Case Report

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Trifurcation of Left Coronary Artery with Absent Left Circumflex Artery and Superdominant Right Coronary Artery in the Heart

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ABSTRACT

The absence of left circumflex artery (LCX) is usually a benign, asymptomatic condition and may present like coronary artery syndrome. The prevalence of absent LCX has been reported as 0.003-0.067%. During routine dissection of isolated heart specimen of a 65-year-old male cadaver, variations in the branching of coronary arteries were observed. The left coronary artery (LCA) trifurcated into left anterior descending, left marginal and left diagonal branches. The LCX was absent. The right coronary artery (RCA) originated from right aortic sinus. Its right marginal branch was absent. The RCA continued beyond the crux after giving the posterior interventricular artery and became superdominant as it supplied branches to the left ventricle. These variations may be useful to the cardiothoracic surgeons and cardiologists while performing coronary angiography.

Introduction

The coronary arteries arise from the right and left aortic sinuses. The most common branching pattern of left coronary artery (LCA) is bifurcation into left anterior descending artery (LAD) and left circumflex artery (LCX). The trifurcation and tetra-furcation of LCA depends on the course and branching pattern.[1] The usual branching pattern in trifurcation is where the LCA gives off LAD, LCX and a left diagonal artery (D2). The incidence of trifurcation varies from 33% to 50%. In 20%, the left diagonal artery may be doubled.[1] There can be two diagonal arteries, D1 and D2. The D1 artery arises as first diagonal branch from the LAD, and the D2 arises either directly from the main trunk of LCA or left marginal artery. The OM1 (obtuse marginal) is considered as a left marginal branch directly from the LCX.[1]

In tetra-furcation, LCA gives off an extra left marginal artery branch. The prevalence of absent LCX has been reported to vary between 0.003-0.067% and it may present as coronary artery syndrome in a patient.[2] The right coronary artery (RCA) gives off the posterior interventricular artery (PIVA) at the crux of the heart, then, it can extend beyond the crux and anastomoses with the branches of the LCX. The dominance of the heart depends on the origin of posterior interventricular artery (PIVA) with respect to the RCA and LCA. The term "superdominant" is used where the RCA continues beyond the crux and supplies the left ventricle.[2] This report presents a rare presentation of trifurcation of LCA, absent LCX with superdominant RCA in a cadaver.

Case report

In a 65-year-old male cadaver's isolated heart specimen, during dissection for the undergraduate students, variations were observed in the coronary arteries. The LCA originated from left aortic sinus of the aorta and its length was 2.20 cm. At the junction of atrioventricular and anterior interventricular grooves, LCA trifurcated into LAD, left marginal (OM1) and left diagonal (D2) branches (Fig. 1A). The length of LAD, left marginal and D2 was 11.5 cm, 6 cm and 4.5 cm, respectively. The LCX was absent. The left diagonal artery (D1), which originated from LAD, was 6 cm long. The RCA originated from right aortic sinus of the aorta. It had a normal course around the anterior atrioventricular groove, here its right marginal branch was absent. The RCA occupied the place of LCX in AV groove, which continued 2.5cm beyond the crux after it gave off the PIVA and the latter was 6 cm long. The RCA was superdominant as it gave off three branches to the diaphragmatic surface of left ventricle (Fig. 1B). The length of the three branches (1, 2, 3) for left ventricle was 5 cm, 6 cm, and 5.5 cm, respectively. The total length of RCA from origin till termination was 12.5 cm.

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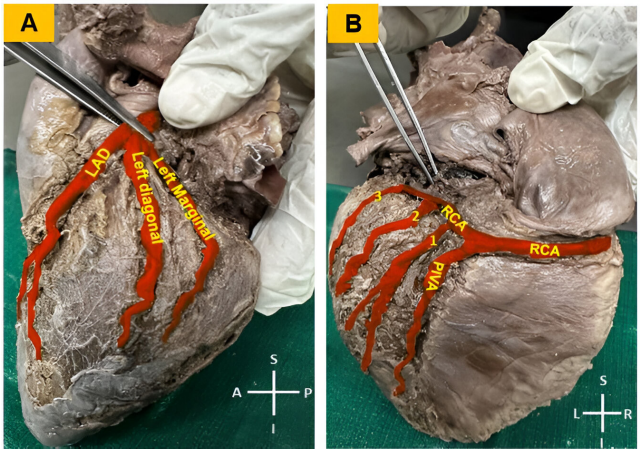

Figure1 A and B: A: Left lateral view shows trifurcation of left coronary artery into left anterior decending, left diagonal (D2),left marginal artery with absent left circumflex. B: Posterior view shows superdominant right coronary artery supplying branches (1, 2, 3) to left ventricle. PIVA- Posterior interventricular artery; LAD-Left anterior descending; Left circumflex artery; RCA-Right coronary artery S -superior, I-inferior; A- anterior; P- posterior; L- left; R- Right.

Discussion

In the present case, LCA trifurcated into LAD, left marginal and left diagonal (D2) branches. Similar reports are usually incidentally detected in coronary angiography. Though LCA mostly bifurcates into LAD and LCX, the diagonal artery sometimes arises from the main trunk of the LCA, which leads to trifurcation.[3] The embryological basis behind the variations is that there are two different origins for coronary arteries: one from the proximal and one from the distal portion of bulbus cordis. The retiform vascular network, which forms in the distal region initially, is comparable to the capillary networks found in other body areas. This retiform network becomes a complete ring and connects to the heart chamber and extracardiac major vessels as it grows in the atrioventricular and interventricular grooves. Following the development and regression of a few vessels, the coronary pattern eventually takes shape.[4] The disturbance in this process of regression is likely to cause variations in branching pattern of coronary arteries like trifurcation.

In a report by Sobrinho et al., the LCA trifurcated into LAD, LCX and marginal artery, and its division into one more marginal artery lead to tetrafurcation.[5] The incidence of the most common pattern of the trifurcation into LAD, LCX and marginal artery was reported as 6.7%-52%.[3, 5] Sinha et al. noted that the LCA trifurcated into LAD, LCX and RCA. The RCA originated from the middle of LAD and coursed into the right atrioventricular groove. In our case report a unique trifurcation pattern of LCA with absent LCX was noted.[6] The absent LCX may be associated with a superdominant RCA.[7] Shaikh et.al. reported normal origin of LCA from the aortic sinus with absence of LCX and the RCA became superdominant supplying the inferior and posterolateral walls of the left ventricle[8] Singh et al. reported the RCA originated from the right aortic sinus, gave off a dilated marginal artery, also gave the posterior interventricular artery beyond the posterior crux, and continued towards the posterior AV groove, further coursed towards anterior left AV groove, and ended at the apex. Here, both the LCA and LCX was absent, and the LAD from the right aortic sinus coursed along the anterior surface of the right ventricle.[9]

Guo et al. reported a case of congenital absence of LCX, where, coronary angiography revealed a superdominant RCA and the ECG findings were suggestive of inferior wall ischemia.[7] Hongsakul et al. noted that the absence of the LCX was related with several enlarged diagonal branches of the LAD. The superdominant RCA continued beyond the crux and supplied the region of the LCX. Thus, the territorial supply of the LCX is covered by the branches arising from the superdominant RCA.[10] Similarly, in our case report the LCX was absent, its territory is then taken by the RCA which became superdominant and supplied the diaphragmatic surface of the left ventricle. The absence of LCX is usually a benign, asymptomatic condition and is incidentally detected by coronary angiography. Sometimes, patients can present with angina-like symptoms in such cases. The symptoms are attributed to the hypoplasia of vessel, myocardial squeezing and endothelial injury that leads to spasm of coronary arteries. Some authors ascribed the symptoms of patients mainly to the steal phenomenon. Steal phenomenon occurs when temporary ischemia in other territories results in symptoms due to an enhanced blood flow to one region.[7] Gentzler et al. suggested that absence of LCX could be associated with systolic click syndrome and the patient could present with chest pain, breathlessness, palpitations, and syncope.[11] There are similar studies reported in the literature about coronary artery anomalies most of which were incidentally detected by coronary angiography.[8, 9] To the best of our knowledge the report on LCA trifurcation with absent LCX and superdominant RCA is not documented in cadavers. The knowledge of this variations in coronary artery anatomy, may aid the cardiothoracic surgeons while doing cardiac interventional surgeries, such as coronary artery bypass graft procedures. Cardiologists performing coronary angiography would also be benefited by awareness of these variations.[8]

List of Abbreviations:

RCA: Right coronary artery
LCA: Left coronary artery
LCX: Left circumflex artery
LAD: Left anterior descending artery
PIVA: Posterior interventricular artery
OM1: First obtuse marginal artery

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