

Original Article

CLINICAL IMPORTANCE OF LEFT CORONARY ARTERY AND ITS VARIATION

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ABSTRACT

The Arterial supply of the heart is by two arteries which are the only branches from ascending aorta. The arteries branch in and occupy atrioventricular and interventricular groove in the shape of a crown. Hence they are called the coronary arteries.

Coronary arteries supply blood to myocardium. Coronary arteries, are normally found in pairs may vary in origin, distribution, number and size. They are responsible for irrigation of the whole surface and interior heart tissue.

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. Therefore the present study was undertaken to see the variations in the left coronary artery and its clinical importance.

Key words: Left coronary artery, Atrioventricular groove, Interventricular groove, Right coronary artery.

INTRODUCTION

According to the World Health Organization (WHO)[1] 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.[1]

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.[2]

CORONARY ARTERIAL SUPPLY

The arterial supply of the heart is by coronary arteries branches from ascending aorta. The branches

of the coronary arteries simulating the shape of crown, hence they are called the coronary arteries.

Coronary arteries, are normally found in pairs may vary in origin, distribution, number and size. 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.[2]The location, level and size of the ostium is very important clinically for the successful performance of a coronary angiogram.[3]

The right and left coronary arteries arises from the ascending aorta in its anterior and left posterior aortic sinuses. The levels of the coronary ostia are variable: they are usually at or above cuspal margins. The two arteries, left coronary artery(LCA) and right coronary artery (RCA) form an oblique inverted crown, in which anastomotic circle in the atrioventricular groove is connected by marginal and

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interventricular (descending) loops intersecting at the cardiac apex. [2]

LEFT CORONARY ARTERY

It supplies a greater volume of myocardium, including almost all the left ventricle and atrium.[4]It arises from the left posterior (left coronary) aortic sinus. The artery lies between the pulmonary trunk and the left atrial auricle, emerging into the atrioventricular groove, in which it turns left.[4]This part is loosely embedded in subepicardial fat and usually has no branches, but may give off a small atrial ramus and, rarely, the sino atrial nodal artery. [4]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.[4]

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. [4]

MATERIALS AND METHODS:

Study Area and population: The population selected for the proposed work was from eastern part of U.P. The heart specimens were collected from the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi. Few other specimens were collected from the preserved Cadavers in the Department of Anatomy and Department of Radiology. Data for present study consisted of 35 hearts specimen and 70 CT angiograms.

We evaluated the coronary artery of heart by anatomical dissection 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. Branching pattern of right coronary artery.
7. Branching pattern of left coronary artery.
8. Myocardial bridging in the course of anterior interventricular artery

OBSERVATIONS

Origin of Left and Right coronary artery

In all 35 anatomical heart specimens, the right coronary artery originates from right anterior aortic sinus and the left coronary artery originates from the left posterior aortic sinus. There is no anomalous origin of either right or the left coronary artery.

Out of 70 radiological specimens, in 70 cases the left coronary artery originates from the left posterior aortic sinus, whereas in 69 cases the right artery originates from right anterior aortic sinus and in 1 case, the right artery originates from upper branch of LAD.(Table 1)

Length of right and left coronary artery:

The mean length of the right coronary artery is 71.5 mm whereas the mean length of left coronary artery is 150 mm.(Table 2)

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) (Table 3, Fig 1,2,3,4,8), trifurcated (Table 3, Fig. 1,2,3,5) in 12 specimen(10 male,2 female), quadrifurcated in 4 specimen(4 male, 0 female) (Table 3, Fig. 1,2,3,6)and pentafurcated in one(male) (Table 3, Fig. 1,2,3,7).The percentage of branching pattern of LCA in bifurcation pattern was 51.42%,trifurcation 37.14%,quadrifurcation 11.42%, pentafurcation in 2.85%.The same braching patter

was observed in the radiological scans wherein (Table 3) no quadrification of pentafurcation was observed

Table 1 : The origin of the coronary arteries from the aorta

S. N.	Radiologically or Anatomically	Right coronary artery from the Right aortic sinus (Nos.)	Left coronary artery from the left aortic sinus (Nos.)	Anomalous origin if any
1.	Anatomically	35	35	0
2.	Radiologically	69	70	1

Table 2 : Length in mm of the right and left coronary artery

S. N.	Length of the right coronary artery (mean in mm)	Length of the left coronary artery (mean in mm)
1.	71.5	150

Table 3 : Division of main Trunk of Left Coronary artery (LCA) by anatomical study and radiological study

Branching Pattern of LCA	ANATOMICAL (A)		RADIOLOGICAL (R)	
	Male	Female	Male	Female
Bifurcation	13	5	38	15
Trifurcation	10	2	11	6
Quadrification	4	0	0	0
Pentafurcation	1	0	0	0
	28	7	49	21

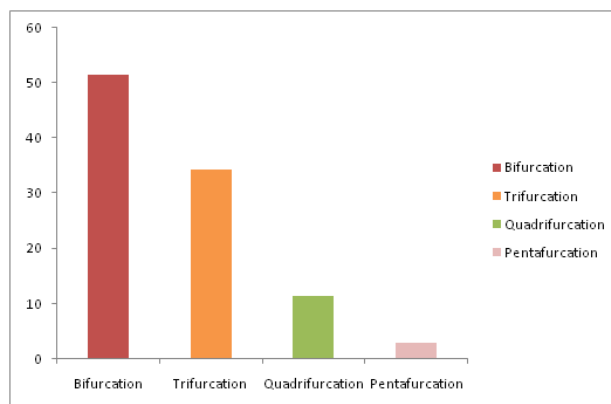


Figure 1 : Bar diagram representing anatomical study branching pattern of left coronary artery

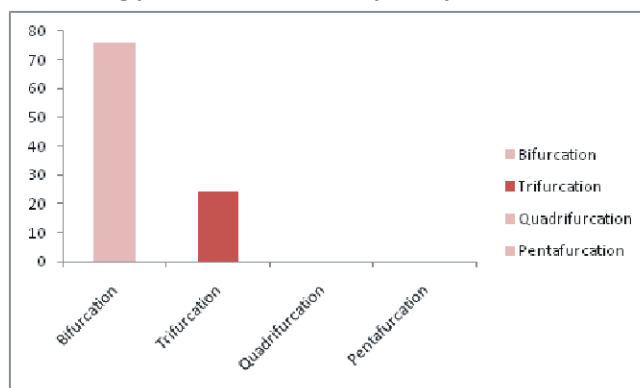


Figure 2: Bar diagram representing radiological study for branching pattern of left coronary artery

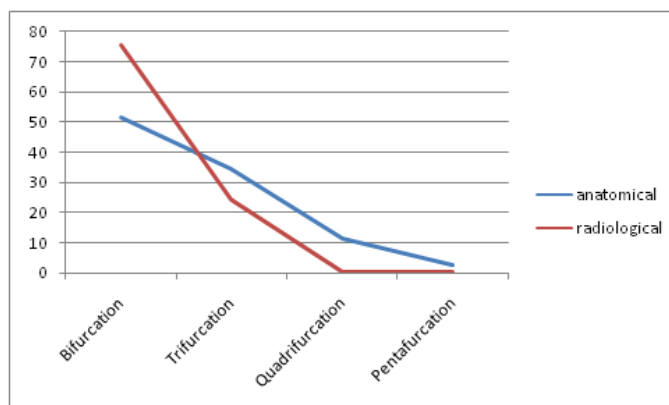


Figure 3: Line diagram showing comparison between anatomical and radiological study for the left coronary artery

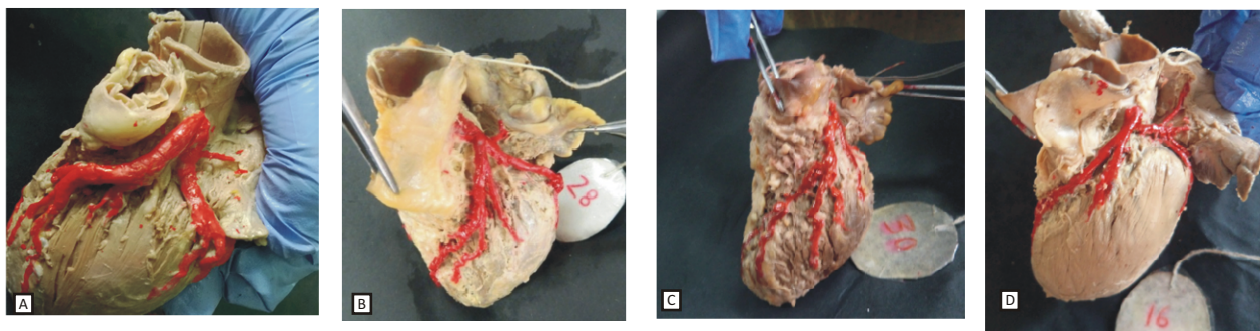


Figure 4: Branching pattern of the left coronary heart in dissected heart

A-bifurcation of left main coronary artery into left anterior interventricular artery and left circumflex artery with anterior atrial branch; **B,C-** Bifurcation of left main coronary artery into left anterior interventricular artery and left circumflex artery, left anterior interventricular artery with two diagonal branch; **D-** Bifurcation of left main coronary artery into left anterior interventricular artery and left circumflex artery, left anterior interventricular artery with one diagonal branch, left circumflex artery with SA nodal and atrial branch.

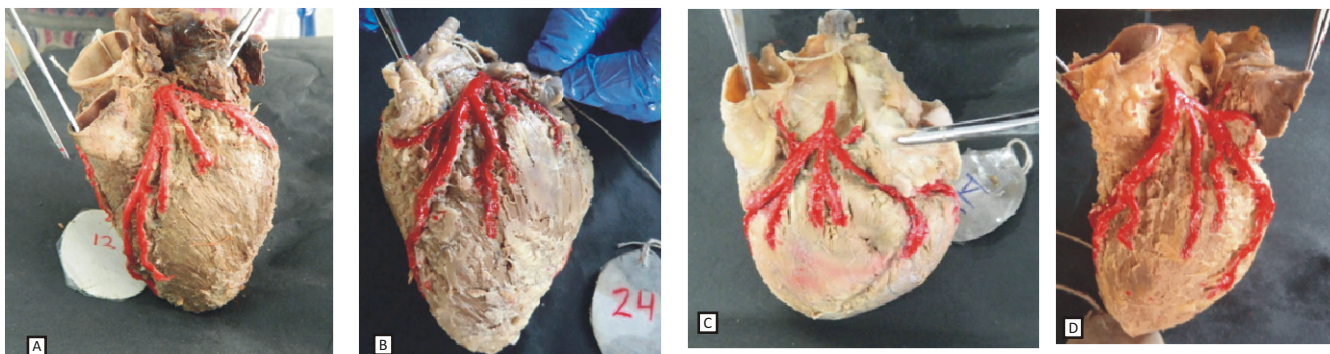


Figure 5: Photograph of dissected heart showing branching pattern of the left main coronary artery **A,B-**Left main coronary artery dividing into left anterior interventricular artery, left circumflex artery and ramus intermedius (median artery) arteries. **C-** Left main coronary artery into left anterior interventricular artery, left circumflex artery, bifurcated ramus intermedius. **D-** left main coronary artery with left interventricular artery with diagonal branch, ramus intermedius, left circumflex coronary artery with obtuse marginal branch.

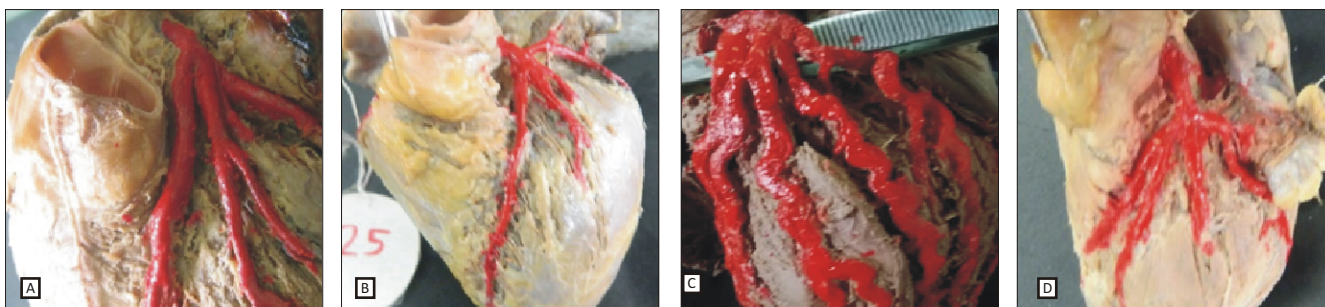


Figure 6: Photograph of dissected heart showing branching pattern of left main coronary artery **A,B,C,D-** Quadrifurcation of left main coronary artery into left anterior interventricular artery, left circumflex artery and two diagonal artery arising directly from left coronary artery.



Figure 7 : Photograph of dissected heart showing pentafurcation of left main coronary artery.



Figure 8 : Photograph of CT angiogram showing normal course of left coronary artery dividing into left anterior descending artery and left circumflex artery.

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.

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.[5] 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%.[6,7,8,9,10,11]

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.[12] 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% (1 case). No any case of tetrafurcation and pentafurcation on radiological evaluation was observed.

Other similar studies (on dissection) had shown various percentage of branching pattern of left coronary artery like Bapista, 1991 (bifurcation-54.7%, trifurcation-38.7%, quadrification-6.7%), Kalpana, 2003 (one branch-1%, bifurcation-47%, trifurcation-40%, quadrification-11%, pentafurcation-1%), Ortale 2005 (bifurcation- 50%, trifurcation-46%, quadrification-4%), Fazliogullari 2010 (bifurcation-

46%, trifurcation- 44%, quadrification-10%), in our study (bifurcation- 51.42%, trifurcation-34.28, tetrafurcation-11.4%, pentafurcation-2.85%).

Based on the evidence by the present study it may be suggested that no striking difference exist between the anatomical and radiological study. The study further assists in the knowledge of normal and variant anatomy and anomalies of coronary circulation which is a vital component in the management of congenital and acquired heart diseases.

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