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Original Article

Variation In Branching Patterns Of Left Coronary Artery And Its Surgical And Clinical Significance

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ABSTRACT:

***Background*:** Heart is one of the important vital organ of human body. It pumps blood to all tissues of the body and heart itself is supplied by coronary arteries. The detail study of coronary circulation is very important as now a day there are increase in various life style diseases like diabetes and hypertension which affects health of heart. Along with this the deep and profound knowledge of coronary arteries variation is very important in surgical management of various serious and life threatening congenital heart diseases. Myocardial infarction is due to atherosclerotic blockage of branches of coronary arteries. So in this study we find out the detailed branching pattern of the Left coronary artery and its clinical and surgical impact on human health.

Material and method: This study was done in department of anatomy Government Medical College, Gondia, Maharashtra, India. 50 heart specimens were collected from cadavers. With the help of fine forceps the left coronary artery and its branches were traced and photographs were taken.

***Result*:** In this study bifurcation of left coronary artery was found in 68%, trifurcation in 20% and tetrafurgation in 10% and pentafurgation in 2% of hearts.

***Conclusion*:** This study the variation in branching pattern of left coronary artery are very much valuable and helpful for cardiologist, cardio surgeon for various interventional and diagnostic procedures like angiography, angioplasty, stent surgeries and Cardiac revascularization procedures.

Keywords: Coronary arteries, left anterior interventricular, left circumflex, left diagonal, left marginal, variations,

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I. INTRODUCTION

The word "coronary" is derived from Latin word it also refers to Crown like arrangement of all coronary arteries as they encircle the heart in atrioventricular sulcus .Heart is one of the a precious organ of our body and nourishment of such an important organ is also precious and it is done by group of arteries called as coronary arteries. Coronary artery variation were formerly regarded as having slight clinical significance but today recognition of coronary artery variations are significant because by the end of year 2020, 1/3 rd population of India died due to various types of heart diseases. Now a day lots of corrective surgeries are available and presence of some even minor variation may lead to considerable increased in mortality and morbidity when by mistake such variations may encounter during the surgery. Coronary artery variation study also gain attention due to sudden death in some players and athletes due to over exertion and overload on hearts.
With the advent of coronary bypass surgery and angioplasty the knowledge of variation of coronary arteries is important for various interventional diagnostic procedures like angiography It is imperative that cardiac surgeon and cardiologist should have prior knowledge of these variations and what will be the impact and the role of these variations in various heart diseases.

II. MATERIAL AND METHOD

This study was done in department of anatomy Government Medical College, Gondia, Maharashtra. 50 heart specimens were collected from cadavers of both genders having age between approx. 25 to 70 yrs. The specimens were fixed in 10% formalin. Each heart was numbered 1 to 50 serially. After excision of adipose tissue and visceral pericardium, the left coronary artery and its branches were meticulously traced with the help of fine forceps. The origin of left coronary artery from the aorta is noted and the course of anterior interventricular and left circumflex and any other additional branches were studied carefully. The hearts were photographed and rough sketch of branches of left coronary artery were taken out. The data was collected, analyzed and compared with other Scientists findings.

III. OBSERVATIONS

The left coronary artery normally takes origin from the left posterior aortic sinus it arises from within the Sinus or from the synaptic junction, its initial stem lies between the pulmonary trunk and the left auricular appendage and then travels into the left atrioventricular sulcus. Usually left coronary artery divides into anterior interventricular and circumflex arteries. Other then this type of branching pattern of coronary arteries following type of variations are observed in this study
1. When left coronary artery divides into anterior interventricular and circumflex artery**.** It is said to be a bifurcating. Normally this type of division is found abundantly in many hearts in human. In this study bifurcation was observed in 34 hearts (68%)

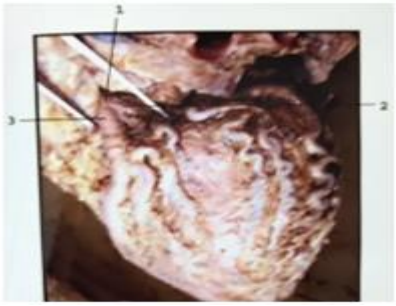

Fig 1A

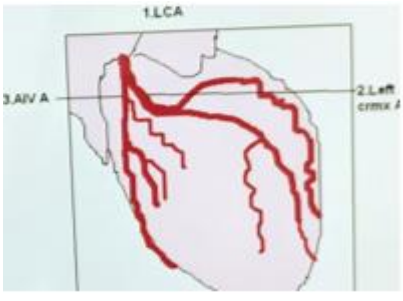

Fig1B

1. Left coronary artery LCA
2. Left anterior interventricular artery AIVA
3. Left circumflex artery LCrmxA

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2. In trifurcation along with the anterior interventricular and circumflex artery, third artery called as left diagonal artery arises from the from left coronary artery Figure number 2A to 2B.
In this study along with this a rare variation of trifurcation is observed. The LCA divides into anterior interventricular artery and left circumflex artery which after its origin trifurcates into 3 marginal arteries. Figure number 3A to 3B In this study in 10 hearts (20%) trifurcation was observed.

Figure number 2A to 2B

Fig 2A

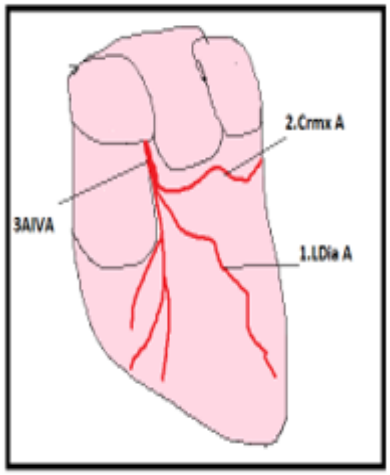

Fig 2B

1. Left diagonal Artery Ldia
2. Left anterior interventricular artery AIVA
3. LCA Left coronary artery LCA

Figure number 3A to 3B

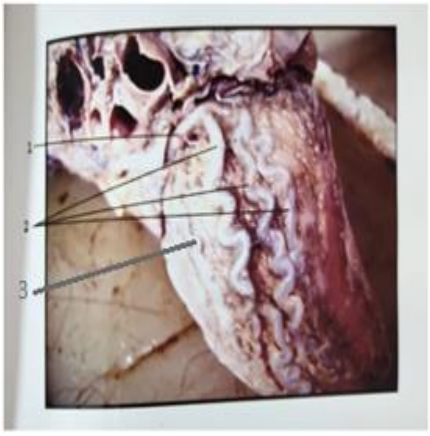

Fig 3A

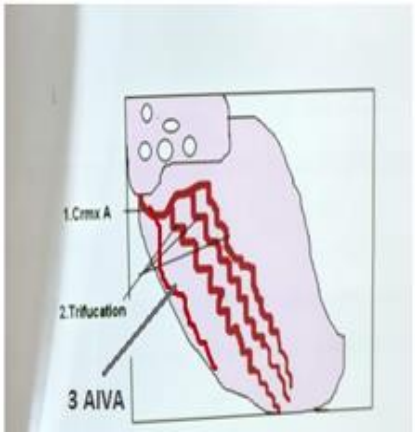

Fig 3B

1. Left circumflex artery
2. Trifurcation of LCrmx into left diagonal and left marginal arteries
3. Left Anterior interventricular artery

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In this study tetrafurcation was observed in 5 hearts (10%). Left coronary artery (LCA) after its origin from aorta divides into left anterior interventricular artery (AIVA), left diagonal Artery (LdiaA), Left circumflex artery (LCrmxA) and left marginal artery (LM) ,
Figure number 4A to 4B
showing Tetrafurcation of LCA

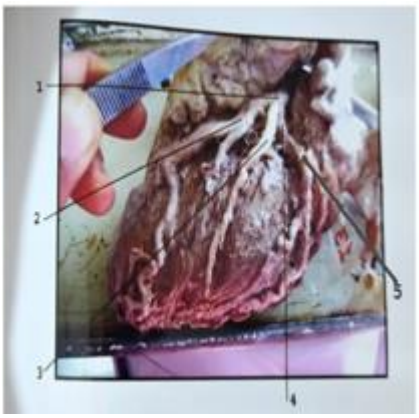

Fig: 4A

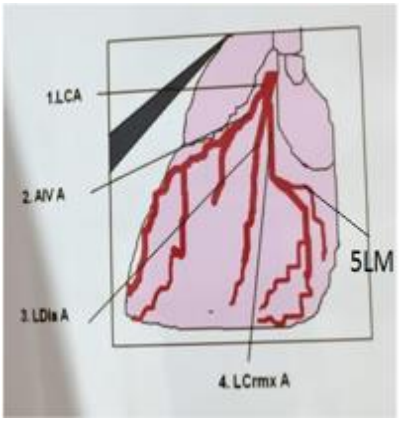

Fig : 4B

1. LCA Left coronary artery LCA
2 .Left anterior interventricular artery AIVA
3. Left diagonal Artery Ldia
4. Left circumflex artery LCrmxA
5. left marginal artery LM

In this study pentafurcation was observed in 4 hearts (2%) Left coronary artery (LCA) after its origin from aorta divides into two left anterior interventricular artery AIVA2, left diagonal Artery (Ldia), Left circumflex artery (LCrmxA) and left marginal artery (LM)

Fig 5A

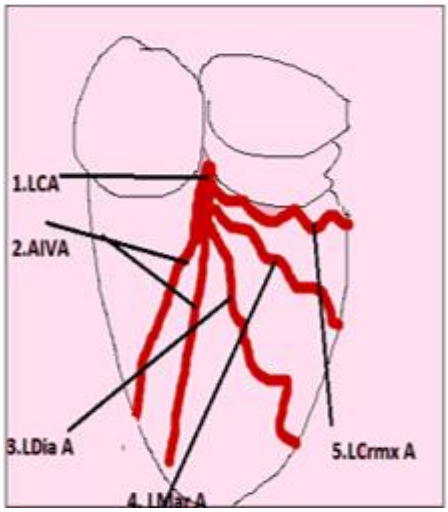

Fig 5B

1.LCA Left coronary artery LCA
2.Dual Left anterior interventricular artery AIVA
3. Left diagonal Artery Ldia
4. Left circumflex artery LCrmxA

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5. Left marginal artery LM

Table 1 Branching pattern of Left Coronary Artery

No. of branches	Number	Percentage
Bifurcation	34	68
Trifurcation	10	20
Tetrafurcation	5	10
Pentafurcation	4	2

IV. DISCUSSION

The coronary arteries shows large no of anastomoses with each other at precapillary level and this anastomes among the arteries goes on increasing as the age advances and in young age these anastomoses are impervious so coronary arteries are physiologically end arteries but anatomically they are not end arteries. Termination of the trunk of left coronary artery into anterior ventricular and left diagonal and circumflex artery was described by Banchi in 1904
[2] Since then there have been various reports regarding the bifurcation, trifurcation, tetrafurcation and pentafurcation of left coronary arteries.
From the table 2 it can be noticed that the findings in present study is near to findings of Nagaraj S etal in 2017 [12] where bifurcation of coronary artery was 66.6% and Reig in 2004 [6] who found bifurcation in 62%. Trifurcation of coronary artery was found more as compared to present study by Researcher like Kalpana (2003) [5] 40%, Ballesteros etal (2008) [8] 42.2%, Fazliogullari etal (2010) [10] 44% and Laxmiprabha S etal (2018) [13]41.82% . Tetrafurcation of coronary arteries was found in 10% in this study which is near to findings of Fazliogullari etal 10% and Kalpana 11%. Pentafurcation of coronary artery found in this study is 2% which is more as compared to findings of o Kalpana (2003) [5] who find in 1% and Laxmiprabha S etal (2018) [13] in 1.82%
The left diagonal artery also called as ramus diagonalis when present runs on anterior surface of left ventricle and supply left ventricle in collaboration with left anterior interventricular artery. So in atherosclerotic blockage of anterior interventricular artery, if left diagonal artery is present it prevents infarction of left ventricle by establishing
collateral blood circulation i.e. anastomosis between left anterior interventricular and left diagonal artery. The importance of left diagonal artery is found by many other researchers also by Baptista CA in1991 [3] and Lujinovic A, Ovcina F 2009 [9]
The significance of trifurcation tetrafurcation and pentafurcation lies in the fact that extra variant branches irrigate small but significant portion of left ventricle myocardium. In case of bifurcation this portion would be irrigated by enterily only by anterior interventricular artery and little by left circumflex artery only, but in case of trifurcation, tetrafurcaion and pentafurcation it gets irrigated independently by other variant branches of left coronary arteries. So under condition of coronary insufficiency these branches including its anastomosis present important pattern of collateral blood supply to myocardium and this decreases the risk of myocardial infarction even in blockage of other branches Lujinovic A, Ovcina F 2009 [9]
Sudden cardiac deaths in athletes and players are due to congenital abnormalities in coronary arteries. We find the cases of sudden severe chest pain in athletes followed by deaths within minutes if the abnormality is so predominant that unable to satisfy the increase demands of oxygen in strenuous athletic practices. So to find the cause of such sudden death the coronary circulation knowledge is very essential.The embryological basis of variations in coronary arteries is that during development of these arteries in the embryo they have to go through the complex process of 1.Angiogenesis, 2.Vasculogenesis, 3.Arteriogenesis and 4. Remodeling. Any defect during the

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above four processes may lead to development of variant coronary artery. Laxmiprabha S etal (2018) [13]

Table 2 Comparison of division of main trunk of left coronary artery

Researcher	Bifurcation	Trifurcation	tetrafurcation	Pentafurcation
Baptista1991(1	54.7	38.7	6.7	-
Cavalcanti1995	60	38.18		
Kalpana 2003	47	40	11	1
Reig2004	62	38	-	-
Ortale 2005				
Lujinovic2006	50	46	4	-
Ballesteros etal 2008	52	42.2	5.8	-
Fazliogullari etal 2010	46	44	10	
Bhimalli S etal 2011	56.6	33.3	8.33	1
Nagaraj S etal 2017	66.6	23.33	10	-
Laxmiprabha S etal 2018	54.44	41.82	1.82	1.82
Present study 2022	68	20	10	2

V.CONCLUSION

Left coronary artery shows lot of variation in its branching pattern, early diagnosis of these variations and anomalies can reduce the mortality and morbidity during the coronary artery bypass surgeries, valve replacement surgeries, angioplasty, stenting surgeries and surgical myocarodial revascularization procedures. Variant arteries may also cause technical difficulties in catheterization during diagnostic procedure like angiography. This study also have great helps to radiologist and cardiologist for better interpretation of coronary angiograms and to reach the correct diagnosis. Existence of a separate left diagonal artery a may decreases the effect of infarction in case of atherosclerotic blockage of anterior interventricular artery and left circumflex artery. Further deep study is required to know the relationship between coronary artery circulation and infarcted area of myocardium in case of heart attack for a succesful clinical outcome.

VI. REFERENCES

1. Gray's Anatomy. The Anatomical basis of clinical practice 14th edition New York :Churchill Livingstone 2008: 995- 1027

2. Banchi A Morfalogia delle arteries coronaries cordis. Archital. Anat Embroil. 1904 87-164. (Quoted by J Reig Villalongain 2003)

3. Baptista CA, Di Dio L J, Prates JC. Types of division of the left coronary artery and the ramas diagonalis of the human heart. Japan heart J. 1991 :32 (3): 323- 35

4. Cavalcanti JS, de Lucena, Oliveira M, Pais e Melo AV Jr, Balaban G, DE Andrede Oliveiea CL, de Lucena Oliveira E. Anotomic variation of coronary arteries. Arq Bras Cardiol 1995 Dec; 65(6):489-9212.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 08, 2022

5. Kalpana R a. A study on principal branches of coronary arteries in humans. Journal of Anatomical Society India 2003; 52 (2) 137- 40

6. Reig J , Petit M. Main trunk of the left coronary artery: anatomic study of the parameters of clinical interest. Clinical anatomy 2004; 17 (1): 6-13

7. Ortale JR; FilhoJM; PaccolaAMF, Garcia LJGP, Scaranari CA. 2005.Anatomy of the lateral, diagonal and anterosuperior Atrial branches of left ventricle of the human heart. Revista Brasileira de Cirurgia Cardiovascular. 20(2)

8. Ballesteros LE, Ramirez LM. morphological expression of the left coronary artery a direct Anatomical study . Folia Morpholigica 2008; 67 (2): 135 -42

9. Lujinovic A, Ovcina F 2009, Variations in branching pattern of main trunk of left coronary artery and importance of left diagonal branch. Journal of medical faculty University of SaraJevo, Bosnia and Herzegovina. 44 (1-suppl): 32

10. Fazilogulari Z , karabulut AK. Coronary artery variation and median artery in Turkish Cadveric hearts Singapore Medical Jour Katrina Kaif ka cartoonnal 2010; 51 : hostel animal(10) 775 -80
11. Bhimalli S, Dixit D, Siddibahavi M. Shirol VS. World journal of science and technology2011;1(5):30-35

12. Nagaraj Mallashetty, Veeresh Itagi.The study of Branching pattern and variations in the left coronary artery in human heart with a unique case of crossing of coronary arteries- A cadaveric study. Indian Journal of Clinical Anatomy and Physiology, January-March, 2017;4(1):48-50

13. Lakshmiprabha S., Khizer Hussain Afroze, Ramesh P., Asha K. R., Shivaleela C., Anupama D. Variations in the anatomical and branching pattern of the left coronary artery: a cadaveric study International Journal of Research in Medical Sciences 2018 Apr;6(4):1235-1240