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Dual Left Anterior Descending Artery with abberrent left circumflex artery: dual abberrency- a multi-modality imaging based identification

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Abstract

Dual left anterior descending (LAD) artery with separate origin of the long LAD with left main coronary artery (LMCA) continuing as short LAD is very rare. A 67-year-old diabetic, and hypertensive male was admitted with history of exertional dyspnoea. He underwent coronary angiography, which showed LMCA continuing as short LAD with early termination while single trunk from right coronary sinus was giving rise to long LAD, right coronary artery, and left circumflex artery (LCx). The long LAD, running on the right side of the anterior interventricular groove, entered the groove distally while anomalous LCx which was dominant, was following a retro-aortic course. These were subsequently confirmed on Multidetector computed tomography angiography (MDCT). Therefore, dual LAD with long LAD, dominant anomalous circumflex artery, and right coronary artery sharing a single, and common origin is very rare and to the best of our knowledge, is being reported for the first time.

Key words- Dual Left Anterior Descending Artery; Multidetector Computed Tomography Angiography; Anomalous Left Circumflex Artery.

Introduction-

Dual left anterior descending artery (LAD) is rare and usually detected incidentally during coronary angiography. Most of these are benign in nature; however some are malignant which may result in sudden cardiac death. An anomalous origin of long LAD, dominant left circumflex artery (LCx) and right coronary artery (RCA) arising from single ostium, along with left main trunk continuing as short LAD is an extremely rare entity. The coronary circulation from single coronary usually has little clinical significance. However variability in anatomical origin and distribution may cause malignant course resulting in sudden cardiac death and increased risk of ischaemia.

Case report-

A 67-year old male with diabetes, and hypertension for past ten years, was evaluated for exertional dyspnoea. He was haemodynamically stable. His cardiovascular, and other physical examinations were normal. Electrocardiogram showed mild ST-T changes in precordial leads. Echocardiography revealed moderate concentric left ventricular hypertrophy, grade-II diastolic dysfunction with normal ejection fraction. Exercise stress testing could not be performed because of bilateral osteoarthritis of knee joints. Considering the baseline risk factors such as age, diabetes, and hypertension, catheter based coronary angiography was performed as first imaging after proper consent. Cannulation of left main coronary artery showed its normal course which was giving few septal branches and further continuing as diagonal branch of left anterior descending artery (**Figure 1**). Right coronary artery (RCA) cannulation showed single ostium which was giving rise to RCA, left circumflex artery (LCx), and left anterior descending (LAD) (**Figure 2**). To confirm the anomalous origin and to better delineate the course of artery, 128-slice multi-detector computed tomography (MDCT) coronary angiography was performed. The LAD which was

arising from RCA was termed as *long* LAD (*l*-LAD) (**Figure 3A**). It had an anomalous prepulmonic course anterior to the right ventricular outflow tract, coursing further on the right side of the anterior interventricular groove and finally entered the groove distally (**Figure 3B**) while anomalous LCx which was dominant, was following retro-aortic course (**Figure 4**). The continuation of left main trunk was labelled as *short* LAD (*s*-LAD) which was functionally serving as major diagonal branch. Therefore, short, and long LAD together constituted dual LAD system. All the four arteries appeared free of disease. In our case, exertional dyspnoea could have been angina equivalence or increased left ventricular end diastolic pressure because of underlying grade-II diastolic dysfunction and moderate concentric left ventricular hypertrophy. Endothelial, and microvascular dysfunction could have been the other reasons. He was managed conservatively with antihypertensive drugs (metoprolol-50 mg once daily, ramipril-5 mg once daily, and hydrochlorthiazide-12.5 mg once daily), and metformin-500 mg twice daily. He was discharged in stable condition and on regular follow-up since then.

Discussion

Congenital coronary anomalies are rare and reported to occur in 0.64-1.3% of patients undergoing coronary angiography, which may occur in association with underlying congenital heart disease or may be an incidental finding during coronary angiography [1]. Anomalies involving the origin, course, and distribution of the LAD are rare, and that of dual LAD, also known as dual anterior interventricular artery, is even rarer as only 60-70 odd cases have been reported previously in the literature [2, 3]. In normal anatomy, left main trunk after giving rise to left circumflex branch continues as left anterior descending artery which courses in the anterior interventricular groove (AIVG) towards the cardiac apex, and gives diagonal branch and septal perforators. While septal branches perfuse interventricular septum, diagonal branches extend to LV anterior wall [4]. Dual LAD anomaly is

characterized by the presence of two distinct segments of LAD in the AIVG and generally designates a *short* LAD (*s*-LAD) which terminates in the proximal while the *long* LAD (*l*-LAD) terminates in the distal AIVG respectively. Traditionally, dual LAD system was classified into six types based on the angiographic findings taking into consideration of origin and distribution of the *l*-LAD [3], but few more types were added later on based on computed tomography coronary angiographic findings [5]. In the first 3 types, both short and long LADs originate from a common trunk while in the next 3 types the short LAD originates from the left main trunk and the long LAD stems from the right coronary sinus or right coronary artery and follows anterior, septal, interarterial, or retro-aortic course to reach the interventricular groove [6]. CT angiography scores over the conventional catheter based angiography as it better delineates three-dimensional anatomy especially when they have aberrant origin [5,7]. The presence of dual LAD has very little clinical significance in the absence of stenosis but assumes importance during surgical graft placement as it helps avoiding incorrect arteriotomy by surgeons [8]. Therefore, case-based CT angiography analyses may well contribute to diagnostic, surgical, and interventional procedures for clinical applications as it is vital to know whether there is a dual LAD before any surgical intervention. Lack of this information may end up with either incomplete revascularization by percutaneous intervention, or coronary bypass graft surgery covering only one of those LADs, or incorrect arteriotomy during surgical graft placement resulting into deficient revascularization [8-10]. Also, when *l*-LAD arises from the right coronary sinus, visualization of only *s*-LAD during catheter angiography may give rise to incorrect impression of mid-LAD occlusion [10]. The coronary circulation arising from a dual LAD system remains silent except when *l*-LAD has interarterial course between two great vessels it may lead to sudden cardiac death due to malignant arrhythmias as a result of repetitive ischemia, inter-arterial course or acute angle made by the *l*-LAD to turn toward the atrioventricular groove. MDCT

also helps to rule out any small dissection which may go unnoticed by conventional angiography or other anomalies. Possible reasons of angina in our case in absence of coronary atherosclerosis may be syndrome-X because of microvascular dysfunction, interarterial course, and “coronary steal” phenomenon as a result of either compromised flow in anomalous artery or acute angle of take-off for the anomalous vessel. There is no consensus about the best management strategy and will depend on the clinical presentation, co-morbid conditions and underlying atherosclerotic burden if any. Our patient’s coronary anatomy is an extremely rare one as it features two distinct coronary anomalies: a type-IV dual LAD along with the aberrant, dominant left circumflex artery, and all three taking origin from single right coronary ostia.

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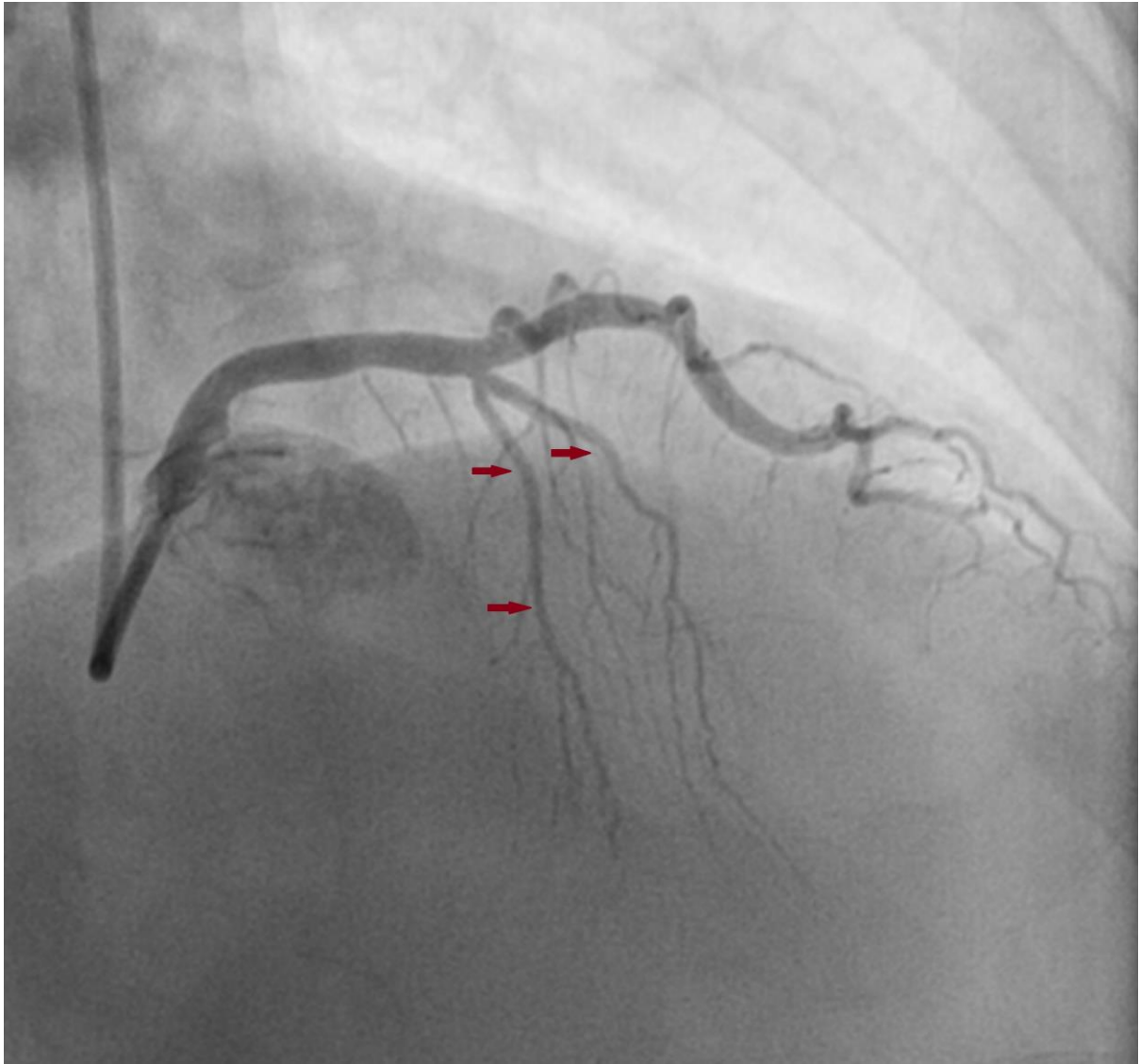


Figure 1. Antero-posterior cranial view showing left main trunk continuing as short LAD (*s*-LAD) giving rise to septal perforators (red arrow).

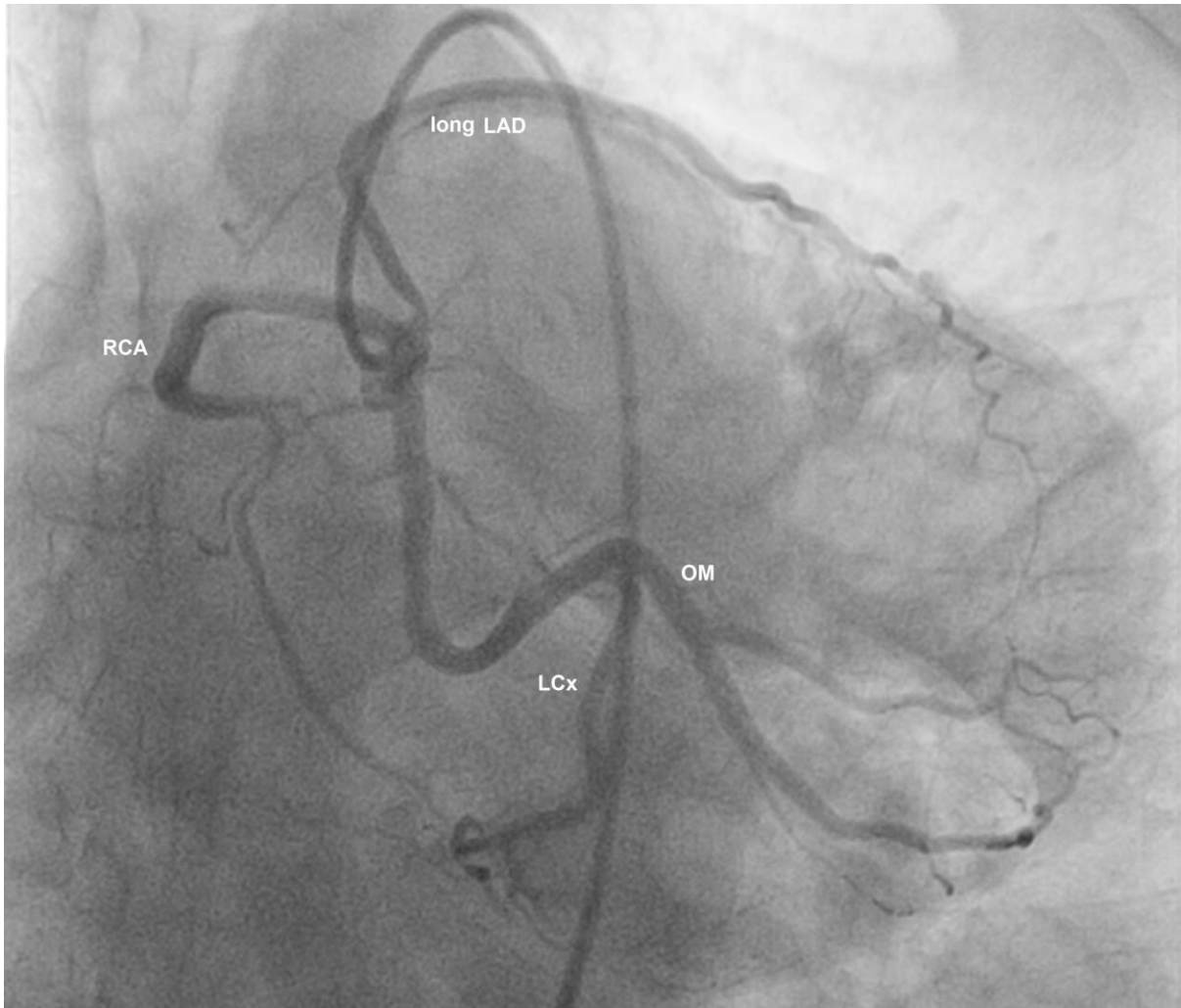


Figure 2. Right coronary artery (RCA) cannulation in antero-posterior view with caudal angulation showing single ostium which was giving rise to RCA, dominant left circumflex artery (LCx), and long left anterior descending (*l*-LAD) artery.

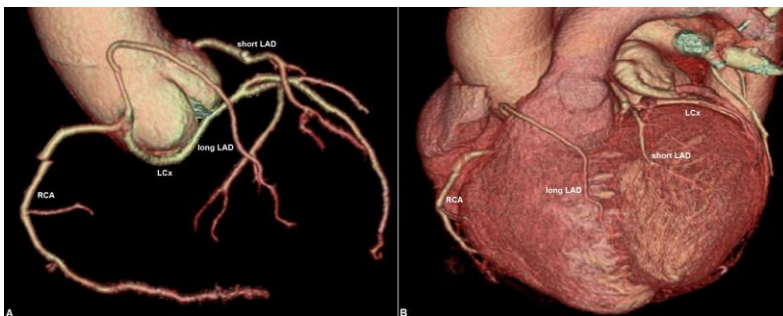


Figure 3. Multi-detector computed tomography (MDCT) coronary angiography showing Type-IV dual LAD along with aberrant, dominant, left circumflex artery arising from right coronary artery- A; Three dimensional coloured volume rendered CT images showing the long left anterior descending artery (*l*-LAD) following a prepulmonic course to reach the distal anterior interventricular groove (AIVG) while short LAD (Diagonal) as a continuation of left main trunk- B.



Figure 4. MDCT coronary angiography with maximum intensity projection at the level of coronary ostia in axial section showing anomalous dominant LCx following retro-aortic course to lateral surface of heart (Ao-Aorta; LCx- Left circumflex artery; PA-pulmonary artery).