

The Study of Number of Ostia, Inner and Outer Diameters of Coronary Arteries at Their Origin in Human Heart: A Cadeveric Study

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1. Introduction

Anatomically coronary arteries are not end arteries because they anastomose with each other by their trunks, branches and sub branches mostly at the precapillary level. Functionally, however, they behave like end arteries, since most of the anastomoses remains impervious.[1] That is why blockage of these vessels lead to critical conditions.

Coronary artery disease is one of the major causes of death worldwide [12.8% of total deaths].In India 28% of total deaths accounted by cardiovascular disease. Roughly 40 million deaths occur annually in India due to cardiovascular disease.[2] The incidence of coronary artery disease is increasing today in developing countries, because of sedentary lifestyle, urbanisation, hypertension, diabetes mellitus and increased type A personality.

The increasing use of diagnostic and therapeutic interventional procedures requires a sound, basic knowledge of the coronary artery pattern. The study of coronary arteries will be useful to the cardiologists and radiologists to predefine the abnormalities by invasive and non invasive studies.

Anomalous coronary origin may cause potentially a dangerous symptom and even sudden death during strenuous activity. Recently coronary artery anomalies as a rare cause of coronary heart disease are going consideration in the diagnostic work up. Most anomalies of coronary arteries have been reported as case reports. The available literature on this study have drawn their samples either from an autopsy population of congenital heart disease or from angiographic studies done for the patients with chestpain complaint. Therefore such studies donot provide data on frequency of occurrence of variation in normal unsuspected population.

By considering the above factors, this current study is done to know the number of ostia and inner and outer diameters of coronary arteries at their origin in human heart ,in an unsuspected population, which will surely help the interventional cardiologists and radiologists for better approach to cardiac diseases.

2. Materials and Method

In the present study 30 heart specimens were collected from department of anatomy and dissected by underwater dissection method. Following observations were recorded.

- No. of ostia in aortic sinus
- Origin of coronary arteries
- Distance from supra valvular ridge
- Ostium diameter, outer diameter of both right and left coronary arteries was measured using digital vernier calliper.

3. Observation

3.1 Number of ostia

Among the 30 hearts studied, 27 hearts showed 2 ostia, one in anterior aortic sinus for right coronary artery and one in left posterior aortic sinus for left coronary artery. Three hearts showed 3 ostia. Two in anterior aortic sinus, one for right coronary and one for right conus artery (third coronary artery).

3.2 Number of ostia in each heart

Number of ostia	Total number of hearts	Percentage
2	27	90%
3	03	10%

3.3 Photograph no.5 showing two ostia in anterior aortic sinus.



3.4 Origin of Coronary Arteries

In all the hearts studied, right coronary artery took origin from the anterior aortic sinus and left from left posterior aortic sinus. In three hearts third coronary artery, a conus artery took origin from separate aortic sinus.

3.5 Showing third conus artery (right conus artery)



Position of ostium of RCA from supra valvular ridge

Position of the ostium of RCA	Total No	Percentage
Below the SVR	30	100%
At SVR	00	00%
Above the SVR	00	00%

Among the 30 hearts studied, ostia of all the right coronary arteries were below the supra valvular ridge and no ostia were present above or at the supra valvular ridge.

Position of ostia of LCA from supra valvular ridge

Position of the ostium of LCA	Total No	Percentage
Below the SVR	26	86.67%
At SVR	04	13.33%
Above the SVR	00	00%

Among the 30 hearts studied 86.6% of the ostia of left coronary arteries were below the supra valvular ridge and 13.3% of were at the supra valvular ridge. None were above the SVR. Ostium of third coronary artery in all the three hearts in which it was present was below the SVR.

Average distance of ostia from supra valvular ridge

	Mean Distance from SVR in mm	SD
Ostium for RCA	1.58	+/- 0.37
Ostium for LCA	1.35	+/- 0.66

Mean distance of ostium for right coronary artery below the supra valvular ridge was 1.58mm, 1.33mm for ostium of left coronary artery and 1.32 mm for third coronary artery. Ostium of left coronary artery is nearer to the supra valvular ridge compared to RCA. On applying Mann Whitney U test (U=359.5), the P value is 0.1734 which is not significant.

Measurement of ostium diameter and outer diameter of RCA

Parameter	Mean	SD
Ostium diameter (mm)	2.49	+/- 0.28
Outer diameter(mm)	4.01	+/- 0.48

Mean ostium diameter of right coronary artery was 2.49+/- 0.28mm, outer diameter was 4.01+/-0.48mm .

Measurement of ostium diameter and outer diameter of LCA

Parameter	Mean	SD
Ostium diameter (mm)	2.67	+/- 0.44
Outer diameter(mm)	4.28	+/- 0.90

Mean ostium diameter of left coronary artery was 2.67+/- 0.44mm, outer diameter was 4.28+/-0.90mm

Comparison of diameters of right and left coronary artery

Parameter	RCA		LCA		T	P
	Mean	SD	Mean	SD		
Ostium diameter	2.49	+/- 0.28	2.67	+/- 0.44	362.5	0.1982
Outer diameter	4.01	+/- 0.48	4.28	+/-0.90	393.5	0.4770

The ostium diameter of LCA is larger than RCA. On applying Mannwhitney U test, P value is 0.1982 which is not significant. The outer diameter of LCA is more than the RCA. On applying Mannwhitney U test, P value is 0.4770 which is not significant.

4. Discussion

Knowledge of normal and variant anatomy of coronary arteries will be helpful for radiologists and interventional cardiologists to predefine the abnormalities. The present study is an attempt to the study various anatomical aspects of coronary arteries. In the present study origin of coronary arteries, diameters of ostia and outer diameter of right and left coronary arteries, branching pattern was noted. The observations in the present study as compared to other studies are as follows

Comparison of number of ostia as observed by other studies

Author & Year	One	Two	Three	Four
KalpanaR[3] (2003)	76%	24%	---	---
Olabu B.O[4].(2007)	64.9%	35.1%	---	---
J.D.Joshi et al.[5](2010)	61.9%	29.5%	07.6%	0.9%
Shilpa Bhimalli et al[6].(2011)	95%	05%	---	---
Shinde V[7] et al(2011)	96.67%	3.33%	----	----
Present study	90%	10%	---	---

Anterior aortic sinus has one ostia for RCA and left posterior aortic sinus has one ostia for LCA. Some times more than two ostia may be present. In the present study 90% of the anterior aortic sinuses showed single ostia and in 10% of specimens it showed two ostia. These extra ostia are for third coronary artery. This result is compared with other studies in the above table

Position of ostia in relation to supra-avalvular ridge as compared to other studies

Author & Year		Below SVR	At SVR	Above the SVR
J.D.Joshi [5] et al.(2010)	Ostium for RCA	89.52%	6.66%	3.8%
	Ostium for LCA	80%	15.23%	4.76%
Shilpa Bhimalli [6] et al.(2011)	Ostium for RCA	84%	16%	----
	Ostium for LCA	93%	6.66%	3.3%
Dalbir Kaur et al[8].(2012)	Ostium for RCA	83%	14%	3%
	Ostium for LCA	78%	15%	7%
Present study	Ostium for RCA	100%	00%	----
	Ostium for LCA	86.67%	13.33%	-----

Most common position of ostia of right coronary arteries in the present study is below the supra-avalvular ridge (100%). In 86.67% of specimens the position of ostia for left coronary artery was present below the supra-avalvular ridge, in 13.33% of specimens the ostia was at the supra-avalvular ridge.

Comparison of ostium diameter and outer diameter of coronary arteries

Author & Year	RCA		LCA	
	Ostium diameter in mm	Outer Diameter in mm	Ostium Diameter in mm	Outer Diameter in mm
Fazliogulari et al[9].(2010)	----	3.32 +/-0.79	----	4.44 +/-1.79
Shilpa Bhimalli et al.[6](2011)	2.38+/-1.33	5.38+/-0.81	3.17+/-0.34	5.73+/-0.74
Dalbir Kaur et al[8] (2012)	3.9+/-1.0	----	4.6+/-1.0	----
Present study	2.49+/-0.28	4.01+/- 0.48	2.67+/-0.44	4.28+/-0.90

In the present study we found average diameter of ostium of RCA (2.38+/-1.33) is less than the average ostium diameter of LCA (2.67+/-0.44). The average outer diameter of RCA 4.01+/-0.48 is also less than average outer diameter of LCA. The importance of the anomalous origin of arteries is during open heart surgeries, it is very difficult to cannulate these vessels which arise from the anomalous ostia. While performing coronary arteriography and angiography, a preliminary aortic root injection of the dye must be given to locate the exact number of orifices and coronary arteries so that fatal outcomes can be prevented. The multiple coronary ostia may be associated with cardiac abnormalities like hypertrophic cardiomyopathy and are rarely associated with congenital coronary anomalies.

5. Conclusion

The knowledge of the existence of such multiple ostia is important to correctly interpret the angiographic findings. Position and size of ostium are very much important for interventional cardiologists. Normal variants, such as multiple ostia, vertical or circumferential shift in position may pose a difficulty during cardiac interventional procedures.

Scope of the study: As the number of ostia and diameters of coronary arteries are variable, it is necessary to report such cases, which will surely enhance the knowledge of radiologists and interventional cardiologists.

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