Case Report

J Korean Soc Radiol 2024;85(2):428-433
https://doi.org/10.3348/jksr.2022.0147
eISSN 2951-0805

JOURNAL of THE KOREAN SOCIETY of RADIOLOGY

Type 4 Dual Left Anterior Descending Artery: A Case Report of a Rare Congenital Coronary Anomaly

제4형 이중 좌전하행 관상동맥: 드문 선천성 관상동맥 기형에 대한 증례 보고

Seon Woong Jang, MD, Ki Hwan Kim, MD*, Byung Hoon Lee, MD

Department of Radiology, Ilsan Paik Hospital, Inje University College of Medicine, Goyang, Korea

Received October 30, 2022
Revised March 13, 2023
Accepted July 8, 2023

***Corresponding author**
Ki Hwan Kim, MD
Department of Radiology,
Ilsan Paik Hospital,
Inje University College of Medicine,
170 Juhwa-ro, Ilsanseo-gu,
Goyang 10380, Korea.

Tel 82-31-910-7397
Fax 82-31-910-7369
E-mail kim7229@naver.com

Dual left anterior descending artery (LAD) is a rare congenital coronary artery anomaly with a prevalence of approximately 1% in the general population. To date, 10 types of dual LAD artery anomalies have been reported. Among these, type 4 is one of the rarest. Knowledge and recognition of the dual LAD artery are important for correct diagnosis and planning of coronary bypass surgery and percutaneous coronary intervention. We report a case of a 59-year-old male with type 4 dual LAD artery who presented with dyspepsia and sweating for several months and had approximately 50%–70% stenosis in a major diagonal branch off the short LAD artery.

Index terms Anomalous Left Coronary Artery; Coronary Vessel Anomalies; Computed Tomography Angiography; Coronary Angiography; Dual Left Anterior Descending Artery

INTRODUCTION

The left anterior descending artery (LAD) artery has the most consistent origin, course, and distribution among all coronary arteries (1, 2). Dual LAD coronary artery is a rare subtype of congenital coronary artery anomaly (3). The reported prevalence in previous large-scale studies is 1%–4% (1, 3, 4). Spindola-Franco et al. (1) first described and classified this anomaly into four types. Six new types have been reported since then (3). Among these, type 4 dual LAD artery is one of the rarest. The short and long LAD artery originates from the left main coronary artery and right coronary artery, respectively (1). Most of the patients with dual LAD arteries are asymptomatic and are diagnosed incidentally during coronary CT angiography. Nevertheless, knowledge and

recognition of dual LAD arteries are important for the correct diagnosis and planning of coronary bypass surgery and percutaneous coronary intervention (2-4).

We report a case of a 59-year-old male with type 4 dual LAD artery. He had 50%–70% stenosis in a major diagonal branch off the short LAD artery.

CASE REPORT

A 59-year-old male complained of dyspepsia and sweating for the past four months and underwent esophagogastroduodenoscopy at a local hospital, which showed no significant abnormal findings. The patient was referred to our institute for further evaluation. He had a medical history of hypertension, dyslipidemia, and diabetes. After admission, the initial electrocardiogram showed normal sinus rhythm without ST-segment abnormalities, and the cardiac enzyme levels were normal. Echocardiography revealed normal left ventricular function and no wall motion abnormalities.

He had visited our outpatient clinic three months ago with the same complaint. We performed coronary CT angiography, which revealed a dual LAD artery. A short LAD artery originating from the left main coronary artery ends in the proximal anterior interventricular groove, giving off a major septal perforator (Fig. 1A-C). A long LAD artery originating from the right coronary artery (approximately 2 mm distal to the ostium) follows a pre-pulmonic course and re-enters the mid-anterior interventricular groove. The long LAD artery gives rise to small septal and diagonal branches (Fig. 1D). This finding is consistent with that of a type 4 dual LAD artery.

There was approximately 50%–70% stenosis with a non-calcified plaque and mild positive remodeling in the proximal part of the major diagonal branch off the short LAD artery.

At the time of admission, invasive coronary angiography and intravascular ultrasonography were performed for further evaluation, confirming approximately 50%–70% stenosis in the proximal part of the major diagonal branch (Fig. 1E). A cardiologist performed balloon angioplasty, which revealed approximately 50% residual stenosis (Fig. 1F). Therefore, a coronary artery stent was placed to treat the residual stenosis. The procedure was successful without complications. A decade after percutaneous coronary intervention, the stent showed good patency, and the patient remained asymptomatic without acute coronary syndrome.

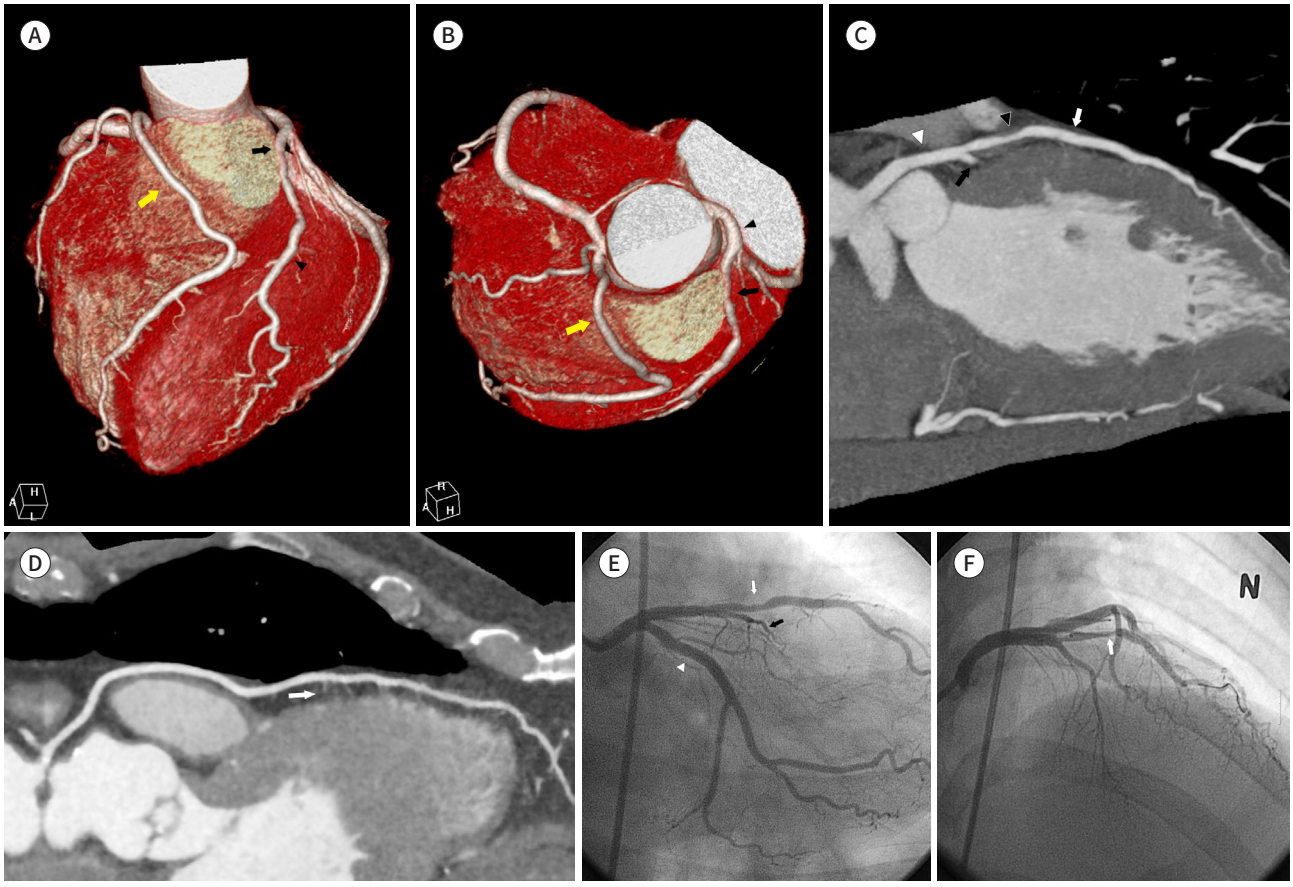
This report was approved by the Institutional Review Board of our institution, which waived the requirement for informed consent (IRB No. 2022-10-004).

DISCUSSION

Congenital coronary anomalies are rare with a reported prevalence of 1.3% among patients who undergo coronary angiography (5). Variations in the origin, course, and distribution are relatively common in the right coronary artery. However, such variations are rare in the LAD artery (1). The LAD artery normally originates from the left main coronary artery and descends along the anterior interventricular groove. A dual LAD artery, first described by Spindola-Franco et al. (1), is composed of a short LAD artery ending proximally in the proximal anterior interventricular groove and a long LAD artery that has an anomalous

JOURNAL of
THE KOREAN SOCIETY of
RADIOLOGY

Fig. 1. Type 4 dual LAD artery in a 59-year-old male.
A. A volume rendering image shows a type 4 dual LAD artery. The short LAD artery (black arrow) gives off the first major diagonal branch (arrowhead) and ends in the proximal anterior interventricular groove. The aberrant long LAD artery (yellow arrow) is seen taking a pre-pulmonic course and enters the mid-anterior interventricular groove.
B. A volume rendering image shows that the long LAD artery (yellow arrow) originates from the proximal right coronary artery. The short LAD artery (black arrow) originates from the left main coronary artery (arrowhead).
C. A curved planar reformatted image shows that the short LAD artery (white arrowhead) gives off a major diagonal branch (white arrow) and septal perforator branch (black arrow), which supplies the proximal septum. There is approximately 50%–70% stenosis in the proximal part of the major diagonal branch (black arrowhead).
D. A curved planar reformatted image shows that the long LAD artery supplies the apical septum by branching into small septal perforators (arrow).
E. A right anterior oblique view of invasive coronary angiography before percutaneous angioplasty shows the first diagonal branch (white arrow) with approximately 50%–70% stenosis. A septal perforator branch (black arrow) is also seen originating from the short LAD artery. White arrowhead denotes the left circumflex artery.
F. A cardiologist performed balloon angioplasty, and approximately 50% residual stenosis (arrow) is noted.
LAD = left anterior descending artery



course outside the anterior interventricular groove and returns to the groove distally. Spindola-Franco et al. (1) categorized this anomaly into four groups. New variants that do not conform to the four pre-existing types have been reported. To date, 10 subtypes have been reported and categorized based on the origin and course of the short and long LAD arteries (Supplementary Fig. 1, Table 1).

A type 4 dual LAD artery is characterized by a short and long LAD artery originating from the left main coronary artery and right coronary artery, respectively, with a pre-pulmonic

Table 1. Ten Types of Dual LAD

Type	LM	LAD Proper	Short LAD	Long LAD	
			Origin	Origin	Course
1	Present	Present	LAD proper	LAD proper	Descends on LV side of AIVG and reenters distal AIVG
2	Present	Present	LAD proper	LAD proper	Descends on RV side of AIVG and reenters distal AIVG
3	Present	Present	LAD proper	LAD proper	Follows intramyocardial course in septum proximally and emerges epicardially in distal AIVG (or terminates intramyocardially)
4	Present	-	LM	Proximal RCA	Follows prepulmonic course and reenters distal AIVG
5	-	-	LCS	RCS	Follows intramyocardial course within septal crest, emerges epicardial, and enters distal AIVG
6	Present	-	LM	Proximal RCA	Courses between RVOT and aortic root and enters distal AIVG
7	Present (originates from RCS and shows interarterial course)	Present	LAD proper	LAD proper	Descends on LV side of AIVG and reenters distal AIVG
8	Present (originates from RCS and shows retroaortic course)	-	LM	Marginal branch of mid RCA	Courses inferior wall surface of RV, turns around apex, and reaches distal AIVG
9	Present	Present	LAD proper	LAD proper	Descends on LV side of mid AIVG, reenters distal AIVG, and terminates before reaching apex
10	Present	-	LM	RCS	Follows prepulmonic course and reenters distal AIVG

AIVG = anterior interventricular groove, LAD = left anterior descending artery, LCS = left coronary sinus, LM = left main coronary artery, LV = left ventricular, RCA = right coronary artery, RCS = right coronary sinus, RV = right ventricular, RVOT = right ventricular outflow tract, - = absent

course. In this case, the short vessel in the proximal anterior interventricular groove branched into a major septal perforator and the major diagonal branch, which corresponds to the short LAD artery. The anomalous vessel originated from the proximal right coronary artery, following a pre-pulmonic course, and entered the mid-interventricular groove, which corresponds to the long LAD artery according to the suggested definition (1).

In most of the cases, a dual LAD artery is asymptomatic. However, in subtypes involving an aberrant artery originating from the opposite side, symptoms may be observed depending on the course. An interarterial course between the right ventricular outflow tract and ascending aorta, can increase the risk of sudden cardiac death and myocardial ischemia (3, 6).

A previous case report described a patient with a type 4 dual LAD artery and long-standing angina (7). Invasive coronary angiography revealed no atherosclerosis. However, myocardial ischemia was observed clinically. The patient underwent coronary bypass surgery and was asymptomatic during the follow-up. It is unclear whether a type 4 dual LAD artery can cause ischemia. However, these patients require long-term follow-up.

Knowledge and recognition of dual LAD arteries are important. In the present case, the patient had a type 4 dual LAD artery with a long LAD artery originating from the opposite side. Without the knowledge of this anatomical variation, it can be misdiagnosed as a mid-LAD arterial occlusion on invasive coronary angiography (2, 8). A previous case report has described such a misdiagnosis with the presumed cause as deep engagement of the catheter on inva-

sive coronary angiography (9). Therefore, coronary CT angiography may have helped prevent misdiagnosis in this case.

Moreover, knowledge about dual LAD artery is clinically important while performing coronary bypass surgery and percutaneous coronary interventions. A lack of knowledge may lead to insufficient or incorrect management if both the short and long LAD arteries have severe stenosis (2-4).

Beyond the diagnosis of a type 4 dual LAD artery, coronary CT angiography confers benefits in the detection of various congenital coronary anomalies. In patients with an anomalous origin of the coronary artery, the interarterial course between the aorta and pulmonary artery is considered a malignant feature (4, 10). In a retrospective study, this feature was detected only on coronary CT angiography and not on invasive coronary angiography (10). In addition, the prevalence of intrinsic coronary artery anomalies on coronary CT angiography was twice as high as that on invasive coronary angiography (55.1% vs. 26.6%). These anomalies include the absent coronary artery, coronary hypoplasia, and myocardial bridging (10).

We have presented a rare case of a type 4 dual LAD artery. The patient had atherosclerosis in a major diagonal branch originating from a short LAD artery, with symptoms of stable angina. We performed coronary CT angiography before invasive coronary angiography, which detected this rare anatomic variant and led to the correct diagnosis.

Supplementary Materials

The online-only Data Supplement is available with this article at http://doi.org/10.3348/jksr.2022.0147.

Author Contributions

Conceptualization, J.S.W., K.K.H.; investigation, J.S.W.; supervision, L.B.H.; validation, K.K.H., L.B.H.; writing—original draft, J.S.W., K.K.H.; and writing—review & editing, J.S.W., K.K.H.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

ORCID iDs

Seon Woong Jang https://orcid.org/0000-0002-3858-5329
Ki Hwan Kim https://orcid.org/0000-0002-6911-8125
Byung Hoon Lee https://orcid.org/0000-0003-4481-7859

Funding

None

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;105:445-455
2. Agarwal PP, Kazerooni EA. Dual left anterior descending coronary artery: CT findings. *AJR Am J Roentgenol* 2008;191:1698-1701
3. Şeker M. Prevalence and morphologic features of dual left anterior descending artery subtypes in coronary CT angiography. *Radiol Med* 2020;125:247-256
4. 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;21:34-41
5. Yamanaka O, Hobbs RE. Coronary artery anomalies in 126,595 patients undergoing coronary arteriography.

Cathet Cardiovasc Diagn 1990;21:28-40
6. Peixoto Oliveira MD, de Melo PH, Esteves Filho A, Kajita LJ, Ribeiro EE, Lemos PA. Type 4 dual left anterior descending artery: a very rare coronary anomaly circulation. *Case Rep Cardiol* 2015;2015:580543
7. Manoly I, Karangelis D, Peebles C, Tsang G. Dual origin of the left anterior descending artery: a rare coronary anomaly with longstanding variant angina. *J Cardiothorac Vasc Anesth* 2013;27:e44-e45
8. Hajdu SD, Qanadli SD. Unexpected dual left anterior descending artery as a source of percutaneous coronary revascularization failure. *Front Cardiovasc Med* 2016;3:45
9. Gürbak İ, Panç C. Type IV dual left anterior descending artery misdiagnosed as chronic total occlusion. *Anatol J Cardiol* 2019;22:91-93
10. Ghadri JR, Kazakauskaite E, Braunschweig S, Burger IA, Frank M, Fiechter M, et al. Congenital coronary anomalies detected by coronary computed tomography compared to invasive coronary angiography. *BMC Cardiovasc Disord* 2014;14:81

제4형 이중 좌전하행 관상동맥: 드문 선천성 관상동맥 기형에 대한 증례 보고

장선웅 · 김기환* · 이병훈

이중 좌전하행 관상 동맥은 일반 인구에서 약 1%의 유병률을 보이는 드문 선천성 기형이다. 지금까지 이중 좌전하행 관상동맥 기형은 10가지 유형으로 보고되었다. 그중 제4형 이중 좌전하행 관상동맥은 가장 희귀한 유형 중 하나이다. 이중 좌전하행 관상동맥에 대한 지식과 인식은 정확한 진단과 관상동맥 우회 수술 및 경피적 관상동맥 중재술을 계획하는 데 중요하다. 저자들은 수개월 동안 소화불량과 발한을 주소로 내원하였고 짧은 좌전하행 관상동맥의 주요 대각분지에 약 50%–70% 협착이 있었던, 제4형 이중 좌전하행 관상동맥 기형을 가진 59세 남성의 증례를 보고하고자 한다.

인제대학교 의과대학 일산백병원 영상의학과