

## TERMINATION OF LEFT CORONARY ARTERY IN THE POPULATION OF ASSAM

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### ABSTRACT

Coronary heart disease is assuming epidemiological proportions, causing increasing mortality and morbidity in both developed and developing countries. Coronary arteries show wide variations in origin, course, termination and branching pattern. These have not been extensively covered in the available Anatomy text books. Failure to distinguish between normal and anomalous structures may lead to misinterpretations in diagnosis and disastrous complications during heart surgery. With the rapid strides made in cardiac care in India, an in-depth study of the coronary arteries specific to the Indian population is needed. This study therefore aims to focus on the pattern of termination of left coronary artery in the population of Assam, which is ethnically unique from the rest of India. Hundred hearts were studied in the department of Anatomy, Gauhati Medical College, Assam. The coronary arteries were examined by gross dissection. The modes of termination of the left coronary artery were noted. The left coronary artery had a length of 3-32 millimeter. It commonly bifurcated into anterior interventricular artery and circumflex artery in 60 % hearts. It showed trifurcation in 35 % and quadrifurcation in 5 % cases. The modes of termination of the anterior interventricular artery and the circumflex artery were also noted. The results of the study were compared with other authors.

**Key words:** *Left coronary artery, Termination, Bifurcation, Trifurcation, Quadrifurcation.*

### INTRODUCTION

Coronary heart disease has been defined as "impairment of heart function due to inadequate blood flow to the heart compared to its needs, caused by obstructive changes in the coronary circulation to the heart"<sup>1</sup> Coronary Artery Disease causes 25-30 % of deaths in most industrialized countries. In India, prevalence was found to be 65.4 and 47.8 per 1000 males and females respectively (urban population) and 22.8 and 17.3 per 1000 males and females respectively (rural population). WHO has described it as our modern "Epidemic"<sup>1</sup>.

Coronary arteries are known for their wide variations in origin, course, termination and branching pattern. These regional variations are not extensively covered in the available Anatomy books. This calls for a study of the coronary arteries specific to the Indian population. The present study concentrates on the modes of termination of the left coronary artery (LCA) in the population of Assam which is derived from the mongoloid race, characterized by wide and short face, projecting cheek bones, low broad nose and short stature<sup>2</sup>.

Cardiothoracic surgeons, cardiac physicians and radiologists/angiographers need to be well informed about the coronary tree and its variations. Failure to distinguish between normal and anomalous structures may lead to misinterpretations in diagnosis and disastrous complications during heart surgery.

The heart is normally supplied by two coronary arteries: Right coronary artery (RCA) and left coronary artery (LCA). The LCA is usually larger in caliber than the RCA, supplying a greater volume of myocardium. The LCA commonly bifurcates into anterior interventricular artery [left anterior descending artery] (LAD) and the circumflex artery (LCF).

### Materials and methods:

A total of 100 hearts without any obvious pathology were collected from the departments of Anatomy and Forensic Medicine. The hearts were preserved in 10% Formalin [Formalin= 40% solution of Formaldehyde in water. 10% Formalin= 10 parts formalin+ 90 parts water]. Visceral pericardium and subepicardial fat were removed. The coronary arteries and their branches were carefully dissected out and followed till their termination. Some of the arteries were painted with red fabric colour to enhance contrast. Photographs were taken. Relevant data were recorded and analyzed statistically by manual method.

### Results:

The LCA was found to originate in the left posterior aortic

sinus. No anomalous origin of the LCA was found in the present study. In all cases, the LCA arose by a single ostium. No accessory ostium was seen. No case of separate origin of LAD and LCF from the aortic sinuses was observed.

The LCA was found to pass forward, downward and to the left between the pulmonary trunk and the left auricle to reach the left coronary sulcus. It then ran for a short distance in the atrioventricular (AV) groove and terminated by dividing into 2 (most common), 3 or 4 branches. No anomalous course was observed in the present study. Length of the main trunk of the LCA in this study ranged from 3 to 32 mm.

The LCA was seen to show wide variation in termination. Most commonly, the LCA was seen to bifurcate into the LAD and the LCF in 60 hearts (60%). It showed trifurcation in 35 hearts (35%) and quadrifurcation in 5 hearts (5%). No case with 5 or more branches was found [Table 1]. The LAD passed along the anterior interventricular sulcus and terminated at the anterior aspect of apex in 12 hearts (12%), posterior aspect of apex in 58 hearts (58%) or 2-5cm up the posterior interventricular septum in 30 hearts (30%) [Table 2]. The LCF on the other hand continued along the atrioventricular sulcus. It terminated between the crux and the acute border in 11 hearts (11%), at the crux in 20 hearts (20%), between the obtuse border and the crux in 53 hearts (53%), at the obtuse border in 16 hearts (16%). [Table 3]

#### Discussion:

The left coronary ostium originates from the left aortic sinus<sup>[3]</sup>. Kimbris D et al<sup>[4]</sup> found the ostium for LCA arose below the level of STJ in 80% and at STJ level in 20% while Banchi<sup>[5]</sup> found the LCA arose at the level of the free

**Table 1: Mode of termination of Left Coronary Artery**

Mode of termination	M	F	Total (%)
Bifurcation (2 branches)	40	20	60 (60%)
Trifurcation (3 branches)	27	8	35 (35%)
Quadrifurcation (4 branches)	3	2	5 (5%)
Total	70	30	100

**Table 2: Termination of Left Anterior Descending artery**

Point of Termination	M	F	Total (%)
Anterior aspect of apex	8	4	12 (12%)
Posterior aspect of apex	44	14	58 (58%)
2-5cm up the Posterior interventricular sulcus	18	12	30 (30%)

**Table 3: Termination of Circumflex Artery**

Point of Termination	M	F	Total
Acute /Right Border	0	0	0 (0%)
Crux-acute border	6	5	11 (11%)
Crux	13	7	20 (20%)
Obtuse border - crux	40	13	53 (53%)
Obtuse / left border	11	5	16 (16%)
Total	70	30	100

**Table 4: Terminal Branches of LCA (compared with other authors)**

Authors	Bifurcation	Trifurcation	Quadrifurcation	Pentfurcation
Baptista <sup>[16]</sup>	54.7%	38.7%	5.7%	-
Cavalcanti <sup>[17]</sup>	60%	38.18%	-	-
Dhar S <sup>[18]</sup>	70%	28%	2%	-
Kalpana R <sup>[15]</sup>	47%	40%	11%	1%
Kili? C et al <sup>[12]</sup>	86%	14%	-	-
Present study	60%	35%	5%	0%

margin of the aortic cusps in 48%, above in 34% and below in 18%.

The main stem of the LCA is the largest of the main trunks and also one of the shortest among the important vessels of the body<sup>[6]</sup>. The LCA length ranges from 2 – 20 mm with 88% of the specimens having length between 6 and 15 mm<sup>[4]</sup>. In this study the LCA length ranged from 3-32 mm.

Length of the common trunk of LCA may be long (>15 mm) or short ( $\leq$  5 mm). Short trunk needs to be kept in mind specially during a perioperative coronary perfusion or coronary angiography as the catheter may enter any of the terminal branch resulting in an incomplete area of the area for drainage<sup>[7]</sup>. A short trunk may also be a risk factor for coronary arteriosclerosis or a cause of blockage in the left branch of the Bundle of His<sup>[7]</sup>.

The LCA lies between the pulmonary trunk and the left auricular appendage, emerging into the AV sulcus, in which it turns left, loosely embedded in subepicardial fat and usually has no branches. Reaching the atrioventricular or coronary sulcus, the left coronary artery divides into two or three main rami<sup>[8]</sup>.

The main LCA divides into two or more branches. The branch that enters the anterior interventricular groove, the 'anterior descending artery' is considered as the continuation of the main LCA<sup>[9]</sup>. The circumflex artery passes forwards directly under cover of the left atrial appendage and then sweeps around the left surface of the heart along the atrioventricular (coronary) sulcus<sup>[10]</sup>.

The main trunk may sometime terminate by dividing into three, four or more vessels of almost equal size. The additional arteries are called the diagonal left ventricular arteries which spread out in a fan-shaped manner over the free surface of the left ventricle. The additional artery is also termed as 'median artery'<sup>[11]</sup>. Occasionally, it may reach the apex cordis itself, or head towards the apical 2/3 of the obtuse border, until reaching the diaphragmatic surface of the left ventricle. Viallonga<sup>[7]</sup> noted three characteristics of a median artery. It originates in the vertex of the angle formed by the main terminal arteries of the LCA or in the first millimeter; it possesses substantial caliber and it extends half the way down the free wall of the left ventricle.

The caliber of the median artery may sometimes be similar to the LAD and the LCF. So stress should also be given to the median artery when looking for lesions, instead of limiting the focus only to the LAD and the LCF as involvement of the median artery may prove equally dangerous<sup>[7]</sup>.

A large area of the heart may be perfused by the median arteries. They may give arteries to the sternocostal surface of left ventricle, one or more septal arteries and arteries to the anterior papillary muscles of the left

ventricle<sup>[7]</sup>. Therefore, adequate perfusion of the median arteries is necessary. The additional branches and their anastomoses are important in collateral blood flow, especially under conditions of coronary insufficiency<sup>[12]</sup>. Angioplasty of bifurcation lesions can lead to side branch occlusion secondary to plaque shifting (snow-plow effect) and retrograde propagation of dissection from side branch to parent vessel. Percutaneous treatment of coronary bifurcation lesions is a challenging aspect of interventional cardiology, but the approach to trifurcation and quadrifurcation lesions can be considered "double jeopardy"<sup>[13]</sup> and therefore needs to be borne in mind. Angioplasty of bifurcation lesions has been commonly done. Khan et. al described a case of angioplasty in a coronary trifurcation lesion<sup>[14]</sup>.

Various authors have recorded various percentages of modes of LCA termination [Table 4]. Kalpana R<sup>[15]</sup> found penta-furcation in 1% of specimens. No case of penta-furcation was however found in the present study as well as in the studies of several other authors.<sup>[12,16,17,18]</sup>

#### CONCLUSION:

Variations in termination of left coronary artery have been observed in the population of Assam when compared to other authors. These regional variations of coronary arteries need to be borne in mind for proper interpretation of coronary angiographies and surgical myocardial revascularisation. This knowledge can

#### ILLUSTRATIONS (FIGURES)

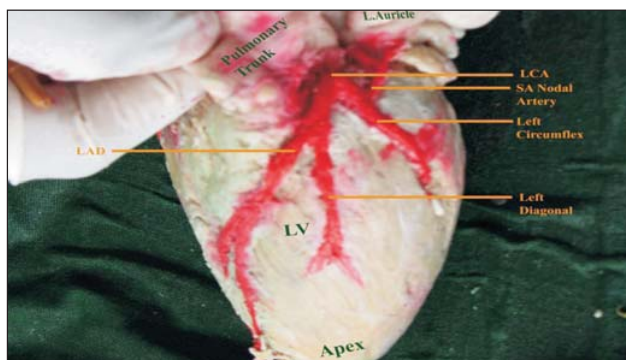
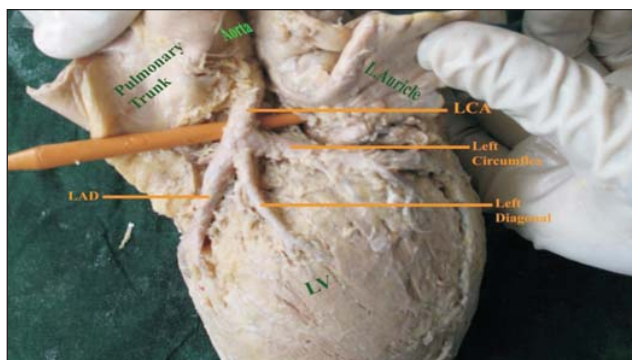
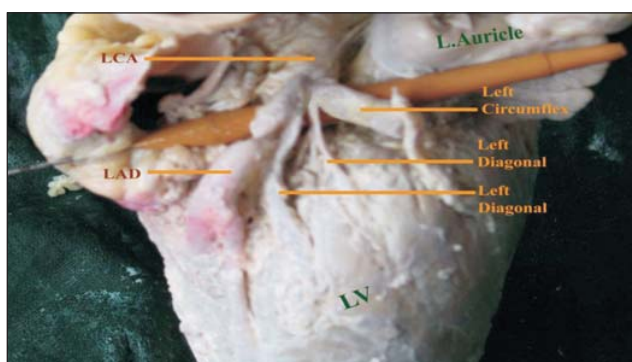


Fig 1: Photograph showing bifurcation of LCA



**Fig 2: Photograph showing trifurcation of LCA**



**Fig 3: Photograph showing quadrifurcation of LCA**

prevent many unwanted and unexpected surgical complications.

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