

## BRANCHING PATTERNS OF LEFT CORONARY ARTERY AMONG NORTH INDIANS

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### SUMMARY

The left coronary artery displays variations in pattern, number and distribution of its branches. These variations influence the manifestation and extent of the coronary artery disease affecting the left main branch. A total of 100 North Indian cadaveric hearts were dissected to observe the main trunk of the left coronary artery. The main trunk of left coronary artery bifurcated, trifurcated and quadrifurcated in 66%, 30% and 4% of cases respectively. The high degree of variability of left coronary artery and its branching patterns have anatomical, pathophysiological diagnostic and therapeutic implications. Adequate knowledge of these variations with regard to source, and incidence is important for the interpretation of coronary angiography, stenting procedures and surgical myocardial revascularization.

**Key words:** Left coronary artery, variability, branching patterns.

### INTRODUCTION

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 (Kalpana, 2003).

Since the 1960s when cineangiography and coronary arteriography were developed, imaging of the coronary circulation in many thousands of people has demonstrated, that there is huge spectrum of variation in the disposition of the coronary arteries (Allwork SP, 2004). Coronary artery variations including origin, as a cause of coronary heart disease are gaining consideration in the diagnostic workup in clinical conditions such as sudden death (Basso et al., 2000). Hence the need to establish diagnostic screening protocols for athletes and other young individuals subjected to extreme exertion (Ottaviani et al., 2008). It is desirable to determine the incidence of the variations, which are potentially capable of inducing sudden cardiac death, in order to analyze the value of screening (Loukas et al., 2009).

The present study intends to establish the branching patterns for the left coronary artery in North Indians. Though the variations in branching pattern have been reported for other parts of India and world, the incidence has not been reported for North Indians. This knowledge has significance as these variations have anatomical, pathophysiological diagnostic and therapeutic implications.

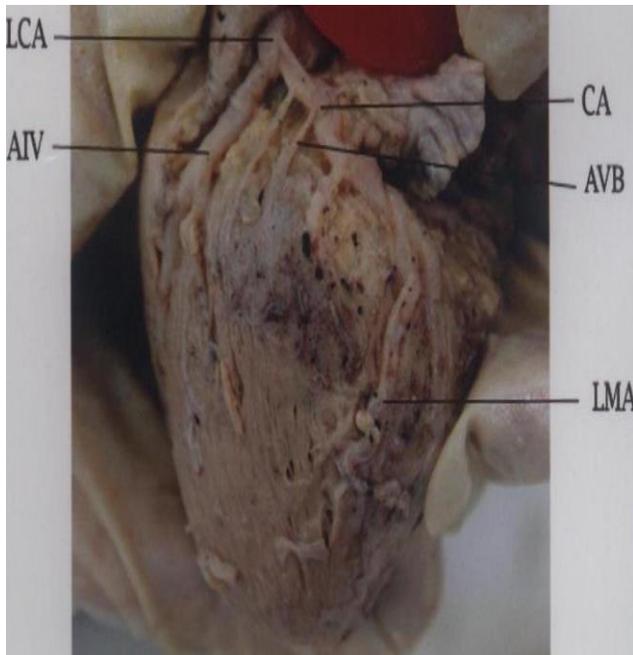
### MATERIAL & METHODS

The 100 specimens were obtained from Department of Anatomy at Government Medical Colleges of Punjab, India. These specimens were fixed in 10% formalin and the visceral pericardium was removed to expose the coronary arteries. The left coronary artery was

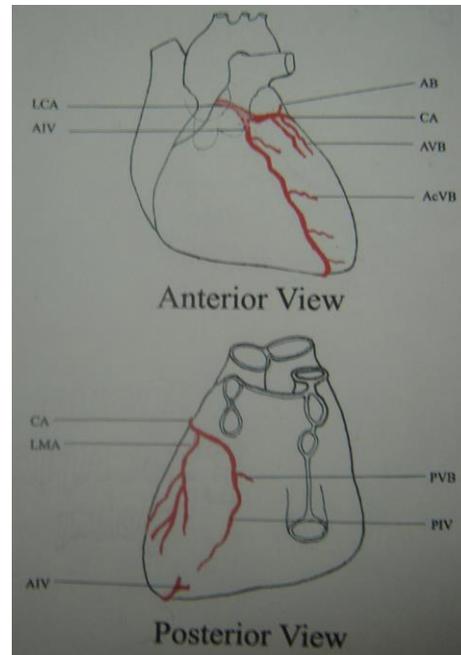
dissected out carefully to avoid damage to small branches. The variations in branching pattern of left coronary artery were noted at subepicardial level. A drawing of each artery was made and each specimen was photographed. The data was collected, analyzed and compared with available data.

## RESULTS

The main trunk of Left coronary artery bifurcated in 66 specimens (66%), trifurcated in 30 specimens (30%) and quadrifurcated in 4 specimens (4%). During bifurcating (Figure 1) the left coronary artery gave the anterior interventricular (AIV) and circumflex coronary arteries (CA). In trifurcation (Figure2) the LCA gave the AIV, CCA and an additional branch, the diagonal artery (DA). Samples showing quadrifurcation, (Figure3) the LCA gave the AIV, CCA and two Diagonal arteries.

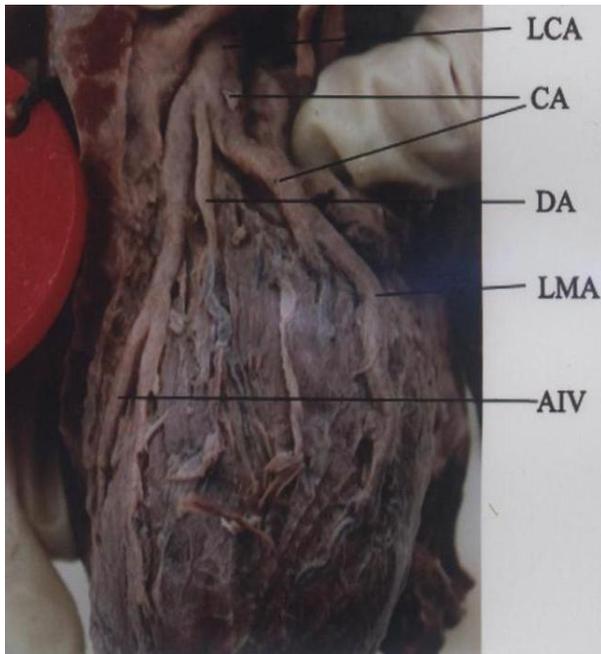


**Fig 1a:** Bifurcation pattern

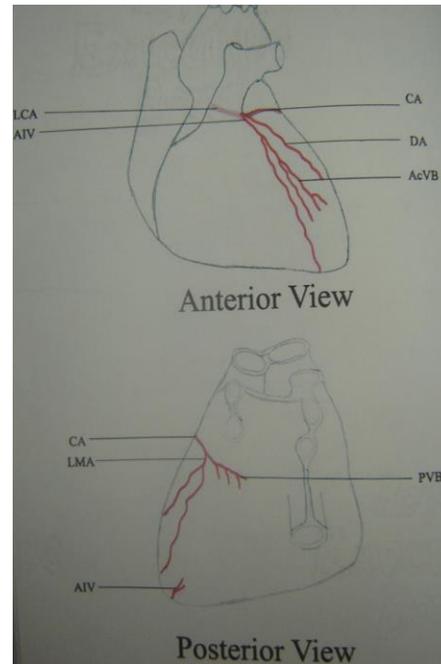


**Fig 1b:** illustrated bifurcation pattern

**LCA**-Left coronary artery; **AcVB**-Acute ventricular branch, **AIV**-Anterior interventricular artery; **AB**-Atrial branch; **LMA**-Left marginal artery; **PVB**-Posterior ventricular branch **AVB**-Anterior ventricular branch; **PIV**-Posterior interventricular branch; **CA**-Circumflex artery.

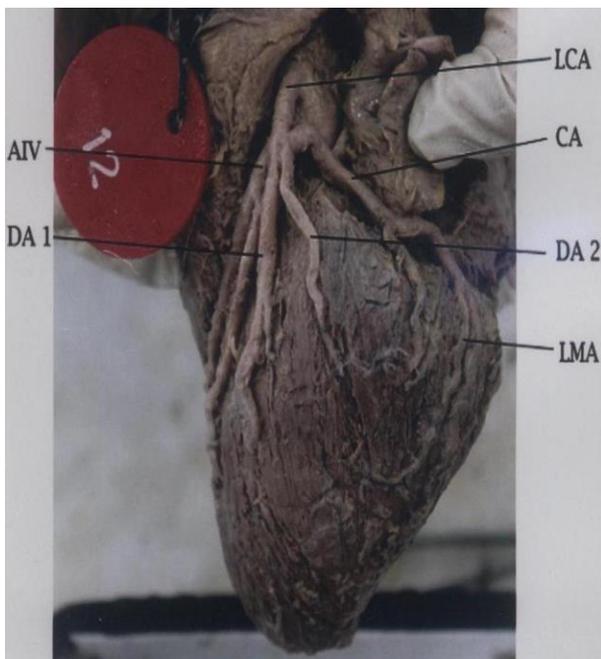


**Fig 2a:** Trifurcation pattern.

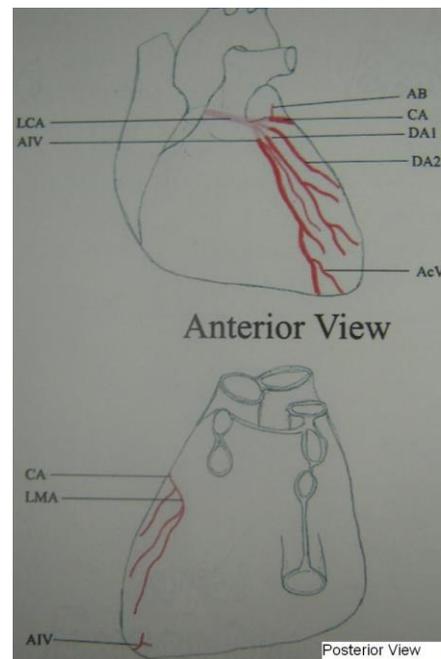


**Fig 2b:** Illustrated trifurcation pattern.

**LCA**-Left coronary artery; **AcVB**-Acute ventricular branch; **AIV**-Anterior interventricular artery; **PVB**-Posterior ventricular branch; **LMA**-Left marginal artery; **DA**-Diagonal artery; **CA**-Circumflex artery.



**Fig 3:** Quadrification pattern.



**Fig 3:** Illustration of the quadrification pattern.

**LCA**-Left coronary artery; **AB**-Atrial branch; **AIV**-Anterior interventricular artery; **AcVB**-Acute ventricular branch; **LMA**-Left marginal artery; **DA1**-Diagonal artery1; **DA2**-Diagonal artery2; **CA**-Circumflex artery;

The comparison of the branching pattern of Left coronary artery in North Indians vis-à-vis the earlier reports is depicted in Table1.

Table1: Showing comparison of branching pattern of Left coronary artery with previous studies

Authors , Year and Number of cases(n)	1 branch (%)	Bifurcation (%)	Trifurcation (%)	Quadrification (%)	Pentafurcation (%)
Bapista(1991) n=150	-	54.7	38.7	6.7	-
Kalpana (2003) n=100	1	47	40	11	1
Surucu (2003) n=40	-	47.5	47.5	2.5	2.5
Reig and Petit (2004) n=100	-	62	38	-	-
Lujinovic et al(2005) n=20	-	65	35	-	-
Ortale (2005) n=20	-	50	46	4	-
Ballesteros and Ramirez (2008) n=154	-	52	42.2	5.8	-
Fazliogullari et al (2010) n=50	-	46	44	10	-
Present Study (2013) n=100	-	66	30	4	-

## DISCUSSION

Results of the present study are consistent with earlier reports that 40—70% of the LCA trunks bifurcate [Table 1] (Lujinovic and Ovcina, 2009; Reig and Petit, 2004; Fazliogullari et al., 2010). Trifurcation of the LCA is less common and lowest reported among Indians [Table 1] (Surucu et al., 2004; Lujinovic and Ovcina, 2005). The wide range in frequency of trifurcated division can be explained by the different approaches used for defining the Diagonal branch. The Diagonal

branch may be considered to be the artery located in the angle formed by the Anterior interventricular artery and Circumflex branch whereas a broader approach envisages that the Diagonal branch originates in the vertex of the angle formed by the terminal branches of the Left coronary artery or in the initial millimeters of the Anterior interventricular artery and Circumflex branch.

Left main trifurcation coronary artery disease stenting is a challenging and complex percutaneous procedure (Shammas et al, 2007). As such adequate understanding and knowledge of the trifurcation pattern is vital for success of the procedure.

The frequency of Left coronary artery trunk quadrifurcation in present study of 4% is in consonance with earlier reports (Lujinovic and Ovcina, 2009; Kalpana, 2003). Congenital abnormalities of the coronary arteries are an uncommon but important cause of chest pain and, in some cases of hemodynamically significant abnormalities, sudden cardiac death. The present study on branching patterns and their percentage incidence North Indians provides vital inputs invaluable in making a correct diagnosis and planning patient treatment. The high degree of variability of left coronary artery and its branching patterns have anatomical, pathophysiological diagnostic and therapeutic implications. Adequate knowledge of these variations with regard to source, and incidence is important for the interpretation of coronary angiography, stenting procedures and surgical myocardial revascularization.

## REFERENCES

1. Allwork SP. 1987. The applied anatomy of the arterial blood supply to the heart in man. *J Anat.* 153:1-16.
2. Ballesteros Le, Ramirez LM. 2008. Morphological expression of left coronary artery-A direct anatomical study. *Folia Morphol.* 67(2):135-42.
3. Baptista C.A, Didio L.J. ,Prates J.C.1991.Types of division of the left coronary artery and the ramus diagonalis of the human heart. *Japanese Heart Journal.* 32(3):323-35.
4. Basso C.,Maron B.J.,Corrado D.2000,Thiene G. Clinical profile of congenital coronary anomalies with origin from the wrong aortic sinus leading to sudden death in young competitive athletes. *J Am Coll Cardiol.* 35: 1493-501.
5. Fazliogullari Z,Karabulut A.K,Unver Dogan N.,Uysal I.2010.Coronary artery variations and median artery in Turkish cadaver hearts.*Singapore Med J.* 51(10):775-80.
6. Kalpana R.2003.Astudy of principal branches of coronary arteries in humans.*J Anat Soc. India.* 52(2):137-40.
7. Loukas M., Groat C.,Khangura R. ,Owens D.G. ,Anderson R.H.2009. The normal and abnormal anatomy of the coronary arteries. *Clin Anat.* 22: 114-28.
8. Lujinovic A , Ovcina F,Voljevica A,Hasanovic A.2005.Branching of main trunk of left coronary artery and importance of her diagonal branch in cases of coronary insufficiency.Bosn. *J Med Sci.* 5(3):69-73.
9. Lujinovic A, Ovcina F.2009.Variations in branching pattern of main trunk of left coronary artery and importance of her left diagonal branch. *Journal of medical faculty university of Sarajevo,Bosnia and Herzegovina.* 44(1-suppl):32.
10. Ortale JR.,Filho JM.,Paccola AMF, Garcia LJGP, Scaranari CA.2005.Anatomy of the lateral, diagonal and anterosuperior arterial branches of left ventricle of the human heart. *Revista Brasileira de Cirurgia Cardiovascular.* 20(2):50.

11. Ottaviani G., Lavezzi AM, Maturri L.2008 Sudden unexpected death in young athletes. Am J Forensic Med Pathol. 29: 337-39.
12. Reig J, Petit M.2004.Main trunk of the left coronary artery:Anatomic study of the parameters of clinical interest. Clin Anat. 17(1):6-13.
13. Shammass NW.,Dippel E.J.,Avila A.,Gehbaur L.,Farland L.,Brosius S.,Jerin M.,Winter M.,Stoakes P.,Byrd J.,Majetic L., Shammass G.,Sharis P.,Robken J.2007. Long-Term Outcomes in Treating Left Main Trifurcation Coronary Artery Disease with the Paclitaxel-Eluting Stent. The Journal of Invasive Cardiology .Vol. 19( 2).77-82.
14. Surucu H.S., Karahan S.T., Tanyeli E.2004. Branching pattern of left coronary artery and an important branch .The median artery. Saudi Med J. 25(2):177-81.