

Transthoracic echocardiography for initial screening of single coronary artery anomaly: a case with multimodal imaging evaluation

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Case Report

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Abstract

Single coronary artery anomaly (SCA) is a rare congenital coronary malformation with only one aortic coronary ostium supplying the whole myocardium. Clinical outcomes mainly depend on the anatomical course of the aberrant vessel. We report a 73-year-old female presenting with intermittent precordial chest pain. Transthoracic echocardiography (TTE) revealed a dilated right coronary artery (RCA) with normal ostial location, non-visualization of the left coronary artery ostium, and diastolic low-resistance arterial flow signal within the interventricular septum along the expected left anterior descending artery (LAD) territory. Coronary computed-tomography angiography (CCTA) demonstrated right-dominant coronary circulation, absence of the native left coronary artery, and an abnormally extended posterior descending artery travelling into the anterior interventricular groove. Multimodal imaging highly suggested Lipton-Yamanaka type R-I SCA. The patient received conservative medical therapy for co-existing mild coronary atherosclerosis. This case underlines TTE as a valuable first-line screening tool for congenital coronary anomalies. Nevertheless, definitive subtyping requires CCTA or invasive coronary angiography.

Background

Single coronary artery anomaly (SCA) is an uncommon congenital coronary origin defect defined by a solitary coronary ostium arising from the aorta and supplying all myocardial regions. Its angiographic prevalence ranges from 0.024% to 0.066%¹. Many affected individuals remain asymptomatic, and risk stratification is primarily determined by vessel trajectory rather than the mere diagnosis of SCA. The Lipton-Yamanaka classification is the most widely accepted system for SCA. The high-risk subtype II-B describes coronary vessels coursing between the ascending aorta and pulmonary artery; physical exertion-related vascular compression may induce myocardial ischaemia, life-threatening arrhythmia and sudden cardiac death even without atherosclerotic stenosis. When SCA coexists with coronary atherosclerosis, plaque progression of the single coronary trunk may jeopardize extensive myocardial territories and raise major adverse cardiovascular event risks.

Case presentation

A 73-year-old female with an unremarkable medical history was admitted due to chest tightness and intermittent precordial pain. Initial TTE showed a normally-positioned but dilated RCA ostium. No definite left coronary artery ostium could be identified. Colour Doppler detected blue-coded flow signals in the interventricular septum corresponding to the expected LAD anatomical course, and spectral Doppler registered diastolic-predominant low-resistance arterial waveforms (Fig. 1, Fig. 2, Fig. 3).

Subsequent CCTA demonstrated right-dominant coronary circulation without visualization of the native left coronary artery. The RCA-originated posterior descending artery had nodular calcified plaque with approximately 30% luminal stenosis; its distal segment abnormally extended into the anterior interventricular groove beyond normal RCA branch perfusion territory. The posterolateral ventricular

branch showed spotty calcification and 20% luminal stenosis. Collectively, multimodal imaging findings highly suggested Lipton-Yamanaka type R-I single coronary artery anomaly (Fig. 4, Fig. 5).

Discussion

TTE identified two key indirect clues for SCA in our patient: RCA dilatation and absence of visualized left coronary ostium on parasternal short-axis view. Doppler interrogation on non-standard windows detected arterial-type flow within the anticipated LAD territory. Collateral circulation was initially considered in differential diagnosis because flow direction differed from native LAD. CCTA confirmed that the distal posterior descending artery arising from the solitary RCA extended into the anterior interventricular groove to supply myocardium normally perfused by LAD, supporting high suspicion of Lipton-Yamanaka R-I SCA. This subtype features a single coronary trunk originating from the right coronary sinus, running along the right atrioventricular groove, crossing the cardiac crux and reaching the anterior interventricular groove². The entire vessel lies within epicardial fat and carries relatively low intrinsic sudden-death risk compared with the inter-great-vessel II-B subtype³.

Historically, TTE coronary assessment was largely confined to paediatric patients. In adults, poor acoustic windows and pulmonary interference frequently prevent complete visualization of mid- and distal coronary segments. Improved transducer resolution expands the feasibility of adult coronary TTE evaluation. Stress echocardiography can detect ischaemia-related regional wall-motion abnormalities, and transthoracic Doppler-derived coronary flow velocity reserve enables functional evaluation of myocardial ischaemia. Non-standard ultrasound views may visualize partial coronary segments only in patients with favourable acoustic conditions; these approaches are heavily operator-dependent and cannot serve as routine screening.

Bhatia et al.⁴ suggested TTE coronary assessment for pre-participation athlete screening for coronary artery anomalies. Recognition and risk-stratification of these anomalies help reduce long-term morbidity and mortality, especially among young competitive athletes.

For the present suspected R-I SCA patient, no high-risk inter-great-vessel course was identified, and coronary stenosis remained mild; therefore surgical intervention was not indicated. Conservative management was implemented, including anti-platelet therapy, statin treatment, and strict blood-pressure and metabolic risk-factor control. Percutaneous coronary intervention carries elevated procedural risks in SCA patients⁵. Ostial injury or coronary dissection may trigger extensive myocardial ischaemia, so thorough pre-procedural anatomical characterization is mandatory. The patient's angina-like symptoms may be partly attributed to acquired coronary atherosclerosis. Since plaque progression or acute occlusion of the solitary coronary artery can cause large-scale myocardial injury, lifelong risk-factor modification and cardiology follow-up are strongly recommended.

Limitations

Several limitations should be acknowledged. First, invasive coronary angiography, the diagnostic gold-standard for definite SCA confirmation and full subtyping, was not performed. Lipton-Yamanaka R-I SCA remains a highly suspected diagnosis. Second, we could not distinguish whether angina originated from atherosclerotic stenosis or anomaly-related functional ischaemia. Third, TTE only yields indirect diagnostic signs, and visualization of mid-distal coronary segments is limited by acoustic window quality and operator experience.

Conclusions

We report a suspected Lipton-Yamanaka type R-I single coronary artery anomaly initially detected by TTE and further characterized by CCTA. TTE is a practical first-line screening modality for congenital coronary anomalies and can identify key indirect markers such as unilateral coronary dilatation and absent visualization of the contralateral coronary ostium. However, TTE cannot accomplish definitive anatomical subtyping. Complementary CCTA or invasive coronary angiography is essential for full anatomical delineation and risk stratification. For adult SCA patients complicated with coronary atherosclerosis, intensive risk-factor control and lifelong cardiology surveillance are critical, given that disease progression of the solitary coronary artery may produce extensive myocardial damage.

Declarations

Funding

No funding was received for this study.

Ethics, Consent to Participate, and Consent to Publish

Written informed consent was obtained from the patient for participation and publication of this case report and accompanying images. This study was conducted in accordance with the Declaration of Helsinki.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Figures

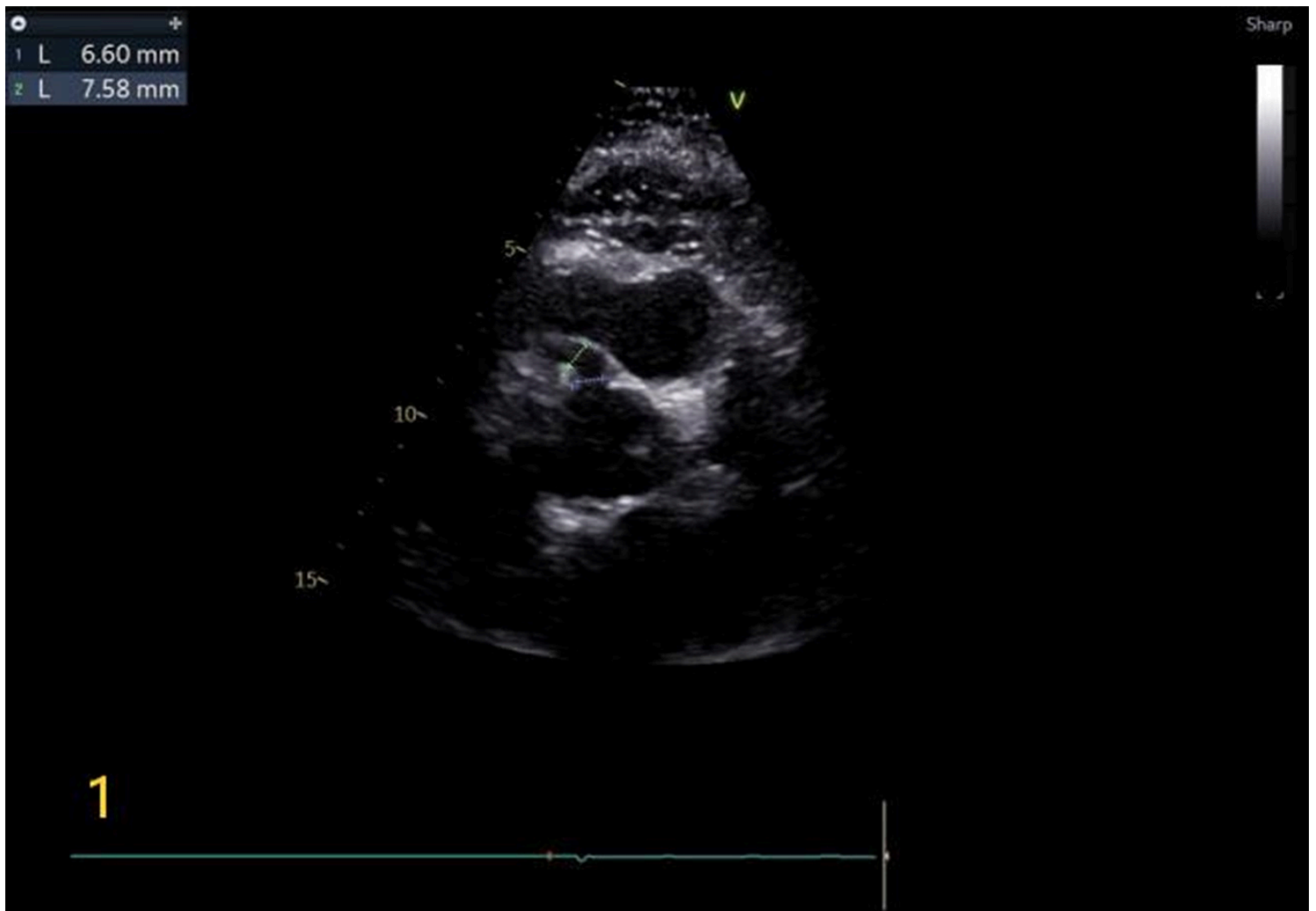


Figure 1

Parasternal short-axis view demonstrating dilated proximal right coronary artery, with no visible left main coronary artery ostium.

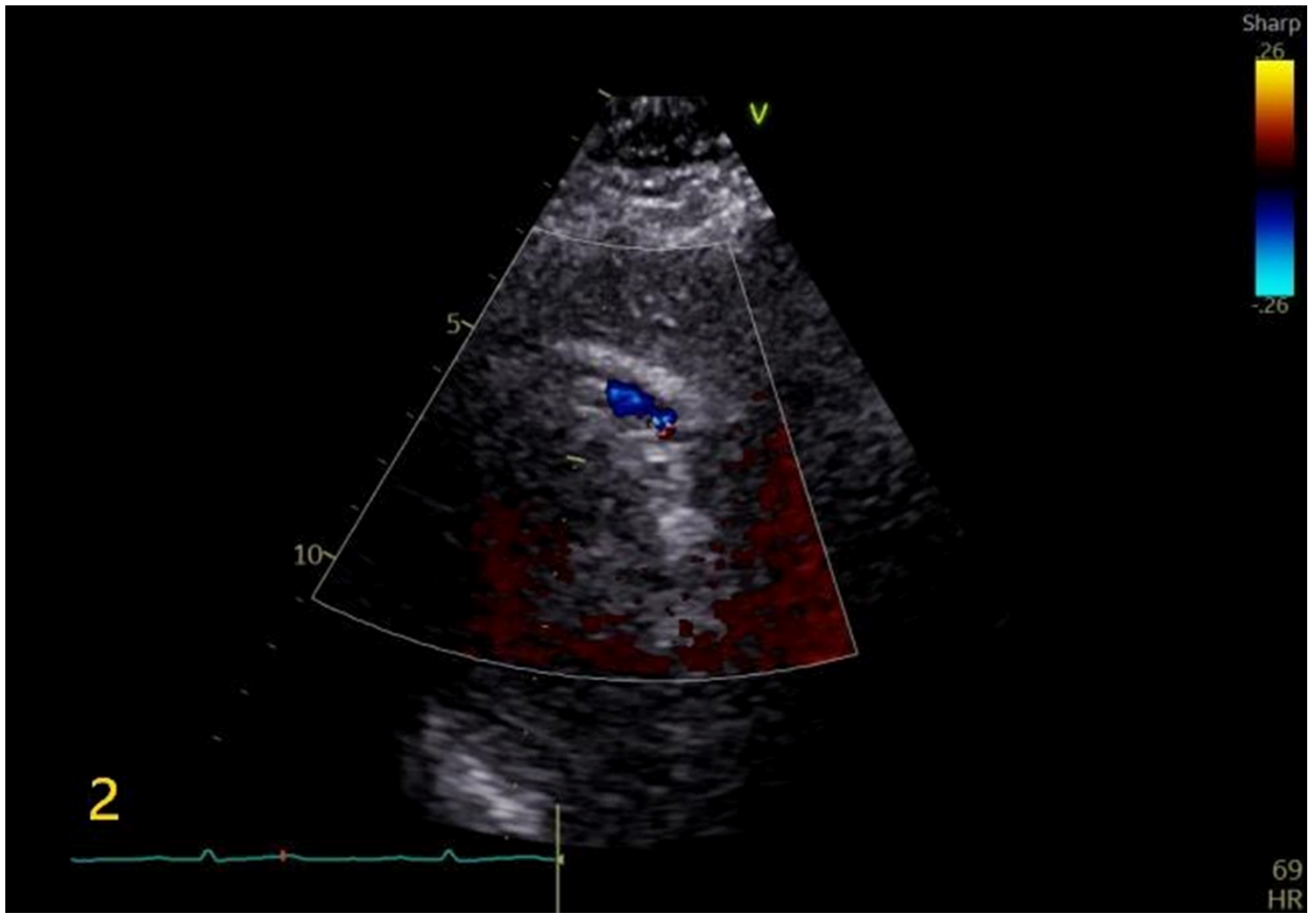


Figure 2

Colour Doppler acquired from a non-standard apical four-chamber view showing flow signals along the expected left anterior descending artery territory within the interventricular septum

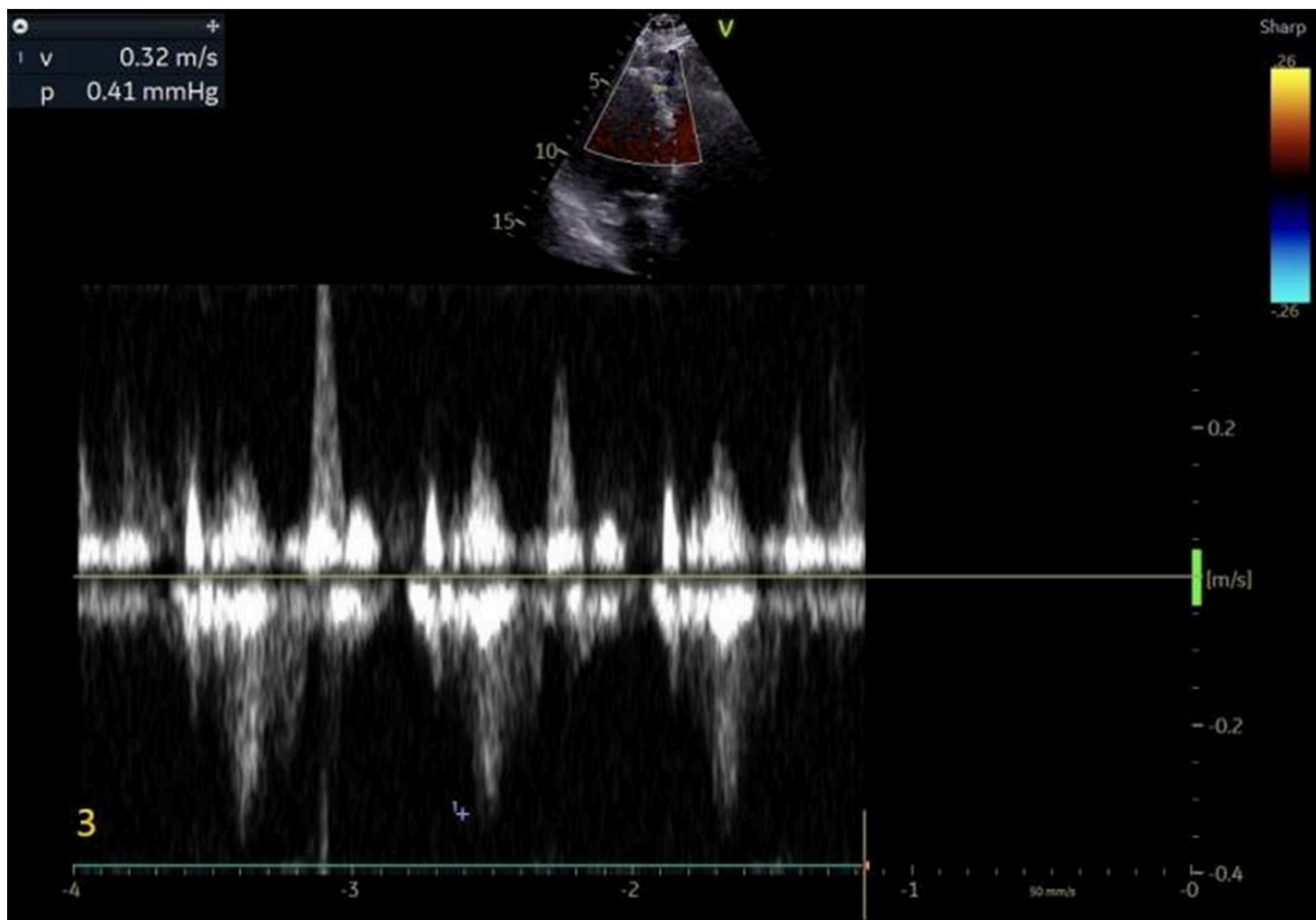


Figure 3

Spectral Doppler recording showing diastolic-predominant low-resistance arterial waveform of the abnormal septal flow

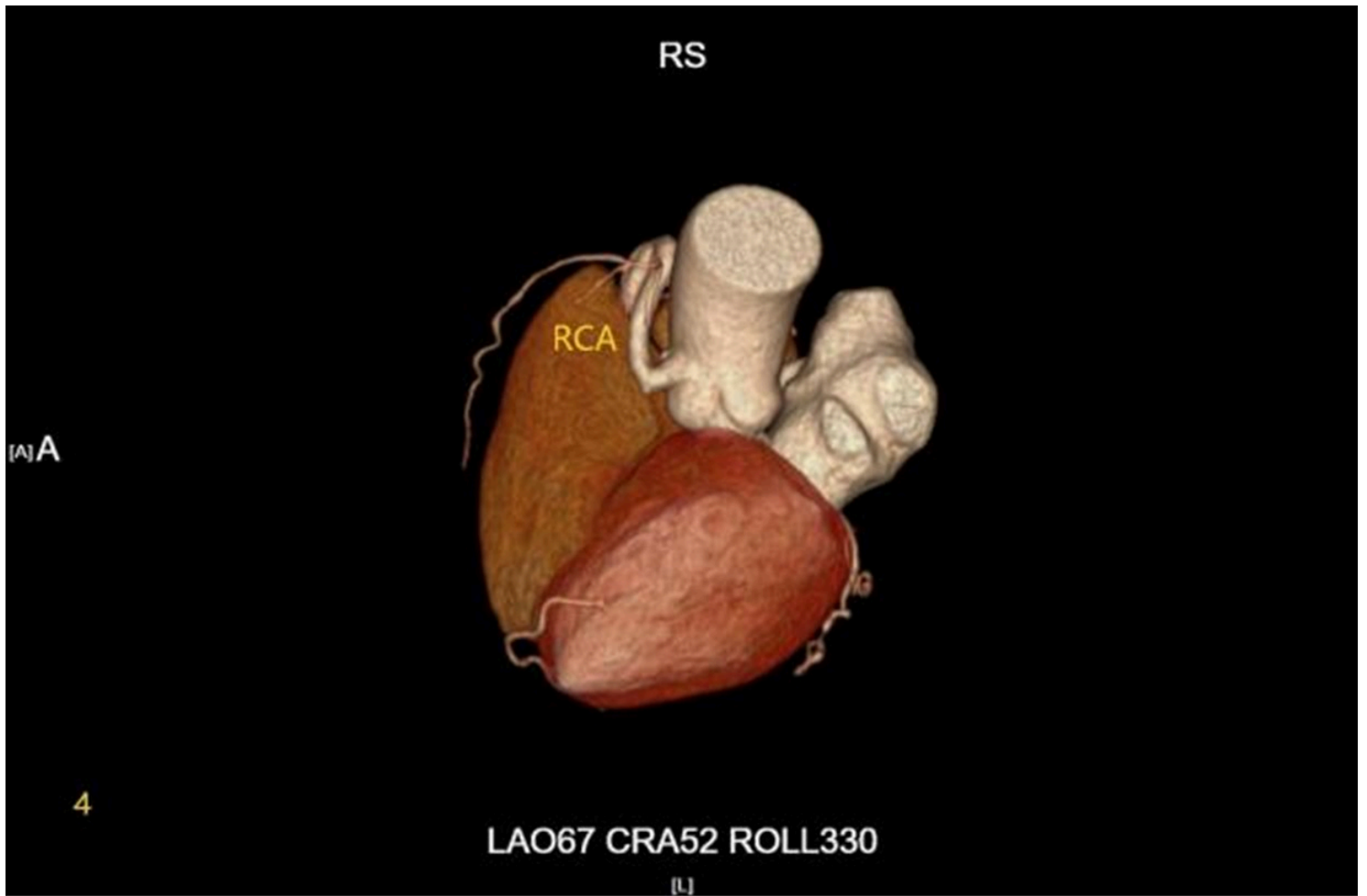


Figure 4

Three-dimensional volume-rendered CCTA reconstruction. No coronary vessel arises from the left coronary sinus; a dilated RCA originates from the right coronary sinus.

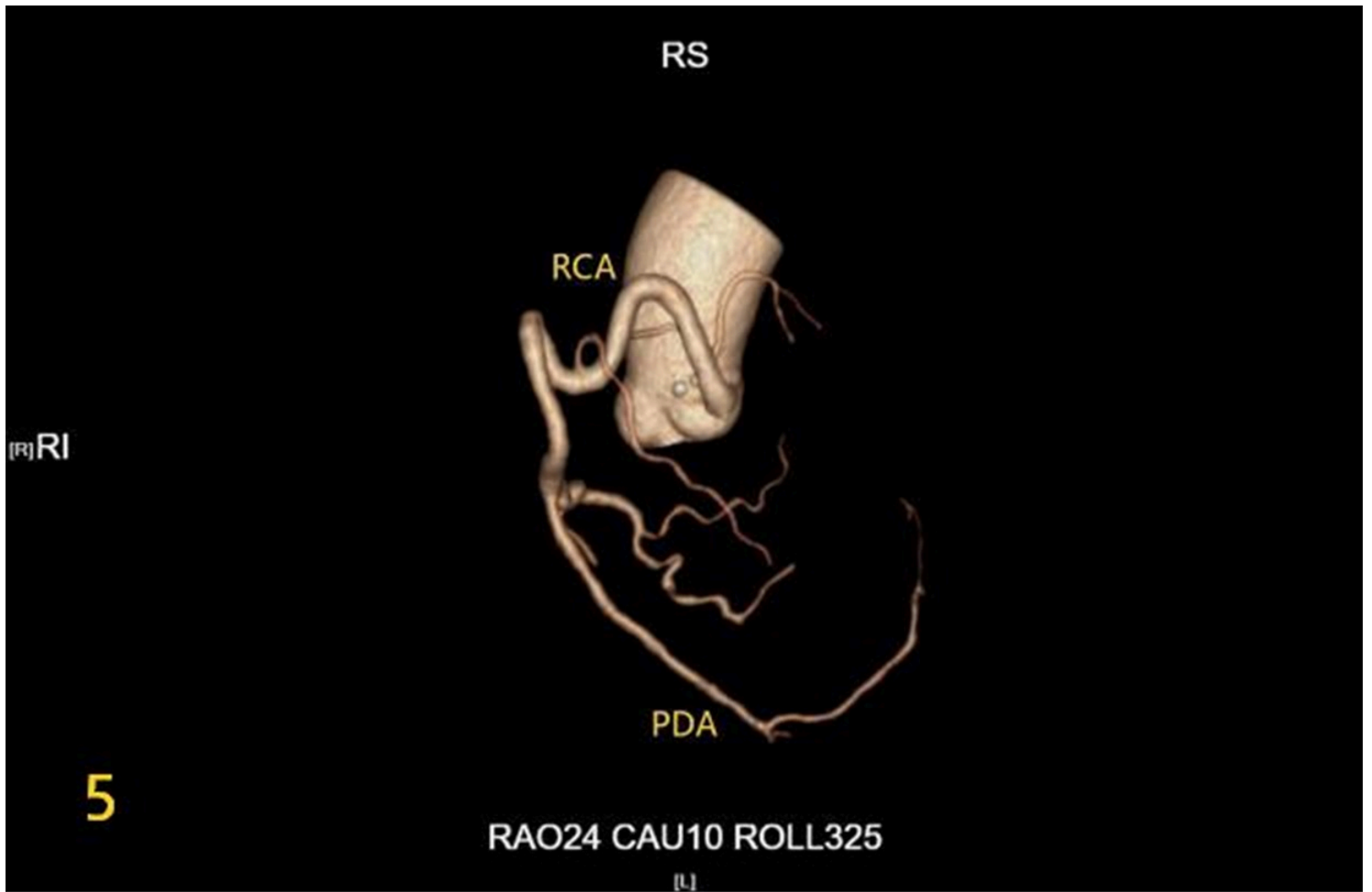


Figure 5

Volume-rendered CCTA image showing the posterior descending artery extends distally into the anterior interventricular groove outside its physiological anatomical distribution.