

CADAVERIC STUDY ON NORMAL AND VARIANT ANATOMY OF LEFT CORONARY ARTERY

Sachin K S ^{*1}, Mamatha H ², D'Souza A S ³.

^{*1}Assistant Professor, Department of Anatomy, K S Hegde Medical Academy, Mangaluru, Karnataka, India.

²Associate Professor, Department of Anatomy, Kasturba Medical College, Manipal, Karnataka, India.

³Professor & Head, Department of Anatomy, Kasturba Medical College, Manipal, Karnataka, India.

ABSTRACT

Background: Human heart is supplied by coronary arteries – Right and Left coronary artery. The coronary arteries arise from the aortic sinuses and the left coronary artery from the left posterior aortic sinus. The left coronary artery has two branches, the anterior interventricular and circumflex arteries. The anterior interventricular branch is the continuation of left coronary artery, gives off septal branches, right and left ventricular branches. The left ventricular branches are called diagonal arteries. The left circumflex artery gives off left atrial and left ventricular branches. One of these atrial branches supply the sinoatrial node in 35% of subjects and AV node in 10-20% of the subjects.

Materials and Methods: The study was carried out in the department of anatomy, Kasturba Medical College, Manipal, India. The study was performed on 50 formalin fixed human hearts of unknown sex and age. The left coronary artery and their branches were carefully dissected. The origin, branches & branching pattern of left coronary artery was observed, noted and photographed.

Results: In present study, 49 samples (98%) showed the origin of left coronary artery from left posterior aortic sinus while 01 sample (02%) had no trunk of left coronary artery. Sino-atrial nodal artery was originating from circumflex artery in 13 samples (26%) and atrio-ventricular nodal artery from the circumflex artery in 05 samples (10%). The trunk of left coronary artery was bifurcating in 37 samples (74%) and trifurcating in 12 samples (24%) with one sample (02%) showing absent trunk of left coronary artery. The median artery was present in 12 samples (24%) and posterior interventricular artery was originating from circumflex artery in 05 samples (10%).

Conclusion: Left coronary artery commonly originated from left posterior aortic sinus with very few variations. Sino-atrial nodal artery and atrioventricular nodal artery commonly originates from right coronary artery. Bifurcation of left coronary artery is commoner than trifurcation. The present study is useful in better understanding of the normal and variant anatomy of left coronary artery.

KEY WORDS: Left coronary artery, Aortic sinus, Sino-atrial nodal artery, Atrioventricular nodal artery, Left circumflex artery.

Address for Correspondence: Dr.Sachin K S, Assistant Professor, Department of Anatomy, K S Hegde Medical Academy, NITTE (Deemed To Be University), Mangaluru, Karnataka, India.
PIN – 575018. Tel No: +91-9611206205. E-Mail: drsachinks63@gmail.com

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INTRODUCTION

Human heart is supplied by two coronary arteries – Right and Left coronary artery. Anomalies of coronary arteries make a diverse group of congenital disorders with presentations and its mechanisms being highly variable. These variations are present from birth but only a few are symptomatic. Most are benign in character but, however some anomalies are associated with some serious clinical outcomes like heart failure, myocardial infarction, arrhythmia and sudden death [1,2]. Hence, the importance of coronary anomalies varies from minor to life threatening.

The coronary arteries arise from the aortic sinuses. The initial portion of the aortic root is occupied by the aortic sinuses, also called the sinus of Valsalva [3]. These sinuses are named according to their position as the anterior, right posterior and left posterior aortic sinuses. The right coronary artery arises from the anterior aortic sinus and the left coronary artery from the left posterior aortic sinus. In clinical terminology, the anterior, left posterior and right posterior sinuses are often called the right, left and non-coronary sinuses, respectively.

The left coronary artery has two major branches, the left anterior interventricular and left circumflex arteries. Occasionally the left coronary artery can trifurcate with a third artery called intermediate artery (median artery) in between these 2 major branches [4]. The left anterior interventricular branch is considered to be the continuation of left coronary artery, gives off septal branches, right and left ventricular branches [5]. Septal branches supply the anterior two-thirds of interventricular septum. The left ventricular branches are called diagonal arteries. They originate from its parent vessel at an acute angle and run parallel to each other in a diagonal fashion. The left circumflex artery gives off left atrial and left ventricular branches. One of these atrial branches supply the sinoatrial node in 35% of subjects and AV node in 10-20% of the subjects [5,6,7].

During the fifth week of development vascular plexus of sinusoids are formed in the sub-epicardial space. Coronary buds on the aortic sinuses connect with these plexuses leading to

the development of coronary arteries. Malformation with one of these systems will lead to coronary anomalies [8].

The term 'coronary dominance' is described based on the artery that gives rise to posterior interventricular branch. If the posterior interventricular artery is a branch of right coronary artery, then it is said to be right dominant circulation. If from the left circumflex artery, then it is left dominant circulation and if it arises from both right coronary and left circumflex arteries then it is said to be co-dominant or balanced circulation. Approximately 60% of general population is right dominant, 20% left dominant and rest are co dominant [5]. The present study is conducted to know the normal and variant anatomy of left coronary artery.

MATERIALS AND METHODS

The study was carried out in the department of anatomy, Kasturba Medical College, Manipal, India after obtaining ethical approval from the Institutional ethics committee. The study was performed on 50 formalin fixed human hearts of unknown sex and age. Visceral pericardium was first striped off and the sub epicardial fat removed. The left coronary artery and their branches were carefully dissected out till their termination and the following parameters were noted.

1. Origin of Left coronary artery.
2. Origin of Sino-atrial nodal artery.
3. Origin of Atrio-ventricular nodal artery.
4. Division pattern of trunk of Left coronary artery.
5. Incidence of Median artery.
6. Origin of Posterior Interventricular artery.

To enhance contrast, the arteries were then painted with red fabric colour and photographs were taken.

RESULTS

Out of 50 samples under the study, 49 samples (98%) showed the origin of left coronary artery from left posterior aortic sinus (Fig.01) while 01 sample (02%) had no trunk of left coronary artery with circumflex artery originating from anterior aortic sinus along with right coronary

artery and anterior interventricular artery originating from left posterior aortic sinus (Fig.05). Sino-atrial nodal artery was seen to originate from circumflex artery in 13 samples (26%) and atrio-ventricular nodal artery was originating from the circumflex artery in 05 samples (10%). The main trunk of left coronary artery was bifurcating in 37 samples (74%) (Fig.01) and trifurcating in 12 samples (24%) (Fig.04) with one sample (02%) showing absent trunk of left coronary artery (Fig.05). The median artery was originating from the trunk of left coronary artery in 12 samples (24%) (Fig.04) and posterior interventricular artery was originating from circumflex artery in 05 samples (10%) (Fig.06). The following data have been tabulated (Table.01-06).

Table 1: Origin of Left coronary artery.

Origin	No of samples	Incidence
Circumflex artery	5/50	10%
Right coronary artery	45/50	90%

Table 2: Origin of Sino-atrial nodal artery.

Origin	No of samples	Incidence
Circumflex artery	13/50	26%
Right coronary artery	37/50	74%

Table 3: Origin of Atrio-ventricular nodal artery.

Origin	No of Samples	Incidence
Left posterior aortic sinus	49/50	98%
Absent LCA	1/50	2%

Table 4: Division pattern of trunk of Left coronary artery.

Division pattern	No of samples	Incidence
Bifurcation	37/50	74%
Trifurcation	12/50	24%
Absent LCA	1/50	2%

Table 5: Incidence of Median artery.

	No of samples	Incidence
Absent	38/50	76%
Present	12/50	24%

Table 6: Origin of Posterior interventricular artery.

	No of samples	Incidence
Circumflex artery	5/50	10%
Right coronary artery	45/50	90%

Fig. 1: Origin of Left coronary artery from left posterior aortic sinus.

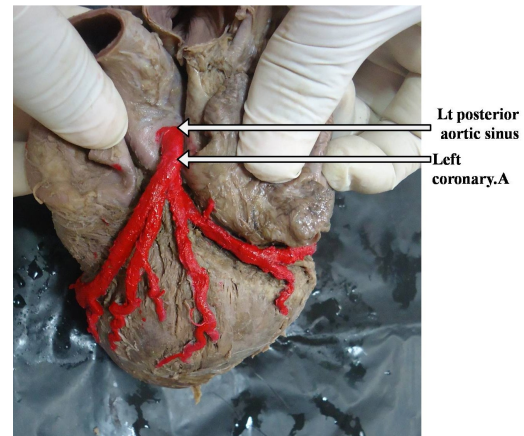


Fig. 2: Branches of left coronary artery.

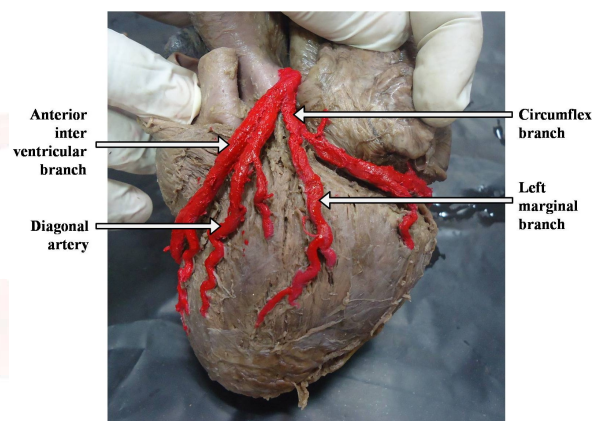


Fig. 3: Branches of left coronary artery.

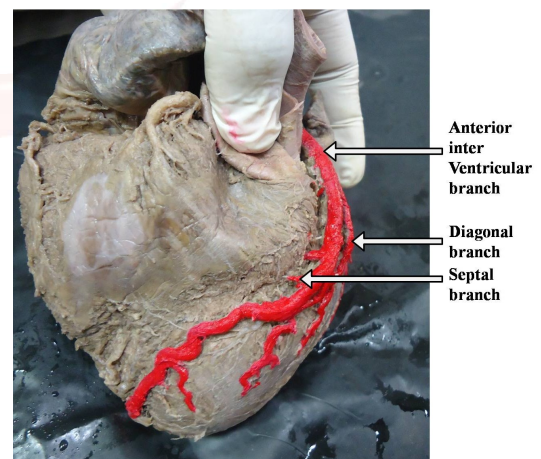


Fig. 4: Trifurcation of trunk of left coronary artery

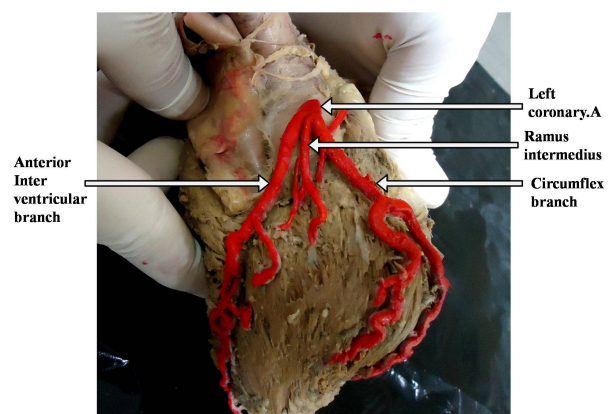
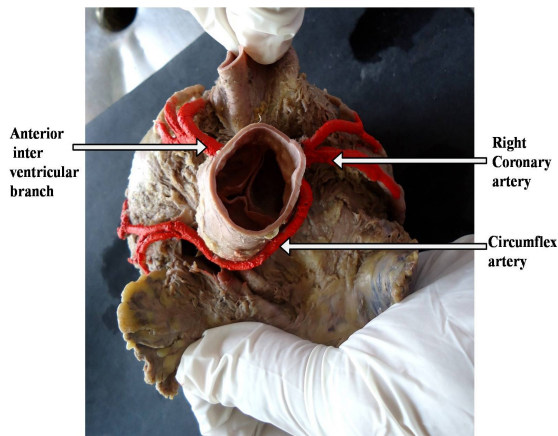


Fig. 5: Absent trunk of Left coronary artery showing abnormal origin of circumflex artery from anterior aortic sinus.



DISCUSSION

This study was conducted on 50 samples. The standard anatomy of coronary arteries was confirmed as stated in the literature. Branching patterns of these coronary arteries varied from specimen to specimen but, in no way they were unique to already existing list of coronary artery anomalies.

In our study, we found in 49 samples (98%), the artery was originating from the left posterior aortic sinus (Fig.01). In one sample (02%) we found that the left coronary artery was absent. In the same sample, the anterior interventricular branch was originating from the left posterior aortic sinus and the circumflex branch was originating from anterior aortic sinus along with the right coronary artery by a separate ostium. The circumflex artery then had a course posterior to aorta and then passed between pulmonary trunk and left auricle to reach the atrioventricular groove from where the further course and distribution was normal (Fig.05). Anomalous origin of left circumflex artery from either the anterior aortic sinus or from the proximal portion of right coronary artery is a commonly seen anomaly.

In our study, we found a sample (02%) where the circumflex artery was originating from the anterior aortic sinus by a separate ostium with a retro-aortic course (Fig.05). In a study by Yamanaka et al, they found 984 cases (0.78%) with anomalous origin of circumflex artery. In all these cases it had a retro aortic course similar to what we have found in our study [2]. In cases of anomalous circumflex artery arising

from anterior aortic sinus, dilatation of aortic root and the initial oblique course of the anomalous artery can lead to compression of the coronary artery and shear stress forces on the coronary ostium leading to a narrowed, slit like configuration of the ostium. If in case the proximal segment courses behind the aorta, it can form an acute angulation between pulmonary trunk and the left ventricle which can be potentially hazardous. Angulation between pulmonary trunk and left ventricle can lead to compression of intramural segment of the artery. These mechanisms can lead to severe myocardial ischaemia, infarction and even sudden death [9].

In total of 50 samples in our study, 13 cases (26%) showed origin of sino-atrial (SA) node artery from the circumflex artery. In a study by Kalpana showed the artery to originate from right coronary artery in 56%, from circumflex artery in 35% and from both in 8% of cases. In one of the specimen it directly originated from the aorta by a separate ostium close to the ostium of right coronary artery [10]. The distribution of SA nodal artery allows to understand the possible ischaemic etiology of the sinus nodal syndrome and permits the surgeon, a safe approach to the cardiac diseases [11]. In our study, out of 50 samples studied we found the atrioventricular artery to originate from circumflex artery in 5 (10%) of samples. A study conducted by Bhimalli S showed the artery to originate from right coronary artery in 80%, from circumflex artery in 16.6% and in remaining 3.33% cases it was absent [12]. They are similar to the results in our study where the artery originated from right coronary artery in 90% and from circumflex artery in 10% of cases.

In our study, out of 50 cadaveric hearts dissected we saw that the left coronary artery was bifurcating (Fig.01) in 37(74%), trifurcating (Fig.04) in 12(24%) of the cases and in one case(02%) the left coronary artery was absent (Fig.05). The incidence of bifurcation of the left coronary artery was 74%, trifurcation was 24% and absence of left coronary artery was 02% in our study. Quadrifurcation and pentafurcation of the artery was not found in our study. In a study by Baptista with 150 hearts, the left coronary artery was bifurcating in 54.7%, trifurcating in

in 38.7% and quadrifurcating in 6.7% of samples [13]. A study by Kalpana showed the pattern of left coronary artery division was bifurcation in 47%, trifurcation in 40% and quadrifurcation in 11%. One specimen showed pentafurcation and one specimen had no main trunk of left coronary artery [10].

The median artery has been given various names by different authors which includes, ramus diagonalis [13], ramus intermedius [14], intermediate artery [15]. The median artery is the one which originates at the vertex of the angle formed by the main terminal arteries of the left coronary artery. It should possess a substantial calibre. It should have an area of distribution extending half way down the free wall of the left ventricle. The median artery follows an oblique route along the sternocostal surface of left ventricle, frequently reaching the midpoint between the cardiac base and the apex cordis [15]. In our study, out of 50 cadaveric hearts dissected, the median artery was present (Fig.04) in 12 samples (24%). Identification of median artery is of clinical importance. Although its area of distribution is small, it irrigates the areas that in the absence of trifurcation of left coronary artery are irrigated by the anterior interventricular and circumflex arteries and its existence may decrease the effects of occlusion of these arteries [16].

In our study, out of 50 cadaveric hearts dissected, posterior interventricular artery was originating from circumflex artery in 05 samples (10%) (Fig.06) indicating the circulation in them as left dominant. Dominance pattern of heart has lots of clinical significance. Left dominance has significantly higher mortality rates when compared to right and co-dominant hearts [17]. Dominance also has a role in anterior interventricular branch stenosis. It is observed that in left dominance the anterior interventricular branch wraps round the apex of heart supplying major portions of myocardium. In right dominance it is the posterior interventricular branch of right coronary artery which supplies the majority of myocardium. Thus any lesion in anterior interventricular branch in a left dominant heart has a profound effect than a right dominant heart [18]. Dominance also plays an important role in inferior infarcts of the heart. Dominant right coronary

artery usually supplies the atrioventricular node in majority of the cases. Hence, inferior wall infarct caused by the occlusion of the right coronary artery will have a higher risk of AV block [19].

CONCLUSION

The present study describes the normal and variant anatomy of left coronary artery observed in samples procured from the costal Karnataka region. The origin of left coronary artery is commonly seen from the left posterior aortic sinus with very few variations as observed in the present study. The sino-atrial nodal artery and atrio-ventricular nodal artery commonly originate from right coronary artery. The bifurcation of main trunk of left coronary artery is more commoner than the trifurcation with the incidence of median artery. The present study provides a better understanding of anatomy of left coronary artery for cardiologists & cardiothoracic surgeons in providing better patient care.

Conflicts of Interests: None

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