

CASE REPORT

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# Type X dual left anterior descending (LAD) artery masquerading as type 1 LAD — a case report



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## Abstract

**Background:** Dual left anterior descending (LAD) coronary artery is a rare congenital anomaly. To date, eleven variants of dual LAD have been described with three published reports of type X dual LAD. Here, we describe a new variant of type X dual LAD with a short LAD artery masquerading as type 1 LAD.

**Case presentation:** A 42-year hypertensive female presented with recent onset angina with a treadmill test positive for inducible ischemia. Coronary angiography showed a normal right coronary artery (RCA). The left main coronary artery (LMCA) originated from the left sinus of Valsalva (SOV), giving rise to a LAD and the left circumflex artery (LCX). Appearing a normal angiogram with type 1 LAD based on its length, the presence of a large bare area in LAD territory (especially at the apex) and lack of septal branches prompted a search for an additional vessel. Right SOV injection showed a vessel originating separately from RCA, which was confirmed to be a long LAD on selective injection, with a pre-pulmonic course and giving rise to septal branches exclusively before wrapping around the apex. Computed tomography coronary angiography (CTCA) confirmed the pre-pulmonic course of long LAD, defined its entry to the distal interventricular septum to the right of short LAD, and ruled out other coronary artery anomalies. In the absence of a stenotic lesion in the epicardial coronaries, angina in our case was presumed to be due to microvascular dysfunction. She was discharged on beta-blocker therapy for co-existing hypertension and is asymptomatic on follow-up at one year.

**Conclusions:** A short LAD artery of type X Dual LAD could be potentially misdiagnosed as type 1 LAD based on its length. However, an active search for a long LAD could properly diagnose the case as a variant of type X dual LAD, which has important clinical implications. Its awareness is critical for cardiologists and cardiac surgeons to correctly interpret the coronary angiogram and plan proper management.

**Keywords:** Dual, Variant, Aberrant, Left anterior descending artery

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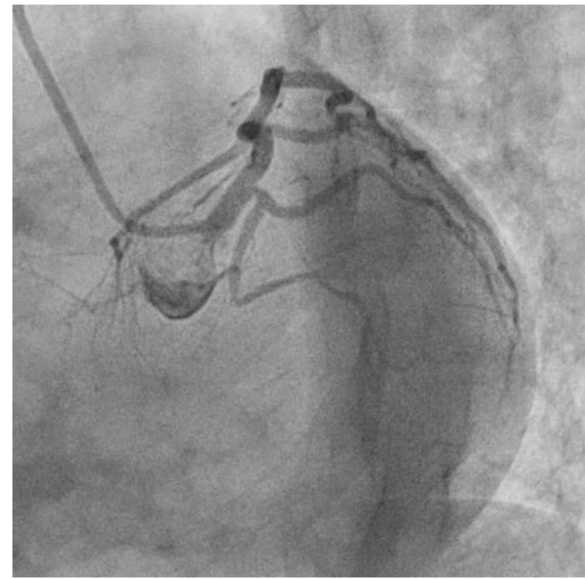
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## Background

Dual left anterior descending (LAD) coronary artery is a rare congenital anomaly [1]. It is defined as the existence of two distinct segments of LAD at the anterior interventricular sulcus (AIS) of the heart. It comprises a short LAD that usually ends high in the AIS and a long LAD that enters the distal AIS ending at the apex. Initially classified by Spindola-Franco et al. in 1983 based on coronary angiography [2], a few more types of dual LAD were added later based on computed tomography coronary angiography (CTCA). Usually benign in itself, knowledge of dual LAD and its variants is indispensable for its occasional malignant (inter-arterial) course and appropriate management of patients undergoing coronary intervention or surgery for various indications. To date, eleven variants of dual LAD have been described, with only three published reports of type X Dual LAD [3–5]. Here, we describe a new variant of type X Dual LAD with short LAD artery masquerading as type 1 LAD classified based on its length. One may misinterpret this short LAD artery as the only LAD and not search for a long artery if dual LAD is not suspected, as initially happened in our case. However, our immediate angiographic reassessment and search for long LAD correctly classified it as a new variant of published cases of type X Dual LAD. This variant has not been described in the literature so far. Here, we review its clinical significance and relevant literature in brief.

## Case presentation

A 42-year hypertensive female presented with recent onset angina for 2 months. Her treadmill test was positive for inducible ischemia at eight metabolic equivalents. Physical examination was unremarkable. An electrocardiogram showed T-wave inversion in right-sided precordial leads (V1, V2, V3) with a normal echocardiogram. Coronary angiography showed a normal right coronary artery (RCA). The left main coronary artery (LMCA) originated from the left sinus of Valsalva (SOV), giving rise to a LAD and the left circumflex artery (LCX) (Fig. 1). This LAD continued as a small caliber vessel in the AIS, gave rise to a single septal and two diagonal branches (D1, D2) and terminated just before the apex (Fig. 2). Appearing as a normal angiogram with type 1 LAD based on its length (not to be confused with type I Dual LAD), a review prompted a search for anomalous segment due to the presence of a large bare area in LAD territory (especially at the apex) and lack of septal branches. Right SOV injection showed a vessel originating separately from RCA, which was mistaken for separately originating conus branch at initial RCA angiogram. Selective injection in this vessel revealed a long LAD originating separately from the right SOV with a pre-pulmonic course, entering AIS lateral to the short LAD (initially thought to be type 1



**Fig. 1** LAO caudal view showing LMCA dividing into LCX and short LAD giving rise to diagonal branches

LAD) and giving rise to septal branches exclusively (Figs. 3 and 4) before wrapping around apex.

CTCA confirmed these angiographic findings, delineated the pre-pulmonic course of long LAD, defined its entry to distal AIS to the right of short LAD, and ruled out other coronary artery anomalies (Fig. 5). This is consistent with the published reports of type X Dual LAD described in the literature with an important variation that short LAD in our case terminated, just short of apex mimicking type 1 LAD in itself. As no stenotic lesions of the epicardial coronaries were noted, angina



**Fig. 2** RAO cranial view showing a short LAD simulating type 1 LAD and giving rise to a single septal and two diagonal branches

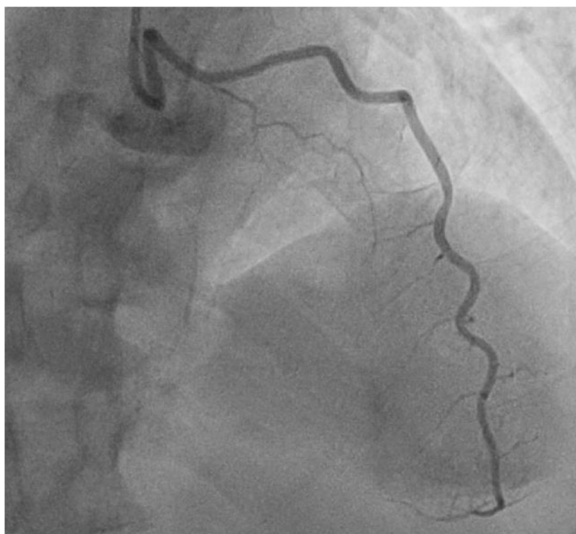


**Fig. 3** Non-selective injection into right coronary sinus demonstrating RCA and long LAD arising separately from RCS

in our case was presumed to be due to microvascular dysfunction. In view of co-existing hypertension, she was discharged on beta-blocker therapy and is asymptomatic on follow-up at 1 year.

**Differential diagnosis**

Short LAD artery of type X Dual LAD can be misinterpreted as type 1 LAD. Also, its differentiation from distal LAD occlusion should be considered.



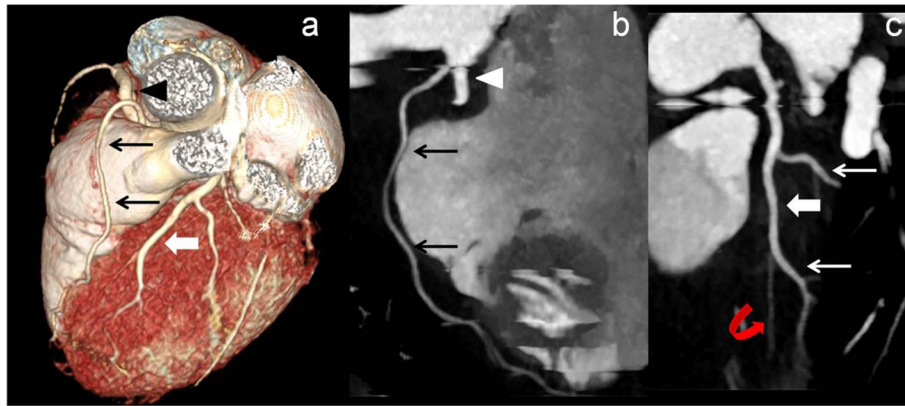
**Fig. 4** LAO cranial view with a selective injection demonstrating long LAD continuing till apex giving small septal branches

**Discussion**

Our case illustrates a new variant of dual LAD with its short LAD artery masquerading as type 1 LAD, overlooking the recognition of long LAD, at least initially. Detection of this rare variant of type X dual LAD requires knowledge of its existence and warrants a high index of suspicion with an active search during selective coronary angiography. Additionally, CTCA may be especially useful for delineating a clinically significant or malignant course of the anomalously arising long LAD. A pre-pulmonic course of long LAD, like ours, becomes clinically significant in patients undergoing cardiac surgery involving the right ventricular outflow tract (RVOT). Further, its occasional inter-arterial course may be associated with coronary ischemia as described in type VII dual LAD. Updated knowledge of described patterns of dual LAD is critical for its angiographic recognition and understanding its clinical implications for coronary interventions.

Dual LAD is a rare congenital coronary anomaly with an incidence of 1%, as reported by Spindola-Franco et al. [2]. Anatomically, dual LAD consists of two distinct segments, short and long, that supply the usual territory of LAD. While short LAD usually terminates proximally in the AIS, the long LAD has a variable course before entering the AIS distally and supply the apex. Variability of its origin and course has led to its latest classification into eleven types [4]. Knowledge of existing patterns of dual LAD and its new variants is crucial for a variety of reasons. Firstly, lack of awareness may lead to misdiagnosis as type 1 LAD or as total distal occlusion. Secondly, complete coronary evaluation is vital for optimal revascularisation during the percutaneous coronary intervention (PCI) or coronary artery bypass grafting. Under-recognition may lead to residual ischemia due to disease in the missed part of dual LAD. Thirdly, its knowledge is indispensable for planning surgical correction in patients with congenital heart disease, such as the tetralogy of Fallot and transposition of great arteries [6]. Finally, its malignant inter-arterial course may be associated with significant ischemia.

Review of literature describes dual LAD system, originally classified angiographically into four types by Spindola-Franco et al. with further addition of two more types V and VI, later [7]. According to this classification, dual LAD consists of a short LAD that ends up high in the AIS and a long LAD that most commonly originates as an early branch of the LAD proper (types I–III) and rarely originates anomalously from the RCA or right coronary sinus (RCS) (type IV–VI) and lies in distal AIS. Bozlar et al. [8] reported the most extensive follow-up study on the prevalence of dual LAD variations based on CT angiography, adding three new types of dual LAD (type VII, VIII, IX) (Table 1) in addition to the standard nomenclature system given by Spindola et al. [2].



**Fig. 5** **a** Volume rendered (VRT) CT angiography images showing a long LAD with a pre-pulmonic course (black arrows) and a short LAD (white arrow) giving rise to first and second diagonal branches. **b** Maximum intensity projection (MIP) curved reformatted CT angiography image showing long LAD (black arrow) continuing till apex. **c** MIP image showing short LAD (thick arrow) entering the AIS and giving rise to first and second diagonal branches (thin white arrows). Small caliber distal LAD terminating just before reaching the apex

**Table 1** Classification of dual LAD coronary anomaly (adapted from references [2, 4, 5, 7–11])

Types	LMCA	LAD proper	Origin		Course	
			Short LAD	Long LAD	Short LAD	Long LAD
Type I	Present	Present	LAD proper	LAD proper	Terminates in proximal AIS	Course on LV side of the proximal AIS and re-enters distal AIS
Type II	Present	Present	LAD proper	LAD proper	Terminates in proximal AIS	Course on RV side of the proximal AIS and re-enters distal AIS
Type III	Present	Present	LAD proper	LAD proper	Terminates in proximal AIS	Follows an intramyocardial course in the septum proximally and emerges epicardially in the distal AIS
Type IV	Present	Absent	LMCA	Proximal RCA	Terminates in proximal AIS	Anomalous pre-pulmonic course and enters the distal AIS
Type V	Absent	Absent	LCS	RCS	Terminates in proximal AIS	Anomalous intramyocardial course within the septal crest, emerges epicardially and enters the distal AIS
Type VI	Present	Absent	LMCA	Proximal RCA	Terminates in proximal AIS	Anomalous course between the RVOT and the aortic root, enters the distal AIS
Type VII	Present (LMCA originates from the RCA and shows malignant inter-arterial course)	Present	LAD proper	LAD proper	Terminates in proximal AIS	Course on LV side of the proximal AIS and re-enters the distal AIS
New variant of type VII (Saglam et al.)	Present	Absent	LMCA	RCS	Terminates in proximal AIS	Anomalous intramyocardial course within the septal crest, emerges epicardially and enters the distal AIS
Type VIII	Present (LMCA originates from the RCA and shows retroaortic course)	Absent	LMCA	Mid-RCA	Terminates in proximal AIS	Courses inferior wall surface of the RV, reaching the distal AIS by turning around the apex
Type IX	Present	Present	LAD proper	LAD proper	Terminates in mid AIS	Course on LV side of the mid AIS, re-enters the distal AIS and terminates before reaching the apex
Type X	Present	Absent	LMCA	RCS	Terminates in proximal AIS	Anomalous pre-pulmonic course anterior to the RVOT and enters the distal AIS
Variant of type X (current case)	Present	Absent	LMCA	RCS	Continues till distal AIS and give diagonal branches	Anomalous pre-pulmonic course giving rise to septal branches only and continues around the apex
Type XI	Absent	Absent	RCS	RCS	Intramyocardial course within the proximal septum and emerges in proximal AIS	Epicardial course anterior to RVOT and then enters the distal AIS

Our case share features with the first published report of type X dual LAD in 2015 [3] but with significant variations. In contrast to the usual description, the short LAD in our patient reached almost to the apex mimicking type 1 LAD, as classified based on its length. Our short LAD originated from the LMCA and continued till the distal AIS before giving rise to single septal and first and second diagonal branches (Figs. 1 and 2). The long LAD originated from the right coronary sinus with a pre-pulmonic course, giving rise to septal branches without any diagonal branches and eventually supplied the apex (Figs. 3 and 4). This anatomy has features suggestive of type IV (pre-pulmonic course), type V (RCS origin), and type X dual LAD. However, it neither has a proximal RCA origin (a feature of type IV) nor has an intramyocardial course (a feature of type V). Furthermore, short LAD, which usually terminates in the proximal AIS as described in the published reports of type X dual LAD, can be seen to be continuing till apex, albeit with a small caliber in our case. Additionally, not mentioned in the published case reports of type X dual LAD, our case uniquely has diagonal branches arising exclusively from short LAD and septal branches arising almost exclusively from long LAD. This contrasts with the usual origin of diagonal branches from long LAD and septal branches from short LAD. This is the first reported rare variant of type X dual LAD anatomy with important clinical implications to the best of our knowledge.

So whenever a coronary angiogram reveals a small LAD coronary artery with a paucity of vascular distribution around the cardiac apex, dual LAD should be strongly suspected, and misdiagnosis of a short LAD as type 1 LAD or mid LAD occlusion and of a long LAD as a conus branch should be avoided. Selective angiography of long LAD coronary artery can help in proper diagnosis. However, at times, invasive coronary angiography may be insufficient to visualize the entire coronary vasculature, particularly in identifying a coronary vessel with an aberrant origin [12]. In such a situation, CTCA can identify duplicated or aberrantly originating vessels and define their course and distribution, thereby helping in making a correct diagnosis and meticulous planning. Thus, cognizance and appreciation of the dual LAD are critical for cardiac interventions in general and coronary interventions in particular.

## Conclusions

Our report shows that the short LAD artery of type X dual LAD may be misinterpreted as type 1 LAD based on its length. So a high index of suspicion and an active search for long LAD is the key to properly diagnose type X dual LAD, especially in the presence of a bare area. Delineation of course of anomalously arising vessel and

knowledge of existing patterns of dual LAD is indispensable for the cardiologists and cardiac surgeons for correctly interpreting the coronary angiogram and planning a proper management.

## Patient's perspective

I am a 42-year-old lady with a long history of high blood pressure for the last 10 years. For the last 2 months, I developed some chest discomfort and heaviness, which worsened with activity. After ignoring my symptoms initially, I consulted my doctor who advised me a treadmill test followed by coronary angiography. I underwent angiography, which did not reveal any blockage of my heart vessels, as was thought earlier. I was started on medications, and currently, I am free of any chest pain.

## Abbreviations

AIS: Anterior interventricular sulcus; CTCA: Computed tomography coronary angiography; LAD: Left anterior descending; LCX: Left circumflex; LMCA: Left main coronary artery; PCI: Percutaneous intervention; RCA: Right coronary artery; SOV: Sinus of Valsalva

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## Authors' contributions

Each author has contributed significantly to the submitted work. Both PS and AB participated in conceptualizing the article and manuscript writing. Both PS and MS were responsible for the intellectual input and review of the final draft of the manuscript. The authors read and approved the final manuscript.

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## Consent for publication

Written informed consent for publication was obtained.

## Competing interests

The authors declare that they have no competing interests.

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## References

1. Agarwal PP, Kazerooni EA (2008) Dual left anterior descending coronary artery: CT findings. *AJR Am J Roentgenol* 191(6):1698–1701. <https://doi.org/10.2214/AJR.08.1193>
2. Spindola-Franco H, Grose R, Solomon N (1983) Dual left anterior descending coronary artery: angiographic description of important variants and surgical implications. *Am Heart J* 105(3):445–455. [https://doi.org/10.1016/0002-8703\(83\)90363-0](https://doi.org/10.1016/0002-8703(83)90363-0)

3. Celik T, Bozlar U, Ozturk C, Balta S, Verim S, Demir M, Demirkol S, Iyisoy A (2015) A new anomaly of the left anterior descending artery: type X dual LAD. *Indian Heart J* 67:514–517. <https://doi.org/10.1016/j.ihj.2015.09.004>
4. Sidhu NS, Wander GS (2019) Prevalence and characteristics of dual left anterior descending artery in adult patients undergoing coronary angiography. *Future Cardiol* 15(6):425–435. <https://doi.org/10.2217/fca-2019-0052>
5. Natraj Setty HS, Moorthy N, Venkatappa J, Ramalingam R, Patil S, Raghu TR, Manjunath CN (2019) A rare case of type X dual left anterior descending coronary artery. *J Cardiol Cases* 20(5):180–182. <https://doi.org/10.1016/j.jccase.2019.08.008>
6. Sajja LR, Farooqi A, Shaik MS, Yarlagadda RB, Baruah DK, Pothineni RB (2000) Dual left anterior descending coronary artery: surgical revascularization in 4 patients. *Tex Heart Inst J* 27(3):292–296
7. Greenberg MA, Spindola-Franco H (1994) Dual left anterior descending coronary artery (dual lad). *Catheter Cardiovasc Diagn* 31(3):250–253. <https://doi.org/10.1002/ccd.1810310323>
8. Bozlar U, Uğurel MŞ, Sarı S, Akgün V, Örs F, Taşar M (2015) Prevalence of dual left anterior descending artery variations in CT angiography. *Diagn Interv Radiol* 21(1):34–41. <https://doi.org/10.5152/dir.2014.14275>
9. Saglam M, Ozturk E, Kara K, Kardesoglu E, Mutlu H (2015) A new variation in coronary artery anatomy: type VII dual left anterior descending artery. *Kardiol Pol* 73(3):217. <https://doi.org/10.5603/KP.2015.0042>
10. Aramberry L, Gentiletti A, Menendez M, Rojo L (2016) A case of variant of dual left descending artery in patient with acute myocardial infarction. *J Cardiol Curr Res* 7(4):00257
11. Al-Umairi RS, Al-Kindi FA, Al-Tai SA (2018) A new variant of dual left anterior descending artery anomaly: type XI. *Sultan Qaboos Univ Med J* 18(3):e386–e388. <https://doi.org/10.18295/squmj.2018.18.03.021>
12. Kantarcı M, Doğanay S, Karçaaltıncaba M, Karabulut N, Erol MŞ, Yalçın A, Duran C, Dursun M, Karakaya A, Tatlı S (2012) Clinical situations in which coronary CT angiography confers superior diagnostic information compared with coronary angiography. *Diagn Interv Radiol* 18(3):261–269. <https://doi.org/10.4261/1305-3825.DIR.5064-11.1>

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