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CASE REPORT
Cardiovascular imaging

Combined intra-cavitary course of left anterior descending artery and myocardial bridge of right coronary artery in right ventricle hypertrophy: a case report

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Background Intra-cavitary (IC) coronary course is a rare anatomical variant that has become more commonly reported in the last decade. While the condition is generally benign and often discovered incidentally during coronary computed tomography angiography (CCTA), these arteries are vulnerable to injury during cardiac interventions. It is unclear whether right ventricle (RV) pathology, such as dilatation or hypertrophy, plays a role in this condition.

Case summary A patient in their fifties with a medical history of rheumatic heart disease and atrial fibrillation presented with dyspnoea and orthopnea but denied any previous chest pain. Upon examination, the patient exhibited slow atrial fibrillation and generalized anasarca. Echocardiography revealed severe mitral stenosis, tricuspid regurgitation, pulmonary hypertension, and a significantly dilated and impaired RV. Before surgery, a CCTA was performed and revealed an abnormal mid-left anterior descending (LAD) course through the RV cavity with complete systolic attenuation. This finding was later confirmed through invasive angiography. Additionally, the right coronary artery (RCA) showed a mid-segment myocardial bridge (MB). The patient was scheduled for mitral and tricuspid valves' surgery with no planned intervention to the LAD or RCA.

Discussion Coronary IC course is a rare finding that poses a risk of arterial injury during invasive cardiac procedures. It is important for all cardiac interventionists to be familiar with this diagnosis and the potential hazards during cardiac interventions. Further research is needed to determine whether RV dilatation or hypertrophy can exacerbate coronary IC course or MB.

Keywords Intra-cavitary course • Left anterior descending • Right coronary artery myocardial bridge • Pulmonary hypertension • Case report

ESC curriculum 2.4 Cardiac computed tomography • 3.4 Coronary angiography • 7.5 Cardiac surgery • 9.6 Pulmonary hypertension • 3.1 Coronary artery disease

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Learning points

- Intra-cavitary (IC) course of coronary artery is an underdiagnosed anatomical variant that poses a risk of coronary injury in cardiac interventions if operators are not aware of the condition.
- Right ventricular hypertrophy may play a role in the development or exacerbation of an IC LAD course as well as RCA myocardial bridge.

Introduction

Intra-cavitary (IC) coronary course is a rare anatomical variant that is characterized by the passage of an arterial segment inside the cardiac chamber. The prevalence has varied from 0.054%[1] to 0.36%[2] with a recently increased trend due to widespread use of coronary computed tomography angiography(CCTA).[3] Although IC course is a relatively benign condition, arteries are at risk of injury, particularly during cardiac interventions.[4]

Right coronary artery (RCA) myocardial bridge (MB) has a prevalence of 5.7% at autopsy.[5] It is rarely found isolated and is usually associated with left anterior descending (LAD) MB. The intra-mural segment may involve the RCA trunk, acute marginal, right ventricle (RV) branch, or posterior descending artery.[6]

We present a rare case of simultaneous IC course of LAD artery and RCA MB in a patient with rheumatic mitral valve disease.

Summary figure

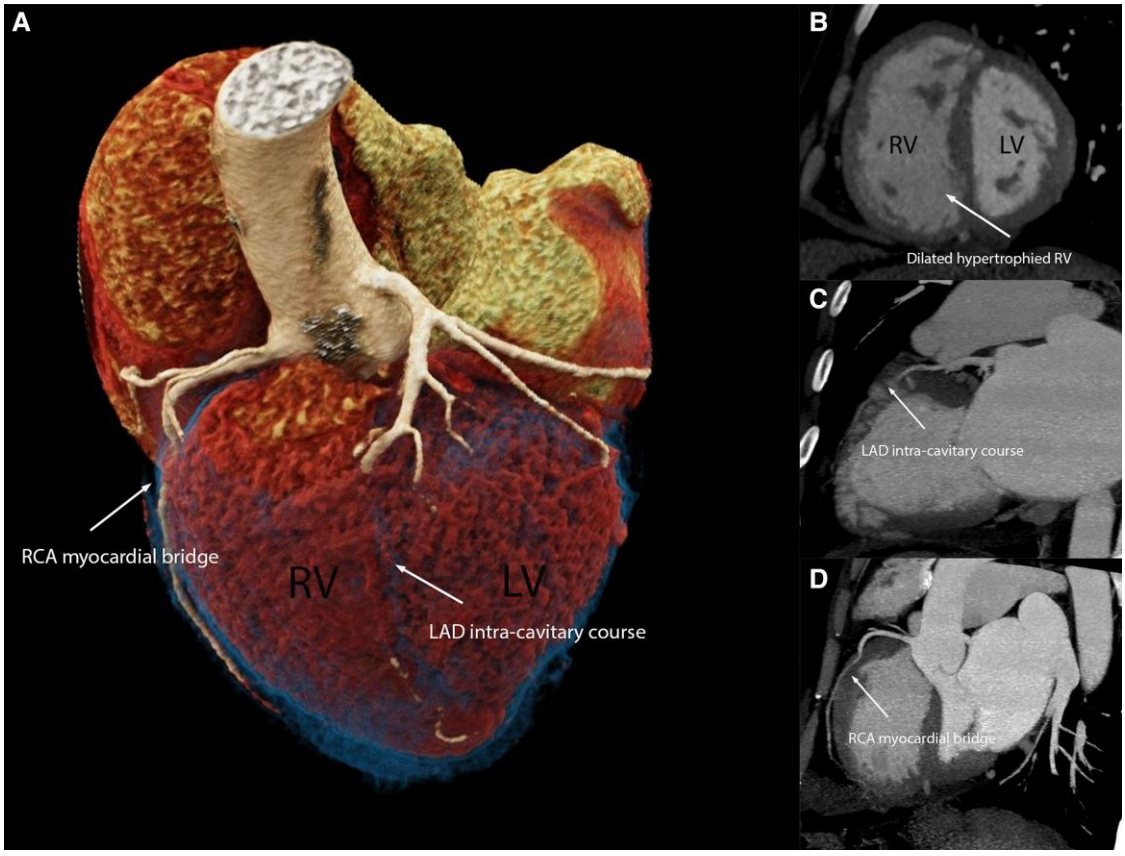
Case presentation

A 51-year-old gentleman with a history of rheumatic heart disease presented with shortness of breath on minimal effort, associated with orthopnea. He did not report any chest pain.

On physical examination, his blood pressure was 100/65 mmHg, pulse was irregular with a rate of 50 bpm, respiratory rate 20 per minute and oxygen saturation was 98%.

12-lead Electrocardiogram showed slow atrial fibrillation. Transthoracic echocardiography revealed severe mitral stenosis with commissural fusion (*Figure 1*). The mitral valve area was 0.9 cm^2 by 2D planimetry. The RV was dilated and impaired, with severe secondary tricuspid regurgitation and estimated pulmonary artery systolic pressure of 140 mmHg. The LV showed normal dimensions and contractility with D-shaped septum. Mild circumferential pericardial effusion was noted.

Initial laboratory workup was normal. Pre-operative CCTA revealed LAD IC course through the RV cavity (30 mm in length) after the second diagonal origin (*Figures 2*, *3A and B*), with no calibre attenuation



MDCT of the patient. A: 3D VRT showing the LAD intra-cavitary course and RCA myocardial bridge. B, Short-axis view of the left and right ventricles showing a dilated and hypertrophied RV; C & D, Thick MIP reconstructed double oblique views showing the LAD course within the RV cavity and the RCA myocardial bridge; VRT, volume-rendered technique; MIP, maximum intensity projection; LV, left ventricle; RV, right ventricle; LAD, left anterior descending artery; RCA, right coronary artery; MDCT, multi-detector computed tomography.

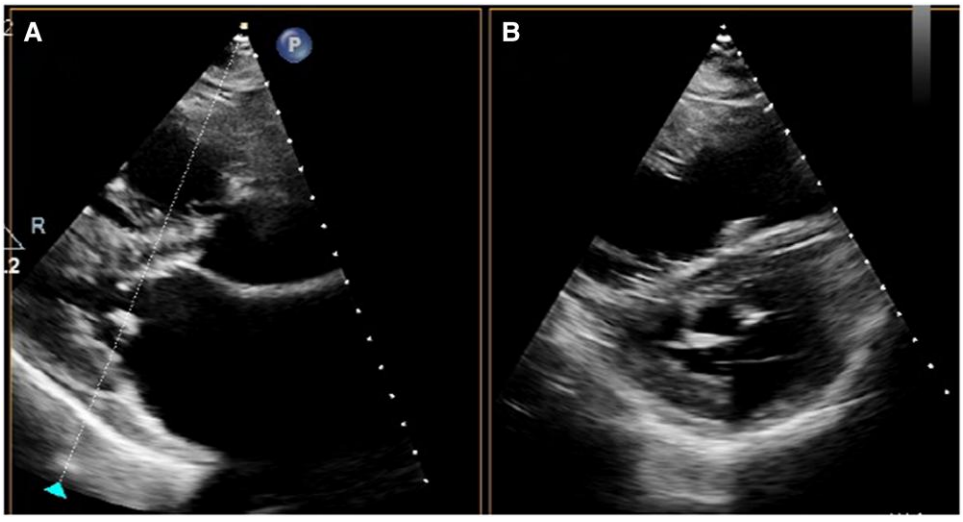


Figure 1 Transthoracic echocardiography, X-plane view on mitral leaflet tips showing limited excursion with diastolic doming of anterior mitral leaflet (*A*), commissural fusion and D-shaped septum (*B*).

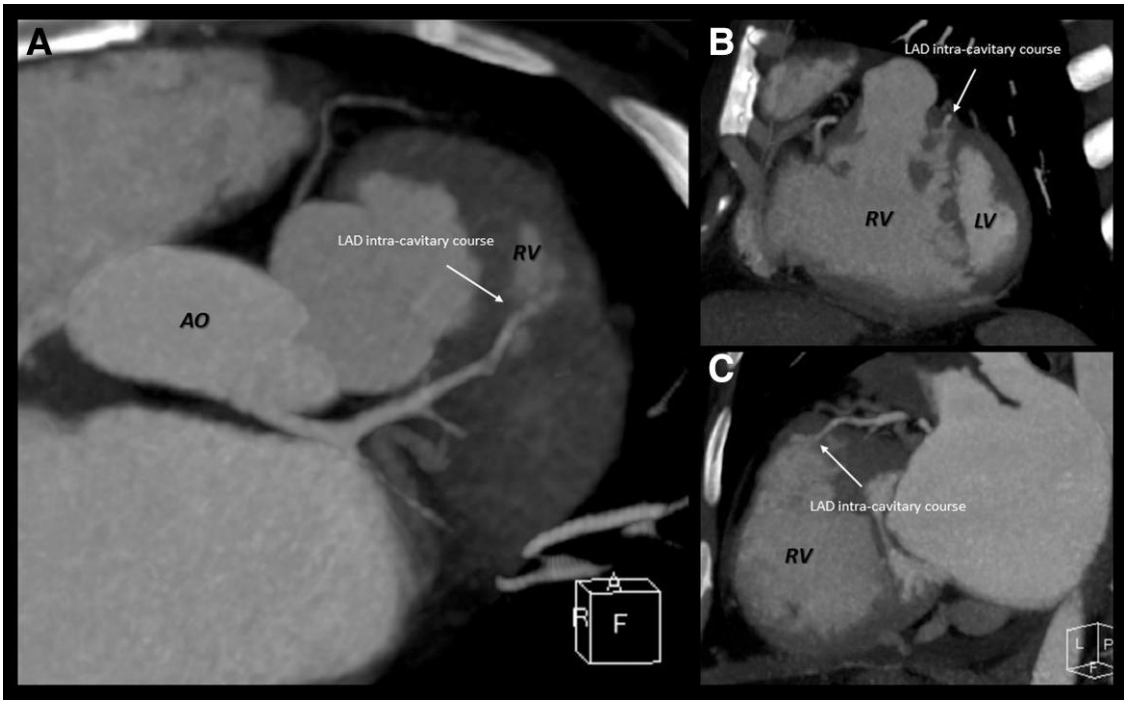


Figure 2 MDCT double oblique axial (*A*), coronal (*B*), and sagittal (*C*) views showing the intra-cavitary course of the left anterior descending artery within the right ventricle cavity. MDCT, Multi-detector computed tomography; LV: left ventricle.

during diastole. However, it could not be properly delineated during systole. The RCA showed a mid-segment MB (3 mm in depth and 15 mm in length) along the hypertrophied RV wall with moderate systolic milking (*Figure 4*). Both the left main trunk and RCA had normal origin. There were no significant atherosclerotic lesions.

Invasive coronary angiography (CA) confirmed complete systolic milking of the mid LAD (*Figure 3C and D* and see Supplementary material online, *Video S1*), and mid-RCA bridge with moderate systolic attenuation (see Supplementary material online, *Video S1*).

After heart team discussion, the patient was planned for valve intervention. Owing to the absence of coronary ischaemia symptoms and due to the hazards of LAD manipulation, the decision was made not to intervene in LAD. One month later, he underwent mechanical mitral valve replacement, tricuspid valve repair, and left atrial appendage excision. The post-

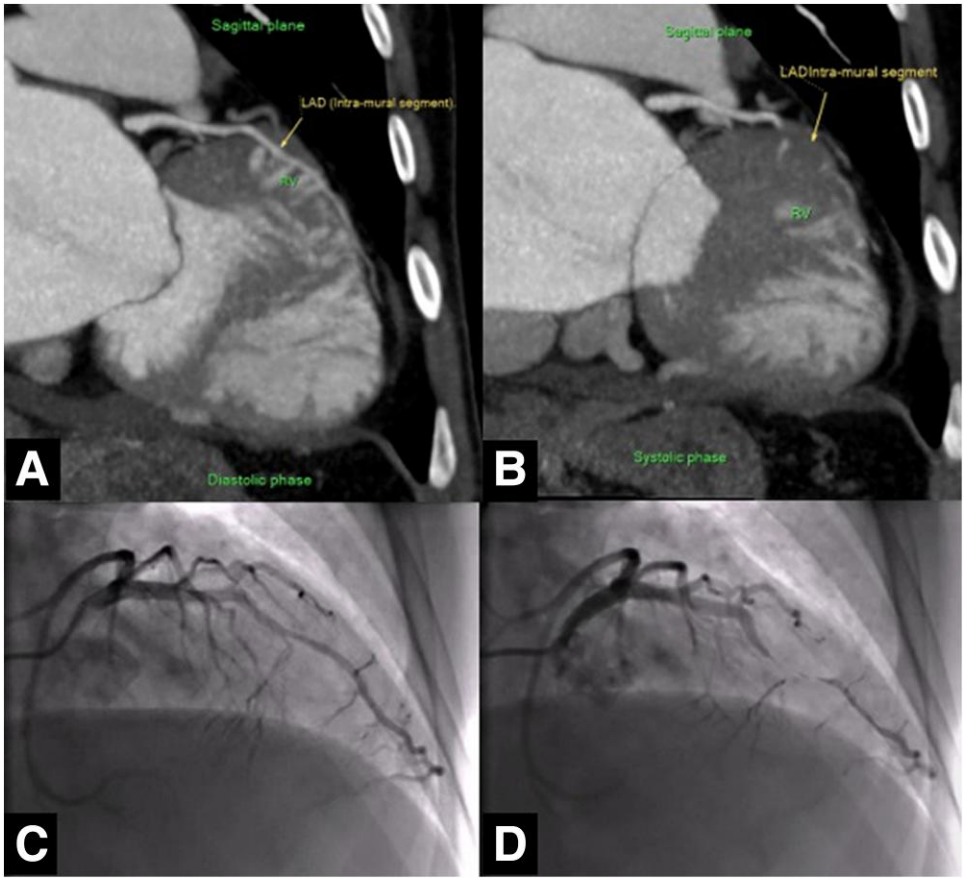


Figure 3 (*A* and *B*) MDCT, sagittal plane showing left anterior descending artery course in the RV cavity during diastolic phase (*A*), and complete milking of the intra-cavitary segment during systolic phase (*B*). (*C* and *D*) Coronary angiography, right anterior oblique view, cranial angulation, showing the mid left anterior descending artery segment during diastole (*C*), with complete systolic milking during systole (*D*).

operative course was complicated by cardiogenic shock due to severely impaired RV. Unfortunately, he died 3 weeks after surgery.

Discussion

Intra-cavitary or intra-cameral (IC) course of coronary arteries is a rare abnormality with the majority of cases accidentally discovered. La Mura *et al.*[3] recently reported a prevalence of up to 1.73%. Two variants were described in the literature; LAD course into the RV cavity and RCA course into the right atrium cavity. To-date, there are no reported cases for IC left circumflex artery. Some studies mentioned higher frequency of IC LAD,[1,3] while others reported more frequent IC RCA.[2]

Although most patients are asymptomatic, the condition carries potential hazards related to arterial injury during cardiac procedures, including ablation, right heart catheterization, and device implantation. Beside the development of ischaemia in the supplied myocardium distal to the injury, the resultant coronary fistula may be severe enough to cause volume overload and heart failure. Unlike epicardial coronaries, injury of an IC artery will not cause blood extravasation or cardiac tamponade.

CA alone is not sufficient to diagnose IC coronary course. Systolic compression of the IC segment is usually absent because of the right chambers' low pressure compared to coronary artery pressure. Significant separation between LAD and great cardiac vein in the right anterior oblique view could be suggestive of IC LAD course.[7] In the presented case, due to pulmonary hypertension (PH), the high RV systolic pressure resulted in systolic milking of the LAD which was clearly evident in angiography.

While medical therapy is the first line of treatment in MB with evidence of ischaemia, keeping surgical intervention for refractory cases,[8] there is no clear consensus about indications of intervention in IC coronary course given the technical difficulties and risks of surgery. Reported cases that underwent intervention were symptomatic with significant atherosclerotic lesions.[1]

Intraoperative identification of an IC LAD is challenging with a risk of RV injury during dissection over the artery course.[9] Many techniques can aid in the tracing of an IC LAD; following a distal segment or a diagonal branch, dissection to the right of the great cardiac vein, use of epicardial ultrasound, or an intraluminal probe after distal arteriotomy.[10] After coronary anastomosis, management of RV entrance can be achieved by placing buttressed mattress sutures approximating the ventricular free edges beneath the LAD. Horizontal mattress sutures may be done instead to avoid diagonal injury,[11] while a pericardial patch can be used in cases of dissection over a long IC segment.

The true prevalence of MB is derived from cardiac computed tomography studies or intraoperative findings as angiography can miss myocardial bridges (MBs) without systolic compression.[8] MB is usually confined to a single vessel, typically affecting the mid-segment of the LAD, however, simultaneous MBs in LAD and RCA were reported.[12,13]

Whether MB is solely a congenital abnormality is still unclear. A higher incidence of LAD MB is found in hypertrophic cardiomyopathy. Similarly, RCA MBs are associated with RV hypertrophy secondary to

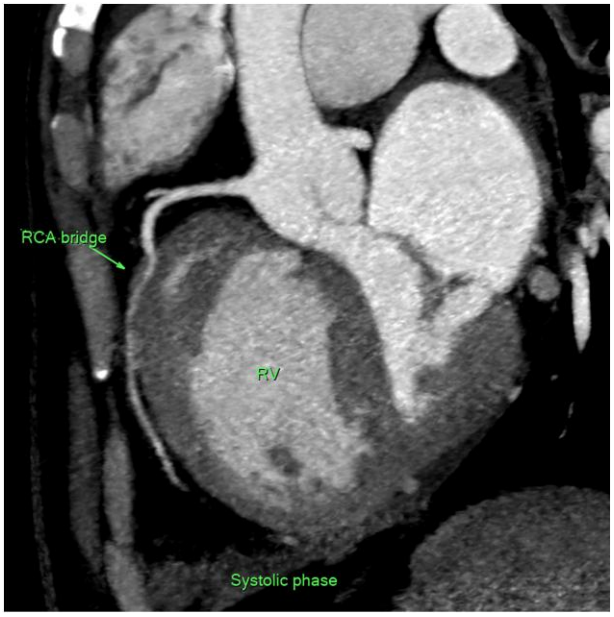


Figure 4 MDCT, sagittal plane showing right coronary artery intramural course into the right ventricle hypertrophied wall.

PH.[14] It is possible that wall hypertrophy disrupts the anatomical course causing artery embedding into the myocardium or at least pushing a superficial intra-mural artery into a deeper position.

Conclusion

Coronary IC course is a rare finding that poses a risk of arterial injury during invasive cardiac procedures. Although the condition is usually asymptomatic, the presence of PH may aggravate systolic attenuation resulting in myocardial ischaemia. Acquired RV hypertrophy could be a precipitating factor for the development of RCA MB. We suggest further investigation to determine whether RV remodelling can exacerbate coronary IC LAD course or RCA MB.

Lead author biography

Dr Hussein is an assistant lecturer and a PhD student of cardiovascular medicine at Kasr Al-Ainy Medical School, Cairo University. He is a member of the Royal College of Physicians of London. He obtained a Master's degree in cardiovascular medicine in 2019 from Cairo University, and is currently an associate specialist of adult cardiology at Aswan Heart Center. Dr Hussein has a special interest in coronary and structural interventions.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

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Data availability

The authors confirm that the data supporting the findings of this case report are available within the manuscript and its supplementary materials.

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