



THE STUDY OF ORIGIN, COURSE, BRANCHING PATTERN, DISTRIBUTION AND CLINICAL CORRELATION OF LEFT CORONARY ARTERY

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Abstract: The demand for diagnosis and management of coronary artery disease is on a rise in developing world. Coronary artery diseases like ischaemia and thrombosis have become more frequent even in younger age group. There is also an increased demand for surgical intervention in congenital, inflammatory, metabolic and degenerative diseases of coronary. In the present study, Left coronary artery (LCA) was always a single branch from left posterior aortic sinus. Branching pattern of LCA was bivalent in 70%, trivalent in 26% and quadrivalent in 2% of specimen. Posterior descending artery arose from LCA in 20% showing left coronary dominance. The correlation was seen in dominance and branching pattern.

Key Words: Coronary artery disease, Left coronary artery, Posterior descending artery.

INTRODUCTION

The four chambered heart is enveloped in double layer of pericardium (fibrous and serous). The automated regular contractions keep the rhythm of life. The la-corona or the royal crown is the term used for coronary arteries. The right and left coronary arteries together form an oblique inverted vascular crown. The LCA supplies to larger volume of the myocardium as compared to Right coronary artery. The LCA is also more variable than its right counterpart in origin, distribution, branching pattern and luminal size.¹ With the increase in stress, improved life style and better paying capacity; myocardial revascularization and bypass surgeries are on a phenomenal rise.²

The coronary anatomy has been studied apart from dissection, by injecting contrast dye in the vessels, followed by X-ray and corrosion cast preparation. In living subjects, the arteries and their vulnerability to ischaemia and myocardial infarction has been studied with interventional diagnostic techniques like Electro-cardiographs, Echocardiography, Angiography and Colour Doppler study. In many cases, clinical diagnosis has been settled after the autopsy study of the heart specimen. With this background; the present work was carried out to dissect and study morphology of LCA.

MATERIALS AND METHODS

The study was conducted at The Institute of Anatomy, Madras Medical College, and Chennai 03. Total fifty specimens of heart specimens were dissected of which thirty were formalin-fixed specimen obtained in dissection room from cadaver. Twenty specimens were procured from Post-mortem Room at the Forensic department of the same Institution.

Exposure of the heart was done following classical incision and dissection procedures. The LCA and all its branches were dissected. Left coronary artery was studied with respect to its origin, course, branching, pattern, distribution, and clinical correlation. The procedures followed were in accordance with ethical standards of handling of cadaver for learning and teaching.

RESULTS

LCA: in all 50 specimens studied, LCA was present. It took origin from sinus and passed between pulmonary trunk and left atrium. Its course in anterior ventricular sulcus to reach the left margin of the heart. (Figure 1)

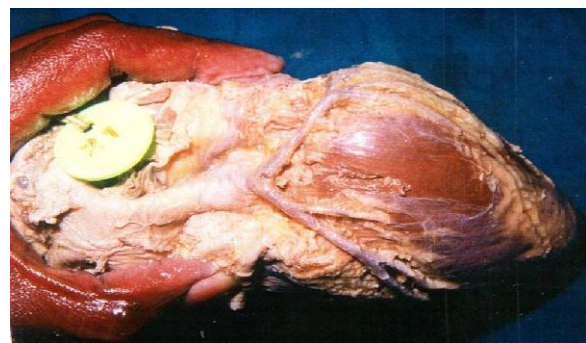


Figure 1: Normal left coronary artery and its major branches

Branching pattern of LCA (Table 1): In all 50 specimen dissected, it divided into 2 branches in 35 specimen (Bivalent pattern); into 3 branches in 13 specimen (Trivalent pattern) (Figure 2) and into 4 branches in 2 specimen (Quadrivalent pattern).

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Table 1: Branches of LCA

Branch to	Frequency	Absent in
Left ventricle	50 (100%)	0
Left atrium	50 (100%)	0
Marginal branches	47 (94%)	3 (6%)
From Anterior descending Branch:		
Left conus	48 (96%)	2 (4%)
Anterior diagonal	45 (90%)	5 (10%)
Anterior ventricular artery to both right and left ventricle	50 (100%)	0
From circumflex branch		
Left arterial	50 (100%)	0
Left ventricular	50 (100%)	0
Marginal	47 (94%)	3 (6%)
Posterior descending branch (intraventricular)	10 (20%)	40 (80%)



Figure 2: Left coronary artery- trivalent pattern

In bivalent pattern: LCA branches into ant DA and circumflex artery branching pattern of trifurcation of LCA

Proximal: ADB → Anterior descending branch, Circumflex, Diagonal branch

Anterior descending branch: 50 specimens including fetal heart the anterior descending branch was present. The intra luminal thickness is variable in some of the specimens.

Circumflex branch was present in all but one specimen. It continued to give marginal or posterior descending branches.

1. Conus artery was present as a branch of anterior descending except in two specimen (absent in specimen no. 9, 18)(Figure 3)

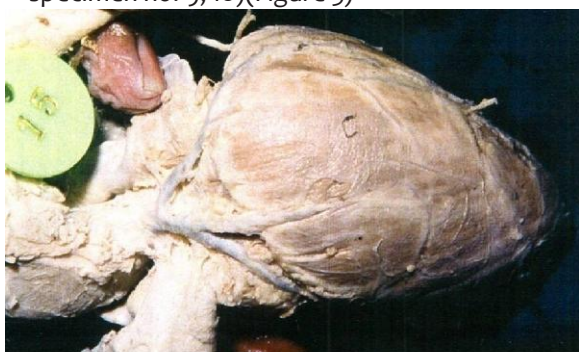


Figure 3: Left conus artery from LAD

2. Anterior diagonal artery- was a branch of anterior descending artery in 45 out of 50 specimens. (absent in specimen no. 1, 14, 18, 38, 46)(Figure 4)

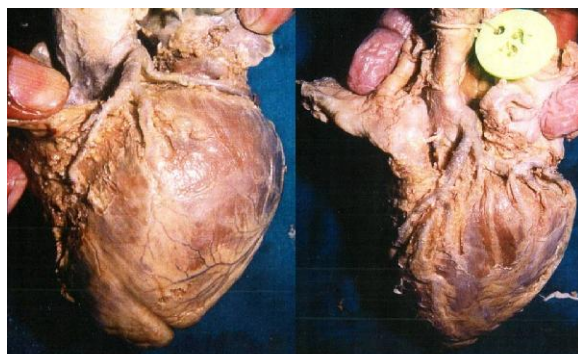


Figure 4: Anterior diagonal branch from LAD

3. Left anterior ventricle branch- present in all 50 specimen.
4. Branch to left atrium, was branch from circumflex artery in all 50 specimen. (Figure 5)



Figure 5: Left atrial branch

5. All 50 specimens showed branch to left ventricle by Circumflex branch.
6. Marginal artery was present in 47 specimens. (absent in specimen no. 24, 26 and 44) (Figure 6)

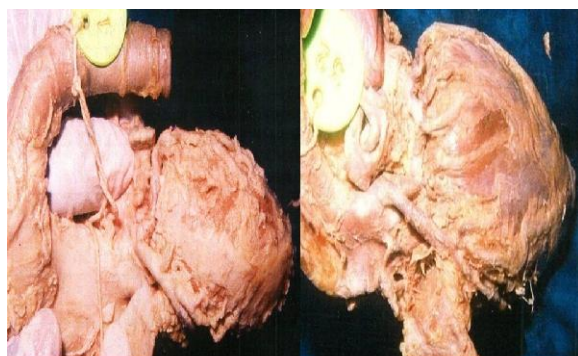


Figure 6: Left Marginal artery from circumflex branch

7. Posterior descending branch- was always present. (Figure 7)

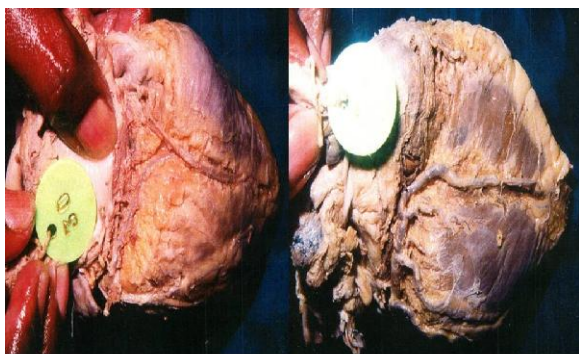


Figure 7: Posterior descending branch from LCA

8. Anterior descending and circumflex branches end at various level:

Anterior descending branch reaching to:

- i. Anterior aspect of apex level present in 10 specimens.
- ii. Posterior aspect of apex level present in 25 specimens.
- iii. 2.5 cm up in posterior inter ventricular sulcus-4 specimens.
- iv. More than 2.5 cm up in post inter ventricular sulcus-13 specimens.

Circumflex branch reaching to:

- i. Ends before left margin-9 specimens.
- ii. Beyond left margin- 4 specimens.
- iii. Between left margin and circumflex: 28 specimens.
- iv. From circumflex to apex- 10 specimens.

Length of Left coronary artery main trunk (from its origin to the first division): Above 1 cm (1-2 cm): 38
Below 1 cm (0.1- 1 cm): 12

Anomalous: Nil

Diameter of LCA: In above all specimen diameter of LCA from its origin to the point of branching was variable.

Diameter of the anterior descending branch: Up to 0.5cm: in 34 specimen

Above 0.5cm: in 16 specimen

Diameter of the circumflex branch: Up to 0.5 cm: in 44 specimen

Above 0.5 cm: in 6 specimen

The left coronary artery supplied: Most part of the left atrium, Most part of the left ventricle. Except a strip along the posterior and inferior surface of the heart

Anterosuperior two thirds of the inter ventricular septum

SA node

AV node in majority of subjects

Coronary predominance: Majority of population has right coronary predominance where posterior interventricular artery is derived from the right coronary. Minority of population, where posterior interventricular artery is a branch of LCA, are more affected by the coronary artery disease because the entire left ventricle and the ventricular septum are supplied by the LCA. In some cases where posterior interventricular artery is derived from both the coronary arteries; such individuals have balanced coronary circulation and are least affected by coronary diseases.

In this study, LCA is 100% of times found to be arising from left posterior aortic sinus. LCA originating from pulmonary artery or anterior aortic sinus along with right coronary artery as a single vessel is not witnessed.

DISCUSSION

The basic knowledge in anatomy about coronary arteries dates back to as early as 3000 BC. Arani DT *et al.*, studied lordotic right posterior oblique projection of the left coronary artery- a special view combining cranial angulation of the X-ray beam with rotation of the patient into the right posterior of the left anterior descending and circumflex divisions. This procedure has proved helpful for assessment of LCA in still more detail.³

Leguerrier A *et al.*, In 1976 dissected 80 human heart specimens and reported following anatomical variations of main trunk of the left coronary artery.

- a. In 1% of cases main left coronary artery is missing.
- b. It may arise as a branch from pulmonary artery.
- c. In 65-70% of cases LCA divide in to anterior descending and left circumflex.
- d. A third branch, diagonal or lateral branch may exist in 20-30% of cases (Trivalent pattern)
- e. In 5-10% of cases LCA may divide in to four (or even five) branches.¹

Johnson AD *et al.*, studied 50 adults control patients with no valve or congenital heart disease compared with 33 adult patients with aortic valve disease. He observed patients with bicuspid aortic valves had higher incidence of immediate bifurcation of the left main coronary artery less than 10 mm and of left coronary artery dominance. The mean length of left main coronary artery was significantly less in patients with bicuspid aortic valves. These variations

may be part of developmental anomaly responsible for bicuspid aortic valve.⁴

Ferguson DW has reported 30yr old female patient with a single coronary artery. The anomalous origin of the left circumflex branch from the right coronary. There was no left anterior descending coronary artery by angiographic study. This abnormal variant is helpful for the clinical and other non-invasive diagnostic procedures.⁵ Sneba *et al.*, has Reported anomalous origin of the left coronary artery from the pulmonary artery by autopsy. It is a rare anomaly. It is seen in 'Bland white garland syndrome'.⁶ Karr SS has diagnosed anomalous origin of the left coronary artery from the pulmonary trunk by Colour Doppler study.⁷

Tyrell *et al.*, in their Study from 1970-1982 observed the anomalous origin of left coronary artery from the pulmonary artery and compared with the clinical study of four patients who had separate conus coronary arteries with a major contribution to collateral circulation.⁸ Murashita *et al.*, in 1992 diagnosed a case of 33 year old man who had complained of chest pain during exercise. That patient was having an anomalous origin of the LCA from pulmonary artery identified by coronary angiography.⁹ Henson KD *et al.*, in 1992 demonstrated the role of the transoesophageal echocardiography identifying the course of anomalous origin of right coronary artery from the left main coronary artery (Single coronary artery).¹⁰ Voudris V *et al.*, has presented a rare anomalous a case of double left anterior descending coronary artery. The double arteries originated from the left main stem and the right coronary artery. There was no stenosis in these two arteries.¹¹

Buffet P *et al.*, did a comparative study was done between the acute and long term results of percutaneous transluminal coronary angioplasty (PTCA) of the LCA in 106 patient's group with chronic occlusion of the right coronary artery.¹² Christiaeris *et al.*, in 1994 did a percutaneous transluminal coronary angioplasty of a single coronary artery where it was arising from the left main coronary artery. It is a very rare anomaly.¹³ Ozdil ED *et al.*, have explained a case of 51 yrs old woman who had a left coronary artery originating from the right coronary sinus. He performed successful percutaneous transluminal coronary angioplasty of an anomalous left anterior descending artery.¹⁴

Iliia R *et al.*, in 1994 have reported a double left anterior descending artery originating from the left and right coronary artery (a rare coronary anomaly).¹⁵ Salachas A *et al.*, in 1996 have described a middle age male patient having isolated corrected transposition of great vessels with double left anterior descending coronary artery originating from the left main stem and

the right coronary artery. There was no stenosis. A very rare anomaly.¹⁶

Hsieh YK *et al.*, in 1996 reported an anomalous origin of left coronary artery from right coronary artery (single coronary trunk) diagnosed by transoesophageal echocardiography.¹⁷ Ohmoto Y *et al.*, in 1977 described stent placement in surgically reimplanted left main coronary artery in patient with anomalous origin of left main coronary artery as a branch from pulmonary artery.¹⁸ Chang CJ in 1997 explained a rare congenital anomaly of dual left anterior descending coronary artery that animates aortic origin of the left circumflex coronary artery.¹⁹ Schwartz ML *et al.*, in 1997 observed anomalous origin of left coronary artery from pulmonary artery.²⁰

Goswami KC *et al.*, in 1998 did a cross sectional and doppler echocardiographic diagnosis of anomalous origin of the left coronary artery from the pulmonary artery and right coronary artery from the posterior aortic sinus.²¹ Nerantziz CT *et al.*, in 1998 have studied variations of the left coronary artery from anatomic and post-mortem angiographic findings. Characterizing the origin of LCA arising as a common trunk with right coronary artery (RCA) from the right arthrostromies and its course via the ventricular septum to the left side of the heart. It sent large branches to the septomarginal trabecula Vs diagonals and the small anterior inter ventricular (anterior descending) artery originated from the later part of this artery. The findings are important for interpreting coronary angiographies in anomalous origin of LCA from RAS (right aortic sinus).²²

Brickman AM *et al.*, in 199 has demonstrated the variability of human coronary artery geometry, an angiographic study of the left anterior descending arteries of 30 autopsy hearts. A computer based system is described to measure objectively the geometric parameters of arteries from pairs of projection angiogram which employs back projection to define the vessel's axis in 3-D space was used to obtain selected parameters of coronary artery geometry from radiographic images from autopsy hearts. He studied 30 cases focusing on the distribution of the geometric parameters of the left anterior descending coronary artery and its first two major branches.²³

Friedman MH *et al.*, in 1996 described relationship between geometry and quantitative morphology of the left anterior descending coronary artery. He studied 15 autopsy cases of angiographic lesion free individual's heart specimen. He observed relationship between morphometry and arterial geometry of the left anterior descending (LAD) arteries. He also postulated that the local curvature

(tortuosity) correlated with the maximum thickness of tunica intima and tunica media and even due to the deposition of atherosclerotic plaque. This observation suggests that there is a significant relationship between arterial geometry and vascular morphology prior to the development of frank disease.²⁴ John LC et al., studied the anomalous origin of the posterior descending artery from the left anterior descending coronary artery verified with coronary angiography.²⁵

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