable condition and continued on intravenous blood thinners. Echocardiography showed normal biventricular function. A right-sided ECG failed to demonstrate any evidence of RV infarction. In addition, the chronicity of the occluded RCA could not be clearly delineated by invasive angiography. A cardiac multidetector CT (MDCT) scan was requested to better define the anatomy and course of the anomalous RCA, and a cardiac MRI was performed to evaluate for myocardial function and viability.

Coronary CT angiography was performed the following day using a 64-slice MDCT (LightSpeed, GE Healthcare). There were no calcified or noncalcified plaques visualized in any of the coronary vessels. Ectatic patent left main (7 mm), left anterior descending (5.6 mm), and left dominant circumflex (6.5 mm) arteries were demonstrated. MDCT revealed a small orifice of the RCA (2 to 3 mm) arising from the left coronary cusp of the aorta just above the right-left commissure, but separate from the left main coronary artery ostium. The ostium of the RCA had an acute-angled takeoff from the aorta, and the proximal segment coursed between the ascending aorta and pulmonary outflow tract/artery (Fig. 1). This interarterial segment showed moderate luminal narrowing compared with the remainder of the vessel most likely owing to hypoplasia or compression between the 2 major vessels. The RCA showed a thrombotic segment approximately 25 mm from the origin of RCA to the origin of acute marginal artery (Fig. 2). Low attenuation thrombus was seen in the center of the occluded segment. The RCA was ectatic proximal to the clot (6 mm). The acute marginal artery was patent but the RCA branches distal to its origin did not opacify. Assessment of regional wall motion at the base was difficult owing to motion but remainder of the ventricles showed normal functioning on MDCT scan.

Cardiac MRI was then performed using a 3-Tesla magnet (Trio, Siemens, Erlangen, Germany). Cine MRI showed severe hypokinesis of the inferior and inferolateral walls of the RV at the basal level. The left ventricle showed normal systolic function. Delayed viability images (inversion recovery segmented fast gradient echo sequence) showed hyper enhancement of the inferior and inferolateral RV walls at the level of the base (Fig. 2). The RV ejection fraction was significantly reduced (37%) when compared with the left ventricular ejection fraction (55%).

The patient was treated medically and remained clinically stable and chest pain free after his isolated RV infarction. He had an uneventful hospital course and was discharged home on hospital day 3 and is doing well in follow-up.

DISCUSSION

RV myocardial infarction accompanied by inferior left ventricular infarction is well known, but isolated RV myocardial infarction is rare (3% of RV infarcts).^{1,2} Our reported patient presented with a very rare form of isolated RV infarction caused by occlusion of a nondominant RCA with anomalous origin. Nondominant RCA occlusion

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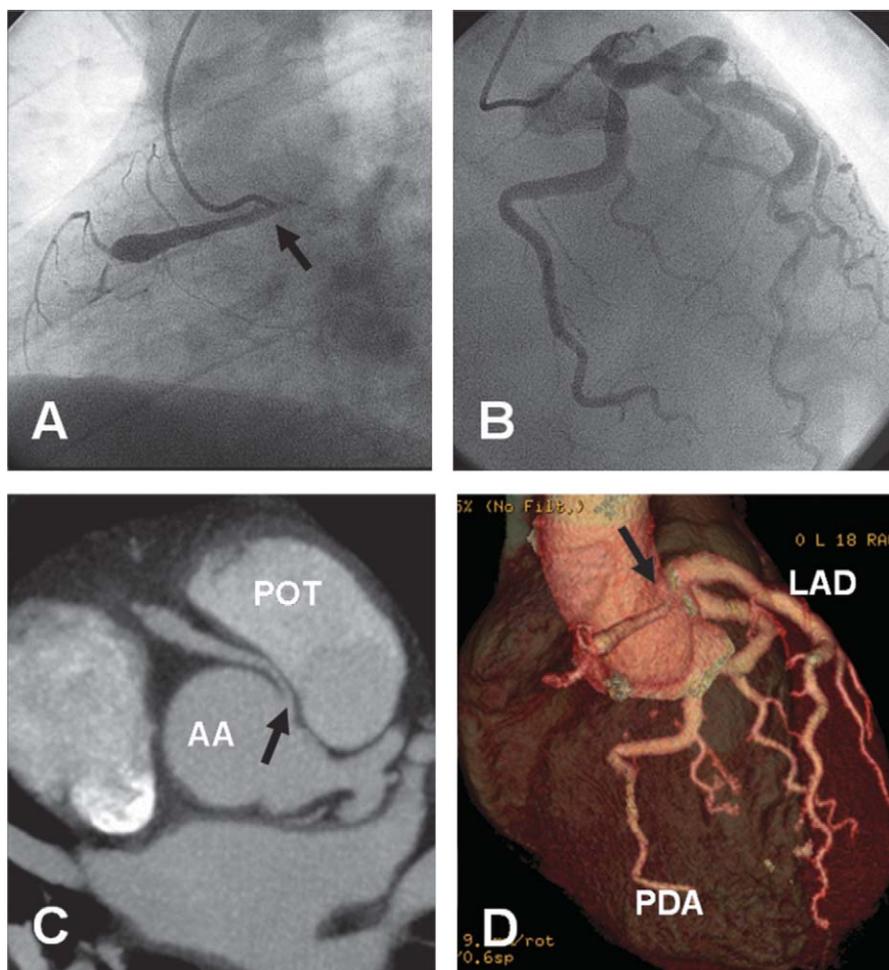


FIGURE 1. Upper panel shows left anterior oblique view of the RCA (A) and right anterior oblique view of the left coronary system (B) on coronary angiography. A demonstrates the proximally occluded RCA, and B shows the large ectatic left coronary artery. Note, the large left coronary system including a dominant left circumflex artery giving rise to the posterior descending artery (PDA). Lower panel shows axial MDCT image at the level of the RCA origin (C) and a 3-dimensional volume-rendered reconstruction of the coronary vessels corresponding to the same projection obtained by coronary catheterization (D). Anomalous origin of the RCA above the anterior commissure of the ascending aorta is shown. The proximal RCA appears funnel-shaped and compressed between ascending aorta (AA) and right ventricle outflow tract (RVOT) with a short intramural segment at the origin (black arrows). It is occluded approximately 25 mm from its orifice. LAD indicates left anterior descending artery; MDCT, multidetector computed tomography; RCA, right coronary artery.

causes isolated RV infarction, however, the diagnosis can be difficult without the use of modern imaging technology such as MRI and MDCT. The ECG findings may be misinterpreted as acute anterior infarction or even missed if not suspected.^{3,4} The coronary orifice in anomalous vessels can be a slitlike opening in some of the cases, making precise catheterization of the artery difficult. It has been reported that MDCT may be superior to conventional angiography in defining the ostial origin and proximal path of anomalous coronary branches.⁵

Anomalous RCA from the left sinus is found only in about 0.03% to 0.9% of the patients undergoing coronary angiography.⁶⁻⁸ And, in 85% to 90% of the patients, the RCA is the dominant coronary vessel.⁷ The ostium originates either from within or above the left coronary sinus or from the aortic wall above the right-left commissure.^{9,10} In either type, it may have a short intramural course within the aortic wall and then follows

a course between the ascending aorta posteriorly and the pulmonary trunk anteriorly.

The anomalous RCA from the left sinus can cause myocardial ischemia, infarction, arrhythmias, syncope, or sudden death during or after exercise, particularly in young athletes.^{11,12} Several mechanisms have been implicated as the cause of ischemia, including increased acuteness of the angle of origin with exercise, compression of the anomalous artery by the right-left (anterior) commissure of the aortic valve or between the great arteries, and systolic compression of the intramural segment.^{7,9,10}

MDCT has proved its sensitivity to detect coronary arteries including congenital malformations and stenosis.⁵ Although MRI can demonstrate the anatomy of coronary vessels in their proximal course it is not as sensitive in depiction of the distal vessel.^{13,14} Otherwise, MRI is the best technique to show the location and extent of myocardial infarction, not only in the left ventricle but also the right

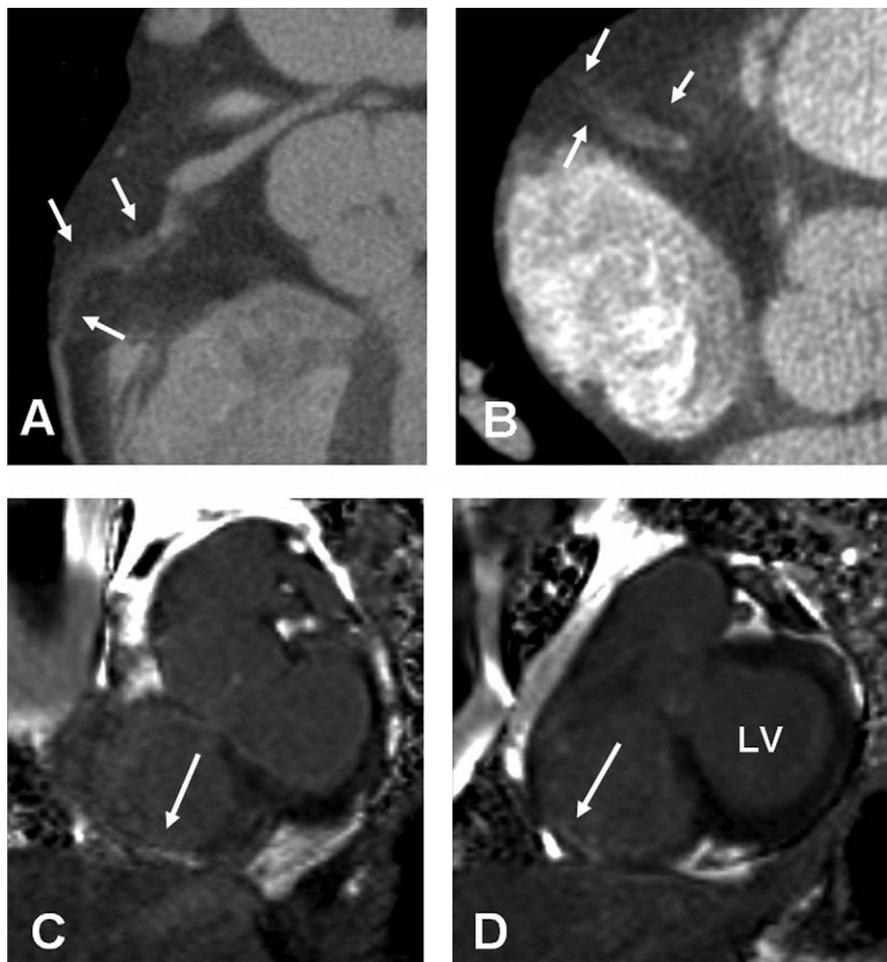


FIGURE 2. Upper panel depicts curved reconstruction (A) and axial views of the RCA. The thrombosed segment is shown by small arrows. In B, a linear filling defect is seen within the thrombosed segment surrounded by contrast, which may represent clot. Lower panel (C and D) shows short axis images of delayed contrast enhanced MRI (phased sensitive, inversion recovery fast gradient echo). Long arrows point to hyper enhancement of the inferior and inferolateral walls of the right ventricle at the basal level. Cine MR (not shown) demonstrated severe hypokinesia of the RV in the area of abnormal enhancement. LV indicates left ventricle; MRI, magnetic resonance imaging; RV, right ventricle.

ventricle.^{15,16} Its high contrast and spatial resolution allows for detection of small irreversibly injured areas of the LV¹⁵ and, as recently shown, in the RV wall.¹⁶ We took advantage of both techniques to diagnose this rare isolated RV infarction caused by occlusion of an anomalous nondominant RCA. The MDCT characterized the anatomy and course of the RCA and cardiac MRI distinguished the area of infarction to the RV.

CONCLUSIONS

Our case demonstrates that isolated RV infarction owing to the occlusion of anomalous origin of nondominant RCA can be successfully evaluated using MDCT and MRI.

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