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A Cadaveric Study on Morphology, Morphometry of Coronary Arteries

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Key Words

Right coronary artery (RCA), left coronary artery (LCA), circumflex artery (CXA), anterior interventricular artery (AIVA), posterior interventricular artery (PIVA)

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ABSTRACT

The number of patients with coronary artery diseases is increasing every year and is a leading cause of death worldwide. Coronary artery disease is caused by occlusion of one of the coronary arteries, which leads to decreased function of the heart and eventually leads to death. Therefore, a detailed study of coronary arteries is important for a better understanding of coronary pathophysiology and better management of coronary heart diseases such as myocardial infarction and angina pectoris. To see the morphology, morphometry of the coronary arteries. The study was done on 30 human cadaveric hearts collected from the Department of Anatomy HIMSR JAMIA HAMDARD (NEW DELHI). Coronary arteries were dissected to see the origin, course and variations. In all specimens RCA was arising from anterior aortic sinus and LCA was arising from left posterior aortic sinus of ascending aorta. The length of RCA, PIVA, LCA, AIVA ranged from 80-140mm, 40-75mm, 10-25mm and 111-156mm respectively. Circumflex artery was seen only in 4 hearts. The length was between 50-70mm.The diameter of RCA was measured in two segments. First segment was ranged from 3-7.5mm and that of second segment was from 2.5-6.3mm.The diameter of PIVA at the beginning was ranged between 2-4mm and that of mid-point was ranged from 0.1-1.7mm. The diameter of the main stem of LCA ranged from 3.1- 7.7mm. The diameter of AIVA at beginning was ranged between 1.9-6.5 mm and that of midpoint was ranged from 0.2-2.9mm. Circumflex artery was seen only in 4 hearts. The diameter ranged between 2-6mm. LCA bifurcates in 20 specimens and 10 shows trifurcation. This study directs the attention toward the importance of the coronary arteries and its main branches and branching pattern. The patterns obtained here may be clinically relevant during percutaneous coronary interventions or surgical revascularization.

INTRODUCTION

The normal heart is supplied by right and left coronary arteries, which arise from ascending aorta[1].The right coronary artery (Figure 1a) arises from the anterior aortic sinus of the ascending aorta. It initially moves anteriorly and a little to the right between the pulmonary trunk and the right auricle. When it reaches the atrioventricular groove, it descends vertically in that groove to the junction of right and inferior borders where it bifurcates into smaller branches i.e- an acute marginal artery and posterior interventricular artery which lies in the posterior part of the interventricular groove where it most of the times anastomoses with the circumflex branch of the left coronary artery[2,3] (Figure 1b).The left coronary artery (Figure 2a) arises from the left posterior aortic sinus and descends between the left auricle and root of the pulmonary trunk, it appears in the atrioventricular groove and then turns left giving two branches anterior interventricular artery and circumflex artery[4] (Figure 2b). The anterior interventricular continues to descend obliquely towards the apex of the heart in the anterior interventricular groove, curves around the inferior border of the heart, and anastomoses with the posterior interventricular branch of the right coronary artery. The circumflex branch of the LCA travels in the coronary sulcus across the left border of the heart to reach the posterior surface[5]. The most often affected vessels by atherosclerosis are the left circumflex artery and the anterior interventricular artery[6]. Near vascular bifurcation, atherosclerotic plaques are frequently observed[7,8]. In comparison to the other main coronary arteries, the left main coronary artery is the shortest and has a variable length. As a result, in some cases, atherosclerotic plaques might fill the entire vessel[9,10]. The morphology of the left coronary artery exhibits significant variation in terms of its length, caliber, and method of branching. Its trunk is divided in many ways: Trifurcation into the LAD, CXA, and median or ramus intermedius arteries, or bifurcation into the anterior interventricular and circumflex branches[11]. Knowledge of coronary arteries, their variations, and anomalies are important for good clinical outcomes following procedures, like coronary artery bypass grafting, angioplasty, etc[12] Occlusion of coronary arteries causes coronary artery disease, which in turn causes the heart's function to decline and ultimately results in death[8]. Nonatherosclerotic coronary anomalies are the main cause of death in young people[13]. Knowledge of coronary arterial circulation becomes essential for treating heart diseases to get better outcomes. The length and diameter of coronary arteries are important predictors for outcomes after percutaneous coronary intervention (PCI), coronary artery bypass graft surgery (CABG), and management of coronary heart diseases. In the literature cited, not many studies have been carried out with all the parameters together that we are reporting in the present study.

Fig. 1a: Right surface of the heart with a right coronary artery in the right atrioventricular groove (black arrow) RA: right atrium, RAr: right auricle, AA: ascending aorta, PT: pulmonary trunk, RV: right ventricle, RAr: right auricle, BCT: brachiocephalic trunk

Fig. 1b: Posterior surface of the heart with the posterior interventricular artery (black arrow) RA: right atrium, LV: left ventricle, RV: right ventricle, PIVA: posterior interventricular artery

MATERIALS AND METHODS

Permission from the concerned ethical committee: Before conducting the study, permission was granted by the concerned ethical committee of Hamdard Institute Medical Science and Research, Jamia Hamdard. The study was conducted in the Department of Anatomy, Hamdard Institute of Medical Science and Research, New Delhi- 110062.

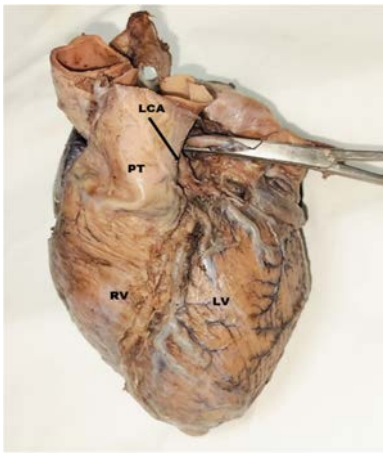

Fig. 2a: Sternocostal surface of heart with LCA between root of pulmonary trunk and left auricle. LCA: left coronary artery, PT: Pulmonary trunk, RV: Right ventricle, LV: Left ventricle

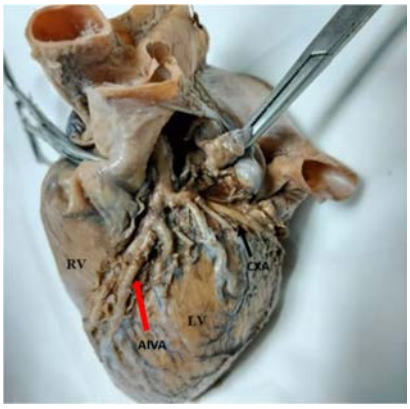

Fig. 2b: Sternocostal surface of the heart withbifurcation of LCA into circumflex artery (black arrow) and AIVA (red arrow). RV: Right ventricle, LV: Left ventricle

Inclusion Criteria: Embalmed human cadaveric hearts were utilized for the study which was obtained from the Department of Anatomy, HIMSR, Jamia Hamdard.

Exclusion Criteria: The hearts in which we couldn't visualize coronary arteries were excluded from the study.

The study was done on 30 human cadaveric hearts collected from the department of anatomy, HIMSR JAMIA HAMDARD (NEW DELHI). Coronary arteries were dissected to see the origin, course and variations. Scalpel, Forceps, Scissor, Marker, Thread, Scale, Tray were used. The heart was collected by following the steps of dissection by the dissector using proper instruments and following universal precautions. Dissection was started by cutting ribs and removing the sternum from the underlying pericardium, opening the thoracic cavity of the cadaver. The parietal pericardium was incised and the heart along with the proximal parts of the great vessels were taken out of the pericardial cavity. Visceral pericardium was stripped and subepicardial fat was removed to study the coronary arteries and their branching pattern. The coronary arteries were traced through the epicardium and sub epicardial adipose tissue. Both arteries were traced carefully to avoid damage to branches. Measurements were taken twice for accurate results.

The length of the following arteries was measured using thread and marking two points from the origin to the branching point or termination of the artery with a marker. Then this thread was kept against a scale and the distance between the two marks tells the length of the artery

The two points of the arteries will be as follows:

Right Coronary Artery:

- From its origin to the crux
- From crux to its termination of PIVA

Left Coronary Artery:

- From its origin to the point of bifurcation
- From the point of bifurcation to the termination of AIVA
- From the point of bifurcation to the crux

RESULTS AND DISCUSSIONS

In all specimens RCA was arising from anterior aortic sinus of ascending aortaand LCA was arising from left posterior aortic sinus of ascending aorta. The length of RCA ranged from 80-140mm with a mean of 115.1±17.10mm, length of PIVA ranged from 40-75mm with a mean of 56.6±8.10mm, length of main stem of LCA was 10-25 mm with a mean of 13.5±2.48mm, length of AIVA was ranged from 111-156mm with a mean of 130.23±13.7mm respectively. Circumflex artery was seen only in 4 hearts. The length ranged between 50-70mm.Diameter of RCA and its branches: The diameter of RCA was measured in two segments. The diameter of the first segment ranged from 3-7.5mm with a mean of 4.63±1.127mm. The diameter of the second segment ranged from 2.5-6.3mm with a mean of 3.89 ± 1.08 mm.The diameter of PIVA was also measured at two points. The diameter at the beginning ranged between 2-4mm with a mean of 2.86±0.54mm. The diameter at the midpoint ranged from 0.1-1.7mm with a mean of 1.03±0.36mm. Diameter of stem of LCA and its branches: The diameter of the main stem of LCA ranged from 3.1- 7.7mm with a mean of 6.19 ±1.06mm. The diameter of AIVA was measured at two points. The diameter at the beginning ranged between 1.9-6.5 mm with a mean of 3.94±1.13mm. The diameter at the midpoint ranged

from 0.2-2.9mm with a mean of 1.71±0.82mm. Circumflex artery was seen only in 4 hearts. The diameter ranged between 2-6mm. Branching pattern of LCA, Out of 30 specimens 20 shows bifurcation and 10 shows trifurcation.

The anatomy of the normal coronary and its variations and anomalies must be thoroughly understood due to the widespread use of improved imaging diagnostic tools. Coronary artery branches can differ in origin, distribution, number, and size. There is a lot of variation in the origins of coronary arteries.

Length of Right Coronary Artery: In the present study, the length of RCA and PIVA was 115.1 ±17.1mm and 56.6±8.10 mm, respectively. These findings were almost similar to Yahya Abass Qasim et al. who reported the length of RCA as 124.3 ±35.3 mm and for PIVA 54.5 ± 10.1mm[14]. The length of RCA and PIVA was reported by many authors. El Sayed *et al*. reported the length of the RCA in two segments. The length of the first segment of the RCA ranged from 5.7 to 8.0 cm with a mean of 6.3 ± 0.6 cm. The length of the second segment of the RCA ranged from 3.4 to 6.0 cm with a mean of 4.9 ± 0.7 cm[15]. Jyoti P Kulkarni reported the average length of the right coronary artery as 4.5- to 7 cm[16].

Diameter of Right Coronary Artery: In the present study diameter of RCA is measured in two segments. The diameter of the first segment ranged from 3- 7.5 mm with a mean of 4.63±1.127mm and that of the second segment ranged from 2.5 -6.3 mm with a mean of 3.89±1.08 mm respectively. A similar study was done by El Sayed in which the diameter of RCA was measured in two segments. The study shows the diameter of the first ranged from 4.0 mm to 7.0 mm with a mean of 5.1 ± 0.7 mm and that of the second segment ranged from 3.1 mm to 5.6 mm with a mean of 4.3 ± 0.8 mm[15]. Silva, j. M. L *et al*. reported an external diameter of 4.38±0.15 mm[17]. A study done by Yahya Abass Qasim *et al*. reported the mean diameter as 3.4 ± 0.7 mm[14]. An Angiographic study was reported by Z Kaimkhan et al. The mean diameter was 3.08 + 0.78 mm[18].

Length of Left Coronary Artery: In the present study the length of the main stem of LCA is 13.5±2.48mm which was almost similar to the studies of Yahya Abass Qasim *et al*. who reported the mean length of LCA as 11.2 ± 3.5 mm[14]. A study done by Sanchita Roy *et al*. reported the mean length as 11.42 +-4.98mm[19]. Anil Kumar *et al*. had the average length as 10.2±3.5mm[20]. G a jos Hemlatha *et al*. reported the length of the main stem between 12.45mm to 25.2mm[21]. Jyoti P Kulkarni reported the average length as 7 mm[16]. Sultana Ruma Alam reported the range from 0.5-2cm[22].

Diameter of Left Coronary Artery: In the present study the diameter of the main stem of LCA is 6.19±1.06mm with a range of 3.1-7.7mm. The diameter of AIVA was taken at two points. One at the beginning and the second at the midpoint which was 3.94±1.13mm for the first segment and 1.71±0.82mm for the second segment respectively. Various other studies were reported. Anil Kumar *et al*. reported the mean outer diameter of the left coronary artery, left anterior descending, and circumflex artery as 4.34+-2.01mm,4.21+-0.28mm, and 2.73+- 0.6mm.20 Yahya Abbas Qasim *et al*. reported the mean diameter of LCA was 4.2 ± 2.0 mm[14].

Branching Pattern: The result of the present study shows that the left coronary artery bifurcates into AIVA and CX in 66% cases and trifurcates into AIVA, CX And diagonal branches in 33% cases. Study done by Roy Sanchita *et al*. reported bifurcation in 56% cases and trifurcation in 40% cases[19]. Study done by Anbusudar *et al*. revealed that LCA shows bifurcation in 80% cases and trifurcation in 20% cases[23]. Bhele *et al*. reported bifurcation in 70% cases and trifurcation in 24% cases[24].

CONCLUSION

This study directs the attention toward the importance of the right coronary artery, left coronary artery its main branches and branching pattern. The patterns obtained here may be clinically relevant during percutaneous coronary interventions or surgical revascularization. Variations in coronary arteries are normal; they are not considered anomalous but a lack of knowledge of these variations may have adverse consequences in catheterization.

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Conflicts of Interest: None

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