

## Anatomical Variation of Left Coronary Artery and its Clinical Importance



### Medical Science

**KEYWORDS :** Left coronary artery, atrioventricular groove, interventricular groove, right coronary artery

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### ABSTRACT

*Arterial supply to heart is achieved by two arteries which are the only branches from ascending aorta. These arteries branch in such a manner that they occupy atrioventricular and interventricular groove in the shape of a crown. Hence they are called the coronary arteries. Coronary arteries, as first branches of aorta, supply blood to myocardium. Coronary arteries, normally found in pairs may vary in origin, distribution, number and size. These arteries emit several branches responsible for irrigation the whole surface and interior heart tissue. This study was done to see the variations in the left coronary artery and its clinical importance. Coronary artery disease is one of the major causes of death in developed countries. The incidence of coronary artery disease is increasing today in developing countries as well, because of changing life style, urbanization, sedentary life style, hypertension, diabetes mellitus and increased type A personality. The increasing use of diagnostic and therapeutic interventional procedures necessitates that a sound, basic knowledge of the coronary artery pattern is essential. More progress has been made in the last few decades than in all foregoing medical history in management of cardiovascular disease.*

### INTRODUCTION

According to the World Health Organization (WHO), coronary heart diseases constitute the main cause of death in the industrial world. The main risk factors are lipid disorders, hypertension, diabetes, obesity, lack of physical activities and other disorders which cause functional impairment and damage to vascular cells.

Furthermore, the knowledge of normal and variant anatomy and anomalies of coronary circulation is an increasingly vital component in the management of congenital and acquired heart diseases. Congenital, inflammatory, metabolic and degenerative diseases may involve the coronary circulation and increasingly complex cardiac surgical repairs demand enhanced understanding of the basic anatomy to improve the operative outcomes.

### CORONARY ARTERIAL SUPPLY

The right and left coronary arteries arise from the ascending aorta in its anterior and left posterior sinuses. The levels of the coronary ostia are variable: they are usually at or above cuspal margins. The two arteries, LCA and RCA indicated by their name, form an oblique inverted crown, in which anastomotic circle in the atrioventricular groove is connected by marginal and interventricular (descending) loops intersecting at the cardiac apex.

### LEFT CORONARY ARTERY

It arises from the left posterior (left coronary) aortic sinus; the ostium is below the margin of the cusps. The artery lies between the pulmonary trunk and the left atrial auricle, emerging into the atrioventricular groove, in which it turns left. This part is loosely embedded in subepicardial fat and usually has no branches, but may give off a small atrial ramus and, rarely, the sinoatrial nodal artery. Reaching the atrioventricular groove, the left coronary divides into two or three main branches: the anterior interventricular (descending) artery is commonly described as its continuation. This artery descends obliquely forward

and to the left in the interventricular groove, sometimes deeply embedded in or crossed by bridges of myocardial tissue, and by the great cardiac vein and its tributaries.

However, more often it turns round the apex into the posterior interventricular groove, and passes one-third to one-half of the way along its length, where it meets the terminal twigs of the posterior interventricular (descending) branches of the right coronary artery. The anterior interventricular (descending) artery produces right and left anterior ventricular and anterior septal branches, and a variable number of corresponding posterior branches. Anterior right ventricular branches are small and rarely number more than one or two; the right ventricle is supplied almost wholly by the right coronary artery.

### MATERIALS AND METHODS:

**Study Area and population:** The population selected for the proposed work is from eastern part of U.P. and surrounding states including western Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh Nepal. Most of the heart specimen collection from the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, which came within Jurisdiction of Varanasi District. Other half of specimen was collected from the preserved Cadavers in the Department of Anatomy, Institute of Medical Sciences, and Banaras Hindu University.

CT scan, heart angiography was taken from the Department of Radiology, Institute of Medical Sciences, and Banaras Hindu University. For all the Specimen Collected as well as Angiography, Inform consent form the patient/ minor next to kin were taken.

Conventional Angiography of patients from the Department of Cardiology was taken along with their personal history.

**Sample Size:**

Data for present study consisted of 35 hearts collected from cadavers from anatomy department unclaimed dead body from the forensic department and 70 CT angiogram and 26 conventional angiogram from the Department of radiology and department of cardiology respectively were taken.

**Table 1: Classification of coronary arterial abnormalities**

Anomalies of origin	1. Number of ostia Multiple (>2), single 2. Anomalous location of ostium in the appropriate coronary sinus 3. Origin from opposite coronary sinus 4. Origin from noncoronary sinus 5. Origin from pulmonary artery 6. Abnormalities of angle of origin
Anomalies of course (normal origin)	1. Myocardial bridging 2. Duplication
Anomalies of termination	1. Coronary artery fistula 2. Coronary arcade 3. Extra cardiac termination
Intrinsic coronary arterial abnormality	1. Coronary stenosis 2. Atresia 3. Ectasia/aneurysm

We evaluated the coronary artery of heart by anatomical dissection and angiographic record by observing the following parameters

1. Termination of right coronary artery.
2. Termination of left circumflex artery.
3. Termination of Left anterior interventricular artery.
4. Termination of posterior interventricular artery.
5. Origin of posterior interventricular artery (dominance).
6. Origin of SAN and AVN nodal artery.
7. Branching pattern of right coronary artery.
8. Branching pattern of left coronary artery.
9. Diameter of Left coronary artery (LCA) Right coronary artery (RCA). Left circumflex artery (LCx) and Left interventricular artery (LIVA) at its origin.
10. Myocardial bridging in the course of anterior interventricular artery

**CT Angiography:**

**Patient's preparation:**

The patients were asked to fast for a minimum of 4 hours prior to the CT examination. The renal function tests of the patients are checked before the doing the CT. 18G IV cannula for adult 20G -22G IV cannula for children was placed preferably in the leg veins or the antecubital vein injection for the contrast.

**Machine:**

CT angiography was carried out with GE (General Electric) Light Speed VCT 64 slice MDCT machine and adw 4.4 version advantage workstation.

**Subject selection:**

Short term prospected study having groups of patients of age rang 25-76 year (mean 65 ± 9 years).

**Inclusion criteria:**

- Patients with atypical chest pain.
- Non pathologic stress ECG finding.

**Exclusion criteria:**

- History of contrast allergy.
- Reactive airway disease.
- Atrial fibrillation.
- Very low cardiac output states.
- Impaired renal function.

**Protocol and Technical Parameters:**

Detector collimation	: 64 × 0.6 mm
Pitch	: 0.984 mm
Gantry rotation time	: 0.4 sec
Tube voltage	: 120 Kv
Tube current	: 400 mA (Adult) 220 mA (Paediatrics)
Table feed	: 55 mm per tube rotation
Slice thickness	: 0.625 mm
Interslice interval	: 0.625 mm

**Coronary angiography may be done if you have:**

- Angina for the first time
- Angina that is becoming worse, not going away as fast, occurring more often, or happening at rest (called unstable angina)
- Aortic stenosis
- Atypical chest pain, when other tests are normal
- Had an abnormal heart stress test
- To have surgery on your heart and you are at high risk for coronary artery disease.
- Heart failure
- Recent heart attack

**DISCUSSION**

Branches of coronary arteries may vary in origin, distribution, number and size. The name and nature of a coronary artery or a branch is defined by that vessel's distal vascularization pattern or territory, rather than by its origin. The location, level and size of the ostium is very important in the successful performance of a coronary angiogram.

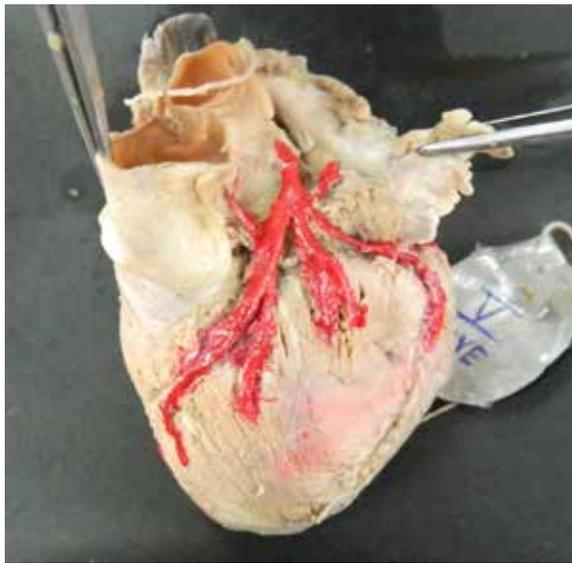
In present study the left coronary ostia were present at the left posterior aortic sinus respectively in all the specimens studied and there were no variations in the location of the ostia which was in contrast to previous study where two cases were observed having double openings in the left posterior sinus, one in each of the two branches of the left main coronary artery. In our study, the main trunk of LCA showed 64% cases of bifurcation, 32% cases of trifurcation and 4% tetrafurcation. Previous studies have reported wide variation in LCAT branching and have found a greater prevalence of bifurcated expression. Our results (64% of this type) coincided with previous reports indicating 40–70% although this was greater than that reported by the trifurcated division (with the addition of a Diagonal Branch) observed in this work (32%) was in an intermediate range in relation to previous reports giving a frequency of 20–50%.

Left coronary distribution is reciprocal, and includes most of the left ventricle, a narrow strip of right ventricle, the anterior two-thirds of the interventricular septum and most of the left atrium. As noted variations in the coronary arterial system mainly affect the diaphragmatic aspect of the ventricles; they consist of the relative 'dominance' of supply by the left or the right coronary artery.

The presence of collateral irrigation in the obtuse face of the heart, with Circumflex Branch or Anterior Interventricular Branch diagonals or collaterals, could respond to vascular compensation for a greater territorial demand in irrigation because of deficiency in the larger arteries.

The prevalence of coronary heart disease had increased rapidly from 1% in 1960 to 9.7% in 1995 in urban population (Mandal S, 2009). Even in rural population the prevalence has doubled in the last decade. The hearts having Left dominance are more susceptible for coronary artery disease than the right dominance (Kumar K, 2007). Hence it can be concluded that anatomical factors are less responsible for development of coronary artery disease in our population.

The cases of anatomical evaluation showed tetrafurcation of about 11.4% and pentafurcation in 2.85% (1case). No any case of tetrafurcation and pentafurcation on radiological evaluation was observed.



**Fig. 1: Left coronary artery showing trifurcation.**

## RESULT:

### Division of Main Trunk of Left coronary artery

The main trunk of Left coronary artery on anatomical evaluation has no single branching pattern. In 18 cases bifurcation(13 male,5 female),trifurcated (fig.1) in 12 specimen (10 male, 2 female), quadrifurcated in 4 specimen( 4 male, 0 female) and pentafurcated in one (male).The percentage of branching pattern of LCA in bifurcation pattern was 51.42%,trifurcation 37.14%,quadrifurcation 11.42%,pentafurcation in 2.85%.

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