

Dual Left Anterior Descending Artery Arising From the Right Coronary Cusp With a Prepulmonic Course: A Case Report

Abstract

Dual left anterior descending artery (LAD) is an uncommon coronary anomaly that may be difficult to characterize with invasive angiography alone. We describe a 49-year-old man undergoing coronary angiography for acute coronary syndrome. Angiography showed mild ostial left main stem disease, mild mid-LAD disease, moderate mid-ramus intermedius disease, mild mid-left circumflex disease, and tight ostioproximal stenosis of the dominant right coronary artery (RCA). An anomalous LAD origin from the right coronary cusp was suspected. Coronary computed tomography angiography demonstrated dual LAD anatomy: a short native LAD arising from the left main stem, with mild proximal and moderate mid-vessel stenosis, terminating in the proximal anterior interventricular groove; and an accessory LAD arising separately from the right coronary cusp. The accessory LAD traversed anterior to the main pulmonary artery before entering the mid-anterior interventricular groove, consistent with a prepulmonic course. It had mild mid-segment disease, estimated at 28%, with a normal distal segment. Computed tomography coronary angiography established the benign course of the anomalous vessel and facilitated planning of revascularization for the severe RCA lesion. This case highlights the complementary role of coronary computed tomography angiography in defining anomalous coronary anatomy in patients with concomitant atherosclerotic coronary artery disease.

Keywords: Dual left anterior descending artery; anomalous coronary artery; coronary computed tomography angiography; prepulmonic course; coronary artery disease.

Introduction

Dual LAD is a rare coronary anomaly in which two vessels collectively supply the usual LAD territory. In the conventional anatomical pattern, a short LAD terminates in the proximal anterior interventricular groove, while a long or accessory LAD travels outside the groove before re-entering it more distally.¹

The long LAD may originate from the left coronary system, right coronary artery, or right coronary cusp. Determining its relation to the aorta and pulmonary artery is essential because a

prepulmonic course is generally benign, whereas an interarterial course may have adverse clinical implications. We report dual LAD anatomy with an accessory LAD arising from the right coronary cusp and following a prepulmonic course in a patient with concomitant obstructive RCA disease.

Case Presentation

A 49-year-old man presented with chest pain for two days and was admitted with acute coronary syndrome. He had hypertension, diabetes mellitus, tobacco exposure, and a positive family history of coronary artery disease. General physical examination was unremarkable. Electrocardiography demonstrated generalized ST-segment depressions, whereas transthoracic echocardiography was normal.

Invasive coronary angiography was performed via right radial access. The left main stem was bifurcating and had mild ostial disease. The LAD was reported to originate from the right coronary cusp and showed mild mid-vessel disease. A ramus intermedius showed moderate mid-vessel disease. The non-dominant left circumflex artery showed mild mid-vessel disease. The RCA was dominant and had tight ostioproximal stenosis.

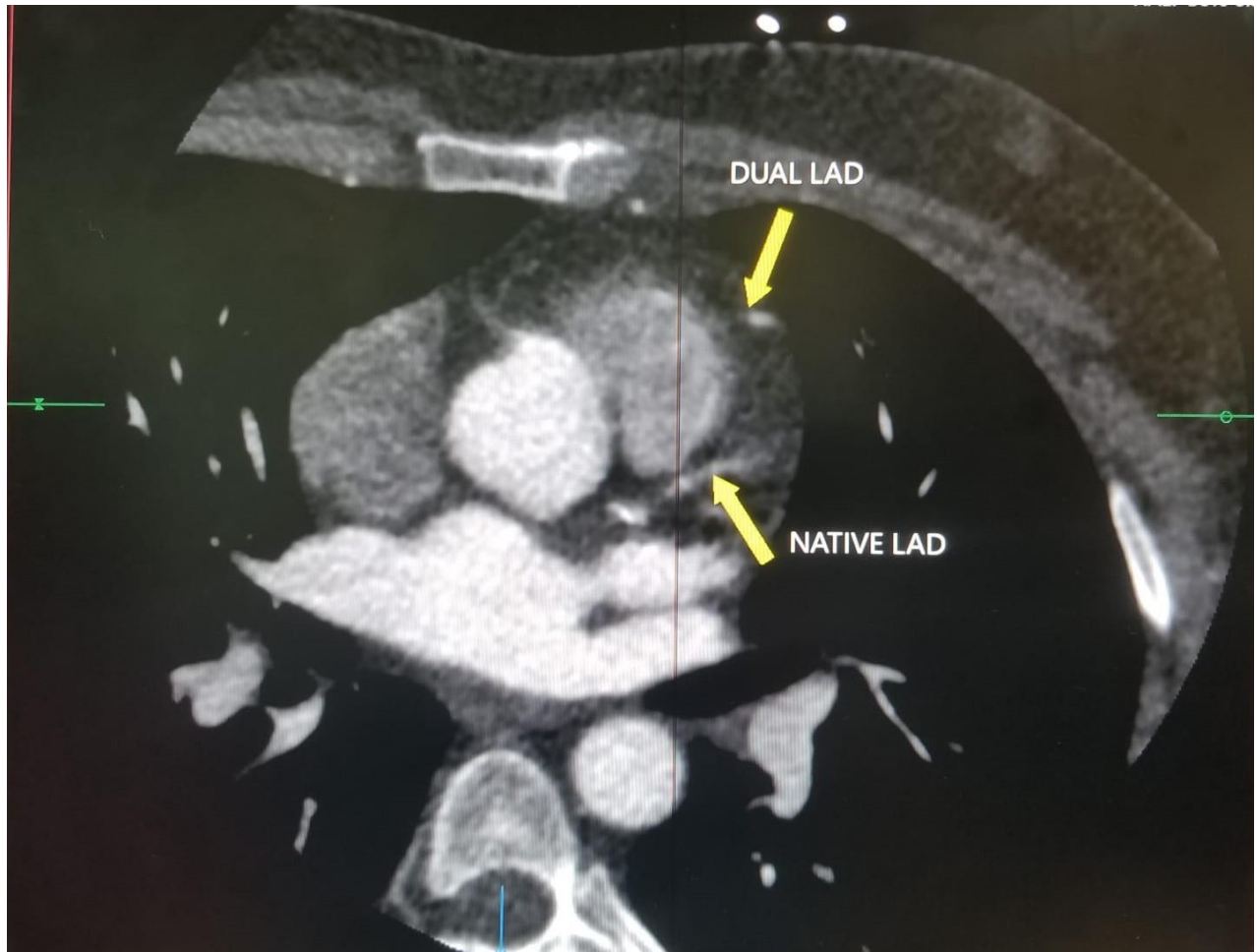


Figure – 1: CT image showing dual LAD.

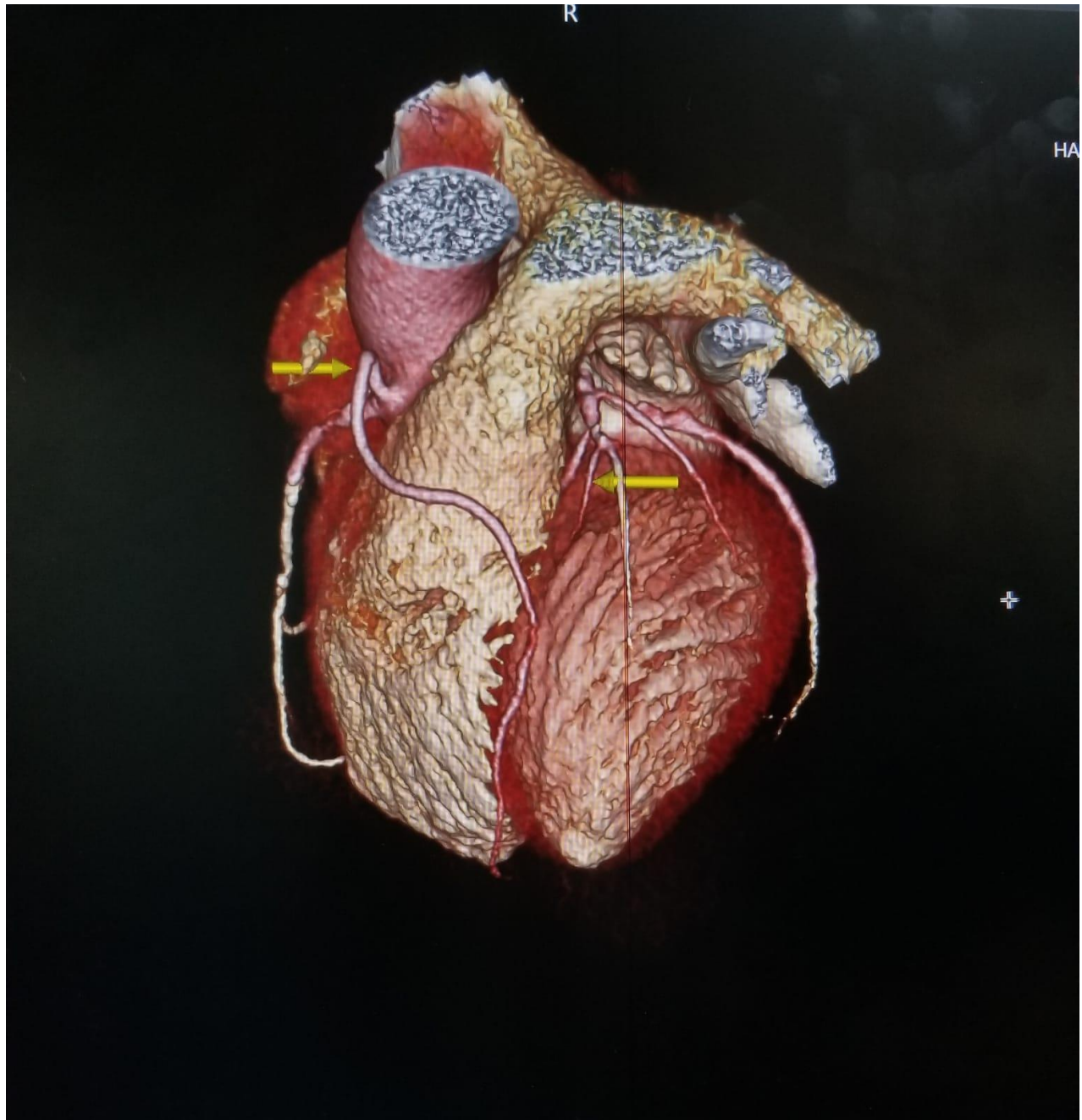


Figure-2: 3D volume-rendered CT coronary angiography (CTCA) image showing dual LAD

Because the origin and course of the LAD could not be adequately defined by invasive angiography, coronary computed tomography angiography was performed. It demonstrated a bifurcating left main stem with mild diffuse calcific plaque-related stenosis. The native LAD originated from the left main stem and had mild proximal and moderate mid-vessel stenosis. It

terminated in the proximal anterior interventricular groove, and its first and second diagonal branches were normal.

A second, accessory LAD arose separately from the right coronary cusp. It passed anterior to the main pulmonary artery and reached the mid-anterior interventricular groove. This anatomical relationship confirmed a prepulmonic course. The accessory LAD had a normal proximal segment, mild mid-segment atherosclerotic disease with an estimated 28% stenosis, and a normal distal segment.(fig-1 and fig-2)

CT-based left ventricular analysis showed an end-diastolic volume of 124 mL, end-systolic volume of 53 mL, and ejection fraction of 58%. Following delineation of the anomalous LAD, PCI to the tight ostioproximal RCA stenosis was planned.

Discussion

This case demonstrates a dual LAD pattern in which a short native LAD arises from the left main stem and terminates early in the anterior interventricular groove, while an accessory LAD arises from the right coronary cusp and supplies the more distal LAD territory. This resembles the classical type IV dual LAD pattern, although traditional descriptions commonly report origin of the long LAD from the RCA rather than directly from the right coronary cusp.^{1,3}

Recognition of this variant has practical importance. During invasive angiography, early termination of the native LAD may be misinterpreted as mid-LAD occlusion, vessel hypoplasia, or failure to selectively visualize the LAD. Coronary computed tomography angiography can accurately delineate both vessels and define the course of the accessory LAD.^{3,4}

Prepulmonic coronary arteries course anterior to the right ventricular outflow tract or main pulmonary artery and are generally considered benign. In contrast, an interarterial course between the aorta and pulmonary artery may be associated with dynamic compression and is the configuration of greater clinical concern. Thus, coronary computed tomography angiography is decisive in distinguishing a benign congenital finding from a potentially high-risk anomalous coronary course.²

The clinically important obstructive lesion in this patient was the tight ostioproximal stenosis of the dominant RCA. The accessory LAD showed only mild mid-vessel narrowing and no reported

high-risk anatomy. Defining the dual LAD anatomy before revascularization is nevertheless essential to prevent diagnostic error and to ensure complete and safe revascularization planning, particularly if PCI or surgical revascularization is considered.

Conclusion

Dual LAD with an accessory LAD arising from the right coronary cusp and taking a prepulmonic course is an uncommon but generally benign coronary anomaly. Coronary computed tomography angiography was essential to confirm the anatomy, exclude a malignant interarterial course, and direct management toward the patient's severe ostioproximal RCA stenosis.

Learning Points

- A short LAD ending high in the anterior interventricular groove should prompt a search for an accessory LAD.
- Coronary computed tomography angiography is valuable when invasive angiography cannot confidently define the origin and course of an anomalous coronary artery.
- An accessory LAD from the right coronary cusp may follow a benign prepulmonic course.
- Anatomical coronary variants and coexisting atherosclerotic lesions should be evaluated separately when planning revascularization.

References

1. Spindola-Franco H, Grose R, Solomon N. Dual left anterior descending coronary artery: angiographic description of important variants and surgical implications. *Am Heart J*. 1983;105(3):445-455. doi:10.1016/0002-8703(83)90363-0
2. Bozlar U, Uğurel MŞ, Sarı S, Akgün V, Örs F, Taşar M. Prevalence of dual left anterior descending artery variations in CT angiography. *Diagn Interv Radiol*. 2015;21(1):34-41. doi:10.5152/dir.2014.14275
3. Kassem J, Yildiz A, Gowda M, Shahab H. Dual left anterior descending artery: A case report. *J Clin Imaging Sci*. 2024;14:47. Published 2024 Dec 3. doi:10.25259/JCIS_122_2024

4. Brothers JA, Frommelt MA, Jaquiss RDB, Myerburg RJ, Fraser CD Jr, Tweddell JS. Expert consensus guidelines: Anomalous aortic origin of a coronary artery. *J Thorac Cardiovasc Surg.* 2017;153(6):1440-1457. doi:10.1016/j.jtcvs.2016.06.066