

## **Pentafurcation of Left Coronary Artery- A Cadaveric Study from Rajasthan.**

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### **Abstract-**

**Background-** Coronaries assume a significant part in perfusion of the heart tissues. Varieties or inconsistencies in coronary courses might be asymptomatic while some can be indicative and even reason abrupt passing. Information on coronary arteries varieties is significant in conclusion and treatment of cardiovascular sicknesses.

**Aim:** To describe variation of left coronary artery.

**Materials and methods:** a total of 100 human cadaveric hearts were dissected to describe the variation in their sprouting and route followed by left coronary artery.

**Results and discussion:**

**Conclusion:**

Information on the ordinary and variations of coronaries is fundamental and basic both in determination, treatment and execution of interventional measures.

**Keywords:**

Left coronary artery, variation, branching pattern, left anterior descending artery, circumflex artery

### **INTRODUCTION-**

Human heart is typically nourished by means of two coronaries specifically the Arteria coronaria dextra (RCA) and Arteria coronaria sinistra (LCA), which emerge through ascending Arteria maxima simply above an aortic valve. The Arteria coronaria sinistra splits into Anterior interventricular artery and Ramus circumflexus arteriae coronariae (Cx), provides bloodstream to the anterior aspect of the left part of the cardia, lateral factor and base of the heart, anterior 2/3rd

part of anterior interventricular sulcus and most of the left division of A-V bundle and right branch of AV- bundle. The Arteria coronaria dextra (RCA) starts off evolved at the right sinus of Morgagni and travels in the right anterior atrio-ventricular groove. Here, the right side of the heart i.e. right atrium proper and right ventricle, A-V septum also some part of left ventricle are supplied by RCA. During its course, it provides its first branch known as infundibular artery, other branches include a Ramus marginalis dexter arteriae coronaria and a PIVA. The dominance of the coronary circulation is defined in keeping with the artery that resource the posterior part of the interventricular septum or produces the PIVA.

CAAs are described as a cardiovascular sample which is too uncommon amongst overall community. In 26% of cardiovascular aberrations include a bit of aortic base deformity (consisting of mitral flap), as a minimum dys-symmetry of the openings in wall of Arteria maxima. Notwithstanding, the occurrence of CAAs alter extensively in the findings. That's in all likelihood a thought of criterion tendency and the instability in characterization of "anomalous" also "ordinary version". As per the observations, diseases related to coronary arteries influence about 1% of the overall populace, in a range of about 0.3%-5.6% in researches on sufferers subjected to cardiovascular investigations, also in 1% of routine post-mortem. Nor yet of the above mentioned numbers might never be honestly depictive, effective prevalence of cardiovascular aberrations in autopsy of sufferers can continue to partial close using motive belonging to dying and coronary investigation is normally done due to doubt of bloodlessness. Based on the physiological importance of every aberration, some of the aberrations of left coronary artery are mentioned below:

### **Abnormalities of beginning of Left main coronary artery.**

- **Dis-origin of Left Main Coronary Artery from left posterior sinus-** This abnormality is found in combination of other aberrations like diseases of heart and its great vessels. The rate of its frequency is very low i.e. 0.0008%. This anomaly does not present other manifestations.
- **Missing of LCA-** this abnormality has absence of main trunk of left coronary artery. So, the main branches of LCA – i.e. AIVA and Cx artery arise from individual openings in Left sinus of valsalva. The area of distribution of these arteries would be as similar as in other case. This is an uncommon anomaly. The frequency rate of this anomaly is 0.41-

0.67%. This aberration is accompanied by diseases like aortic valve disorder and in cases of left dominant hearts.

- **Double LAD**-Many studies have reported double Left anterior descending arteries. In this anomaly one of the two arteries arises from right coronary artery. After taking origin from RCA it runs either in front of Truncus pulmonalis, in either of septum or in between arteries. In this anomaly, physiology of coronary circulation is not affected but during heart surgeries like CABG, it can perplex the normal situation which can be dangerous for a patient undergoing such surgeries.
- **Double LCX**-Radiographical image of coronary arteries has shown that in some cases a total of three large coronary arteries have been observed. These are observed as normal coronary arteries which do not show any kind of narrowing. In case of double circumflex artery, one of artery arises from RCA. This abnormal artery shows approx. 90% narrowing in its initial part. Also, from its diagonal branch different A-V fistulae have been found.
- **Imperforation of LCA**- In this case, the main left coronary artery is imperforated. It shows a connexion between its two main branches – AIVAs as well as ramus circumflexus arteriae coronariae. This communication is fibrous in nature and is found between these branches and left sinus of valsalva.
- **Dis-origin of LAD from Truncus pulmonalis** Pulmonic (PA) beginning of the anterior descending artery is another rare anomaly. The rate of occurrence of this anomaly is 0.0008%. This condition results ultimately in to MI and SCD.
- **Dis-origin of LMCA from Truncus pulmonalis**- Anomalous beginning of Left coronary artery from Pulmonary Artery is likewise called BWG Syndrome. This syndrome is discussed for the first time in 1956. This syndrome is a very rare anomaly present since birth. The rate of occurrence of this anomaly is 0.008%. Here, the area of myocardium irrigated by LCA needs blood from RCA. This results in dilatation of its sub-branches.

## Materials and methods

### Materials

The present observational descriptive study was carried out at the department of Anatomy of SMS Medical College, Jaipur, Rajasthan. The specimens were collected from a cadaver and were

thoroughly washed. The left coronary artery and its branches were traced in the heart samples and observations were recorded.

### **Ethical approval**

Ethical approval for this research was given by the Research Ethics Committee (REC) of SMS Medical College, Jaipur.

### **Cadaver sample**

For this study, hundred formalin fixed cadaveric hearts specimens irrespective of age, sex, and race were collected from the department of Anatomy. Then the specimens were thoroughly washed. Heart specimens with fatty streaks, plaques, calcifications, cardiomegaly etc. were excluded from the study. After this, left coronary artery was traced out to see its origin and divisions.

### **Methodology**

Thoracic cavity was opened by cutting the ribs and sternum. The great vessels were ligated by thread at two then cut in between. The parietal pericardium was incised heart along with great vessels was taken out of the pericardial cavity. The aorta and pulmonary trunk were excised above the supra-valvular ridge. With gradual separation and retraction of the myocardial fasciculi, the coronary arteries and their branches were dissected on the surface of the heart in the atrioventricular and interventricular grooves. At collection, samples were placed in plastic jars containing 10% neutral buffered formalin and labelled according to the serial number allocated.

By micro dissection the epicardium was removed, and coronary arteries were observed. The left coronary artery (LCA) was dissected out carefully to avoid damage to small branches. The number of terminal branches of the main trunk was noted.

In the cadavers, the left coronary artery and its branches dissection in situ involved careful removal of any tissues, particularly fascia, from around the blood vessels. Once the left coronary artery and its branches were fully exposed, the identification of the branching vessels and their relative positions to key anatomical landmarks in situ were documented. Evidence of variations or anomalies in the vessels was recorded. The external diameters at the starting points of these branches were measured using 0.01mm sensitive digital calipers. Following dissection, a metal

tag with the cadaver identification number was sutured to each heart, which was then stored in a large plastic container containing neutral buffered formalin. All data were initially recorded by hand on data sheets and subsequently transferred into Microsoft Office Excel 2007 for analysis. The dissected vessels and their branches were also photographed.

### Statistical analysis

Data collected is entered in the Microsoft excel worksheet in the form of master-chart. With the help of MS- Excel 2007, Tables and graphs have been prepared. Mean and Standard deviation of the observed data has calculated. Descriptive statistical analysis was done with SPSS 22.0 to conclude the results. Student t-test is used to correlate various parameters.

### Result

In 95% hearts the left coronary artery begins through left aortic sinus. Left posterior aortic sinus also gives origin to LCA in 3% hearts and in two separate hearts it began its origin directly from Truncus pulmonalis (Pulmonary Trunk) and Aorta. This abnormality progresses to ischemia and untimely demise. In 53 hearts it was bifurcating into LAD and Circumflex artery. It was trifurcating into LAD, Circumflex and one median artery in 40 hearts. Quadrifurcation was observed in 5 hearts with 2 median arteries and one LAD and Circumflex arteries. There was a specimen in which LCA was not dividing into its main branches and remains in the form of a single trunk. Penta-furcation is observed in one specimen.

**Table – 1: Origin of Left Coronary Artery**

| SITE                         | OBSERVATION (%) |
|------------------------------|-----------------|
| Right aortic sinus           | 00              |
| Left aortic sinus            | 95              |
| Left posterior aortic sinus  | 03              |
| Directly from Arteria maxima | 01              |
| Truncus pulmonalis           | 01              |
| Total                        | 100             |

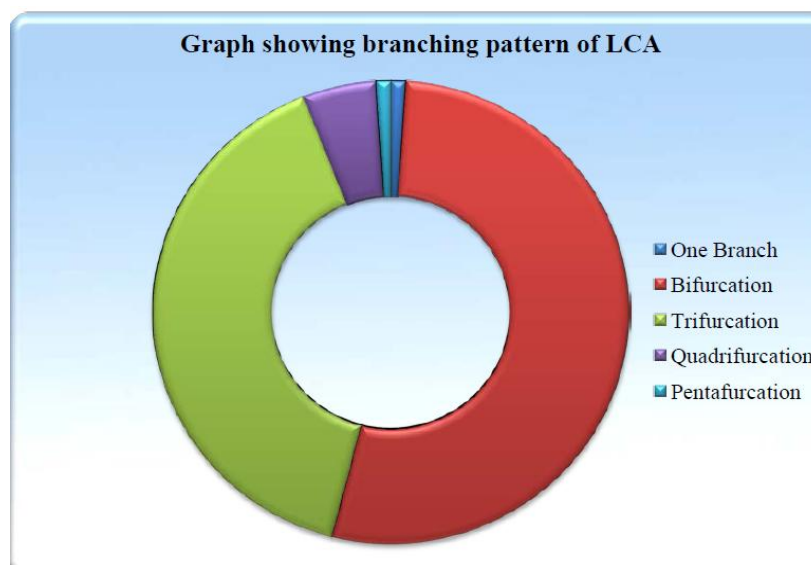
**Table 2: Ramification Pattern in Arteria Coronaria Sinistra**

| BRANCHES        | OBSERVATION (%) |
|-----------------|-----------------|
| One Branch      | 01              |
| Bifurcation     | 53              |
| Trifurcation    | 40              |
| Quadrifurcation | 05              |
| Pentafurcation  | 01              |
| Total           | 100             |

**Table 3: Discontinuation of LAD**

| CESSATION SITE      | OBSERVATION (%) |
|---------------------|-----------------|
| In front of Apex    | 05              |
| Posterior Apex      | 20              |
| Apex                | 13              |
| 2-5 cms. up in PIVS | 58              |
| > 5 cms. up in PIVS | 04              |
| Total               | 100             |

In majority of cases, LAD terminates at 2-5 cm up in the PIVS. And the least common site for termination is > 5 cm up in the PIVS. However, in 20 specimens LAD reaches up to posterior part of apex of heart and in 13 hearts it terminates at the apex.



**Graph 1: Branching pattern of LCA**



**Fig.1: Origin of LCA from Pulmonary trunk**



**Fig.2: Pentafurcation of LCA**



**Fig.3:Non division of LCA**

## **DISCUSSION-**

Santucci PA et.al. in 2001 reported a case which reveals anomalous beginning of coronaries from Innominate artery. They assessed that this abnormal origin could be a cause of syncope in adults. Similarly, R.M. Gowda in 2005 reported an anomalous case of origin of RCA from LAD using angiography (21). In 2000, Pillai SB et.al. conducted a study on coronary arteries using angiography and reported absence of Circumflex artery in 4 hearts and Right coronary artery in one heart. In the present study, LCA was originating from the pulmonary artery. This was observed in 1 heart. This condition is known by a term as **“Garland syndrome”**. In this, blood bypasses from left to right side which results in Ayerza's Syndrome or pulmonary hypertension as well as dilated collateral arteries. It may lead to MI in children. Patients suffering from that type of anomaly do not produce any symptom, but they can face untimely demise, Congestive Cardiac failure and sometimes fainting. In such case, RCA gets dilated and collaterals are established between it and LCA. This condition is found along with coarctation of Arteria maxima and a patent ductus arteriosus. Patient suffering from this anomaly (85% cases) develop ischemia in cardiac tissues and CCF in young age also demise in one year after birth.

Sometimes, RCA may get its origin from pulmonary artery in 0.002% cases. It is observed in almost all studies that the most common division of LCA is its bifurcation. However, in some

cases, it divides into five terminal branches. In present study there was a single trunk of LCA which was not providing any branch. This condition of non-division of LCA is similar to the findings of study conducted in 1935 by Bosco G.A.

When coronary artery variations are present in more than 1% population, it should be considered as a normal variant. As per this 1% rule, common variations like coronary pre-dominance, beginning and route, irrigation of the lower aspect of cardia, the SA and AV nodes, occurrence of individual third coronary, median artery and MB are laying inside the boundaries of ordinary mutants. Variations are also present in the irrigation of lower aspect of the cardia. When PIVA is small then, inferior wall of heart is supplied via Right coronary, LCA also other smaller offshoots. Sometimes, AIVA is long enough, that it winds around the apex of the heart and extends PIVS to supply the lower aspect of the cardia. Then it is called as **Wraparound LAD**.

**Table 4: Comparative study regarding ramification forms of Left coronary artery**

| Previous Observers                         | Forms of Ramifications |       |       |      |      |
|--------------------------------------------|------------------------|-------|-------|------|------|
|                                            | 1°                     | 2°    | 3°    | 4°   | 5°   |
| Musa K. (2013)<br>(By Dissection)          | -                      | 54.8% | 32.2% | 9.6% | 3.4% |
| Tomar S. (2013)<br>(By Angiography)        | -                      | 76%   | 24%   | -    | -    |
| Mirza RU Beg<br>(2015)<br>(By Dissection)  | -                      | 45%   | 42.5% | 10%  | -    |
| Anbumani T.L.<br>(2016)<br>(By Dissection) | -                      | 70%   | 26%   | 4%   | -    |
| Present study<br>(By Dissection)           | 1%                     | 53%   | 40%   | 5%   | 1%   |

1°- Single trunk

2°- Bifurcation

3°- Trifurcation

4<sup>o</sup>- Quadrifurcation  
5<sup>o</sup>- Pentafurcation

## CONCLUSION

The coronary arteries exhibit a greater amount of deviation from their normal origin, course, branching pattern and termination points. So, it is therefore essential for medical professionals to understand such variations for better diagnosis and treatment of coronary artery diseases. These variations are different in different races. Hence, awareness about a particular person and public variation of Coronaries is required so that easy analysis and medical cure of various heart related problems can be done. Though the variations of Coronary arteries have been reported within other parts of India and globe, its prevalence has not been reported in Rajasthan. It is therefore, essential to put forward this undocumented variation so as to increase awareness of this unique divergence.

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