



A CADAVERIC STUDY ON CORONARY ARTERY VARIATIONS AND ITS CLINICAL SIGNIFICANCE

Anatomy

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ABSTRACT

Coronary artery variations are one of the commonest variations observed during clinical procedures. Normally, there are two main coronary arteries, the right coronary artery (RCA), left coronary artery (LCA). Left coronary artery gives two important branches left circumflex artery (LCX) and left anterior descending (LAD) arteries. Knowledge about the coronary vessels and its variations are essential to clinicians to prevent untoward injury of vessels during any procedures. **Aim:** To study the morphology and variations of coronary arteries by dissection. **Materials and Methods:** The present study was a cadaveric study which was conducted on 50 hearts obtained from adult human cadavers. Coronary arteries were dissected to see the origin, course and variations. The data was entered in Microsoft excel sheet and expressed in percentage. **Results:** The Right coronary artery branched out from the right aortic sinus and had an average diameter of 3.5mm. The left coronary artery arose from left aortic sinus and had an average diameter of 4mm. LMCA divided into two branches in 60 percent, three branches in 30 percent and four branches in 06 percent of the hearts and direct branches from left aortic sinus in 4 percent hearts. Based on the origin of Posterior descending or interventricular artery, Right dominance was observed in 68 percent, left dominance in 26 percent, and equal dominance in 06 percent of the hearts. **Conclusion:** Knowledge about the variations of coronary vessels is a prerequisite for clinicians to perform interventions of coronary vessels.

KEYWORDS

Right coronary artery, Left coronary artery, Left anterior descending, Posterior descending artery(PDA), Coronary dominance

INTRODUCTION

With the rising trend of coronary artery disease secondary to various causes leading to increasing rate of mortality. Various procedures such as coronary angiography (CAG) and cardiac bypass surgeries are performed as part of the diagnostic and treatment procedures [1]. Coronary artery disease (CAD) is due to occlusion of coronary arteries leading to decreased function of the heart and eventually leading to death. In normal anatomy, coronary arteries arise from the aortic sinuses, converging towards the apex of the heart. Normally, there are two main coronary arteries, the right and left coronary arteries. Left anterior descending (LAD) and left circumflex artery (LCX) are most common vessels involved in atherosclerosis and both arising from a common stem, the left main coronary artery (LMCA)[2,3].

According to the literature, coronary artery anomalies (CAA) affect around 1% of the general population undergoing coronary angiography, and in approximately 1% of routine autopsy. The clinical relevance of this coronary anomaly may be due to underlying coronary atherosclerosis: It has been proposed that the abnormal origin and course of anomalous coronary arteries could make them more prone for Myocardial infarction [4,5,6]. In nearly 15% of patients with CAAs, myocardial ischemia can develop in the absence of atherosclerosis. In recent years, there is also evidence suggestive of geographical variations in the pattern of coronary arteries from region to region across the globe [7]. Hence, the present study was taken to study the geographical variation of coronary arteries in individuals of Andhra Pradesh.

MATERIALS AND METHOD

The present descriptive study was conducted in the Department of Anatomy, Kurnool Medical College, India. Ethical approval for this research was granted by the Ethics Committee of Kurnool Medical College. In this study, a total of 50 heart specimens irrespective of age, sex, and race were obtained from cadaveric lab used for undergraduate teaching purpose. The specimens were collected from June 2011 to July 2017. Specimens with intact vessels were included in the study. Damaged specimens were excluded from the study. All specimens were initially fixed in 10% formalin. Later the specimens were transferred to a water basin and dissected. At first, subepicardial dissection was done to remove the fascia and fat bridging the vessels. Both Right and Left Coronary artery was studied in detail. The origin of the RCA and its branches-conus, posterior descending artery (PDA) or posterior interventricular branch and the variations of the RCA branches were studied. The origin of LCA from the aorta, courses and variations of the anterior interventricular branch and circumflex branch, and the existence of the median artery were observed. The external diameter and the length of these branches were measured

using sensitive digital calipers. Any evidence of variations in the origin or anomalies in the vessels was noted. The specimens were duly numbered and preserved in formaldehyde solution. Photographs of each specimen were taken by digital camera.

Statistical Analysis

The data was entered in Microsoft Excel sheet and descriptive analysis was done in terms of percentages (%).

RESULTS

The origin, branches and the termination of RCA and LCA was studied. In all the hearts, the RCA originated from the right aortic sinus and course in the right atrioventricular sulcus. The average diameter of the RCA was 3.5mm. Conus branch arose from RCA in all hearts. Based on the origin of posterior descending artery the dominance 34(68%) pattern was studied, Right dominance was seen in 35 specimens (70%) (Fig 1A), Left dominance in 12 specimens (24%) 13 specimens (26%) (Fig 1B) and Co-dominance or balanced was seen in 3 specimens (6%) (Fig 1C, Table 1). On observation of the level of termination of right coronary artery, it terminated between right border & crux in 7(14%) specimens, at crux in 18 (36%) specimens, and beyond crux in 25(50%) specimens.

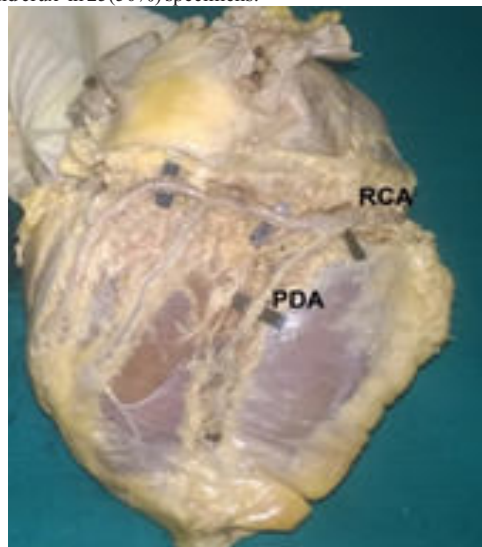


Figure 1A: Showing Right Dominance and RCA terminating beyond apex

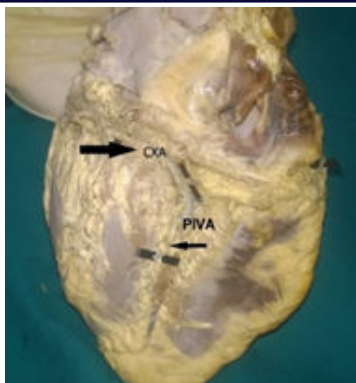


Figure 1B: Showing left dominance origin of PDA from Left Circumflex artery

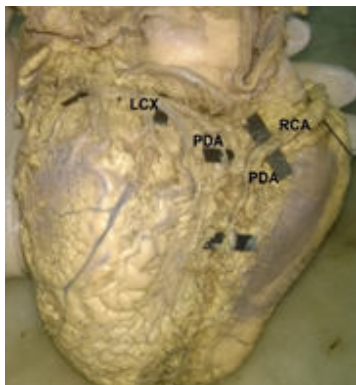


Figure 1C: Showing Codominance A

On measuring the length of LMCA, the range was between 5-15mm. It is said to be short if the trunk length is < 5mm and was seen in three (6%) out of the 50 specimens and a long main LCA trunk >15mm was seen in five (10%) specimens. The length of the LCA trunk in the rest of the 42 specimens (84%) was between 5-15 mm.

On examination of the main branches and variations of the LCA, it was noted that in all the hearts LCA originated from left aortic sinus and the average diameter of the main trunk at its origin was 4 mm. In 30(60%) specimens LMCA bifurcated into left anterior descending (LAD) and circumflex branches (LCx). In 15(30%) specimens LMCA trifurcated into LAD, LCx and anterior ventricular ramus /median /diagonal artery (Fig 2A) in 3(6%) specimens Quadrification into four branches- LAD, LCx and two ventricular rami (Fig 2B) was seen and in 2 specimens (4%) LMCA was absent and separate origin of LAD, LCx and Median artery was noted (Fig 2C/Table 2).

It was observed that left anterior descending (LAD) terminates at apex in 7 (14%) specimens, lower 1/3rd of posterior iv groove in 38 (76%) specimens and before the apex in 5 (10%) specimens.



Figure 2A: LMCA trifurcation into 1.LAD,2. Median artery 3.LCX

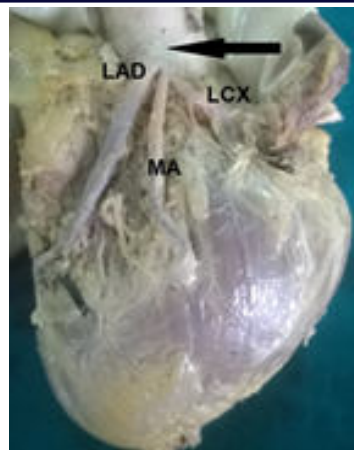


Fig 2B: Figure showing LMCA absent and branches arising directly from ascending aorta.

Table 1: Dominance Pattern In The Heart Based On PDA

S.No	Coronary artery	No of Specimens	Percentage%
1	RCA	34	68
2	LCA	13	26
3	BOTH	03	6

Table 2: Branching Pattern Of Left Main Coronary Artery (LMCA)

S No	Branching Pattern of Left Main Coronary artery (LMCA)	Specimen number	Percentage (%)
1	Bifurcation	30	60
2	Trifurcation	15	30
3	Quadrification	03	06
4	Absent LMCA	02	04

DISCUSSION:

Coronary artery disease is one of the leading cause of mortality in India. Three arteries namely LAD, LCX and RCA are most often involved. The coronary arteries regulate blood supply to the heart muscle. There are two main coronary arteries that supply oxygenated blood to the myocardium –the left main coronary artery (LMCA) and the right coronary artery (RCA). The LMCA originates from the left sinus of Valsalva (SV) and RCA originates from the right SV. Right coronary artery supplies sinoatrial node (SAN), atrioventricular node (AVN) right atrium and right ventricle [7,8]. In the present study, a note on the origin of coronary arteries, diameter of the main trunk, branches of RCA, LCA and dominance pattern of heart was studied.

Right Coronary Artery (RCA):

In the total 50 specimens studied, right coronary artery (RCA) branched from anterior aortic sinus of ascending aorta in all the specimens. Branches of RCA such as conus artery, nodal artery and Posterior descending artery (PDA) were traced. In all hearts, conus branch and nodal artery branched from RCA. Posterior descending artery is one of the important branch of RCA which supplies inferior wall and inferior third of the interventricular septum [7]. Coronary dominance was named according to the origin of PDA from coronary artery. In the present study PDA originated from RCA in 34 specimens (68%), in 13 hearts (26%) it originated from circumflex branch of left coronary artery and in 3 hearts (6%) it was double PDA from both RCA and LCA (Table 1). The findings of the present study are also similar to earlier reports [6,7,8] in case of right dominance while left dominance is higher in the present study in comparison to other studies. In the present study, RCA terminated between right border & crux in 8 out of 50 (16%) specimens, at crux in 15 (30%) specimens and beyond crux in 27 (54%) specimens. Knowing the termination of RCA is important to understand the blood supply of inferior surface of Heart. In hearts with termination of RCA beyond crux, inferior surface is supplied by RCA [9,10]. In such cases, apex of heart is supplied by both RCA and LCA [11,12].

The LMCA originates from the left sinus of Valsalva and bifurcates into the left anterior descending (LAD) artery and the circumflex artery (CXa). An additional artery called the intermediate artery/diagonal artery/median artery may arise at the bifurcation of the LMCA,

forming a trifurcation [13,14]. In some heart, there may be quadrification with two intermediate artery. In the present study, LMCA bifurcates into two LAD and Circumflex artery in 60% of the specimens, while trifurcation was 30% and quadrification was 6% which is also similar to reports of earlier reports [15,16,17]. However, in some cases where the LMCA is absent, three ostia can be detected. In the present study 4% of the specimens showed separate origin of LAD, LCx and Median artery. Earlier reports says that absence of the LMCA is a common anomaly that can be detected in 0.4%–8% of the population [18,19]. Absent LCMA (separate origin of LAD and LCX) CAA is fairly common, with a frequency of 0.41%–0.67%, and is found with increased incidence in aortic valve disease and left system dominance. Hence, non-selective injection into the left aortic sinus must be done prior to any intervention to know the origin of vessels and to prevent inadvertent clinical consequences if damaged during surgery or coronary catheterization.

The length of the LMCA trunk is generally about 5–15 mm long (1). Short and long LMCA trunks were therefore considered to be variants in the length. In the present study in 6% of specimens the length of LMCA was short less than 5mm and in 10% specimens it was more than 15mm. In 84% cases it was between 5-15mm. The findings of the present study is similar to results of Mamatha et al [15]. A short LMCA poses increased risk of damage when carrying out angiography [17,18], while a long LMCA with more than 15mm length has less clinical significance. Left anterior descending artery (LAD) arises from the bifurcation of LMCA, and descends obliquely towards the apex of the heart in the anterior interventricular sulcus. It mainly supplies the left ventricle, apex of the heart and interventricular septum. In the present study, LAD terminates at apex in 15% specimens which is higher compared to the studies done by Kalpana (12%), termination at lower 1/3rd of posterior iv groove 72.5% compared to 80% by Kalpana and before the apex in 12.5% specimens which is higher compared to Kalpana and Julius [6,20]. The findings of the present study shows that LAD is predominantly terminating into posterior interventricular groove. Knowledge about the level of termination is important for reperfusion interventional studies.

CONCLUSION(S)

Coronary artery and its variations are important for clinicians for coronary vessel interventions. It is important to study variations among individuals of different geographical background.

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