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CORONARY OSTIA DIMENSIONS IN HUMAN CADAVERIC HEARTS – AN ANATOMIC EVALUATION

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ABSTRACT

Background: The anatomical knowledge including morphometry and topography of coronary ostia is essential for several cardiac procedures including cardiac catheterization and aortic valve replacement. Hence the present study was aimed to study the morphometry and topography of coronary ostia in related to coronary sinus of human cadaveric hearts.

Material and methods: A source of 40 human cadaveric hearts from 26 male and 14 female cadavers without gross abnormalities were considered. Parameters including diameter of coronary ostia, diameter of root of right and left coronary arteries, distance from aortic leaflet commissure, position of coronary ostia at sinotubular junction and frequency of coronary ostia were assessed.

Results: The mean diameter of right coronary ostia (3.7 mm) was significantly less than left coronary ostia 4.1 mm (p=0.0318). The mean diameter of roots of right and left coronary arteries was 3.12 mm and 3.84 mm respectively. Right coronary ostia were lied below the sinotubular junction in 80% of hearts and left coronary ostia was observed at the level of sinotubular junction in 50% of hearts. Single coronary ostia were commonly observed in anterior (92.5%) and left posterior aortic sinus (97.5%).

Conclusion: The anatomical understanding of variations in the morphometry and topography of the coronary ostia accentuate the need of taking them into account in various cardiosurgical operations and interpretation of radiological findings.

Keywords: Coronary ostia, Morphometry, Aortic sinus of Valsalva, Cadaveric heart, Coronary artery

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INTRODUCTION

The origin of ascending aorta from the left ventricle exhibits three aortic leaflets with three corresponding aortic sinuses of Valsalva above (1). These sinuses are lodging the ostia through which coronary arteries arise. Right coronary artery originates from the anterior aortic sinus and left coronary artery arises from the left posterior aortic sinus. The right posterior aortic sinus is non-coronary sinus (2). The position and diameter of coronary ostia in related to supravalvular ridge are important considerations during canulation procedures of coronary arteries. Studies have reported incidence of extra coronary ostia in central India was 32% - 40% and 10% - 18% in southern India (3, 4).

Positional variations in the coronary artery and coronary ostia were frequently associated with coronary heart disease (5). Anomalous origin of coronary artery is frequently observed variation with significant clinical manifestations including sudden death, usually in young athletes (6). Superior origin of coronary arteries is associated with increased risk of myocardial ischemia, and infarction (7). Knowledge on anatomical variations, morphometry and topography of coronary ostia is essential for radiologists to interpret radiological findings, cardiovascular surgeons, and anatomists to attain successful surgical outcome during coronary artery bypass grafting, angioplasty, coronary angiogram. The present study was aimed to assess the morphometry and topography of coronary ostia in related to coronary sinus of human cadaveric hearts.

MATERIALS AND METHODS

The present cadaveric study was conducted in the Department of Anatomy at Kamineni Academy of Medical Sciences and Research Centre, Hyderabad during January 2022 to December 2022. A source of 40 human cadaveric hearts from 26 male and 14 female cadavers with aged ranging from 34 to 65 years were included. Cadaveric hearts with gross abnormalities and evidence of congenital heart diseases were excluded.

Exposure of coronary ostia:

About 1 cm above the aortic leaflet commissures, the ascending aorta was transversely dissected. Later, the level of the posterior aortic sinus was used to longitudinally open the aorta in order to visualise and analyse the right and left aortic leaflets as well as their respective coronary ostia. Following that, the branches of both coronary arteries were dissected. The accompanying veins were removed for proper observation. We investigated branch diversity as well as the prominence of the posterior interventricular branch. The changes of the coronary arterial pattern, site and number of coronary ostia were investigated.

Parameters including diameter of coronary ostia, diameter of root of right and left coronary arteries, distance from aortic leaflet commissure, position of coronary ostia at sinotubular junction and frequency of coronary ostia. he morphometric parameters of coronary ostia were measured by using standard vernier sliding calipers. The data was analyzed by using SPSS 23.0 and represented in mean and standard deviation. Chi-square analysis was used to compare study parameters and $p<0.05$ was considered as statistically significant.

RESULTS

The distance from bottom of aortic sinus to coronary ostia was 13.9mm on right side and 13mm on left side, which was statistically significant ($p=0.001$). The distance from right

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aortic leaflet commissure to coronary ostia was 10.12mm and 15.90mm on right and left sides respectively. while the distance from left commissure was 12.24mm and 12.18mm respectively, which was statistically significant (p=0.0152). The mean diameter of right and left coronary ostia was 3.7mm and 4.1mm respectively, which was statistically significant (p=0.0318). The mean diameter of roots of right and left coronary arteries was 3.12mm and 3.84mm respectively, which was statistically significant (p=0.001) (Table 1).

Table 1: Morphometric details of coronary ostia (n=40).

	Right coronary ostia	Left coronary ostia	p-value
	Mean±SD	Mean±SD	
Distance from bottom of aortic sinus	13.9±2.2	13.0±1.8	0.001
Distance from aortic leaflet commissure			
Right commissure	10.12±2.38	15.90±3.85	0.0152
Left commissure	12.24±2.75	12.18±2.69	
Diameter of coronary ostia	3.7±1.1	4.1±1.3	0.0318
Diameter of roots of coronary arteries	3.12±0.76	3.84±0.98	0.001
Position of coronary ostia at sinotubular junction			
Above	02 (5%)	05 (12.5%)	0.0210
At the level	06 (15%)	20 (50%)	
Below	32 (80%)	15 (37.5%)	

The right coronary ostia were located below the sinotubular junction in 80% of hearts, at the level in 15% and above in 5% of hearts. Whereas, left coronary ostia were located at the level of sinotubular junction in 50%, below in 37.5% and above in 12.5% of hearts (Table 1).

Table 2: Frequency of coronary ostia in aortic sinus.

Number	Anterior aortic sinus		Left posterior aortic sinus	
	Frequency	Percentage	Frequency	Percentage
None	01	2.5%	-	-
One	37	92.5%	39	97.5%
Two & More	02	5%	01	2.5%

One coronary Osita was common observed in anterior (92.5%) and left posterior aortic sinus (97.5%). Two or more number of coronary ostia was seen in 5% of anterior and 2.5% of posterior aortic sinus. Coronary ostia were not seen in 2.5% hearts on anterior aortic sinus (Table 2).

Fig 1: Single coronary ostia in left posterior aortic sinus.

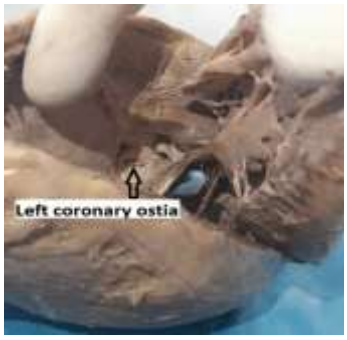

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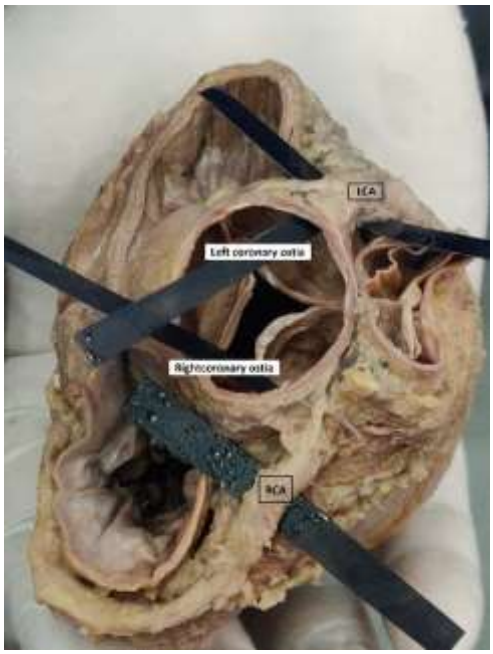
Fig 2: Single coronary ostia in respective coronary sinus.



DISCUSSION

Knowledge on the position of the coronary ostia in relation to the aortic sinus and its accompanying changes are crucial during angiography and coronary artery surgeries. Numerous studies have documented multiple ostia in related to aortic sinuses that give rise to arteries such the sinoatrial nodal artery, conus artery, and third coronary artery (8). The right and left coronary arteries may originate from same aortic sinus. The incidence of origin of both coronary arteries from right posterior aortic sinus was seen in 33 out of 475000 cases and people with this anomaly may often die suddenly after exercise (9). According to a study by Vaishaly K. Bharambe et al., right coronary ostia were found in anterior aortic sinus in 98% of cases and right posterior aortic sinus in 2%. The left coronary ostia were located in left posterior aortic sinus in all the cases (10). However, in the present study right coronary ostia was observed in anterior aortic sinus and left coronary ostia was observed in left posterior aortic sinus.

According to Sharma SK et al., right coronary ostia were found below the sinotubular junction in 94% of hearts, whereas left coronary ostia were found below the sinotubular junction in 88% of hearts, and at the sinotubular junction in 10% of hearts (11). According to Joshi et al., majority of the ostia were lied below the sinotubular ridge (89%) (2). According to Pejkovic B et al., In 60% of hearts, the left coronary artery ostium in the left posterior aortic sinus was above the sinotubular junction, in 22% it was at the level, and in 18% it was below. While the right coronary ostium in the anterior coronary sinus was at the level of the sinotubular junction in 71% of the hearts, it was above in 19% of them and below in 10% (12). In present study, 80% of hearts, the right coronary ostia were below the sinotubular junction, 15% were at the level, and 5% were above the junction. Contrarily, in 50% of hearts, the left coronary ostia were found at the level of the sinotubular junction, in 37.5 % of them below, and in 12.5% of them above.

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According to several investigations, the mean diameter of the left coronary ostia was greater than that of the right coronary ostia (12-17). Similarly, in present study the mean diameter of the right and left coronary ostia in the current study was 3.7mm and 4.1mm, respectively. The mean diameter of the right coronary ostium was larger in this study than in prior investigations, although it was similar on the left side (Table 3). The mean diameter of root of left coronary artery was comparatively higher than the right coronary artery. The results of the current study were consistent with earlier findings and marginally higher than those of previous studies (Table 3).

Table 3: Comparison of diameter of coronary ostia and root of coronary arteries with previous studies.

Parameters	Cavalcanti et al. 2003[13]		Pejkovic B et al. 2008 (n=150)[12]		Jyoti PK et al. 2015 (n=90)[14]		Jyothi SR et al., 2017 (n=49)[15]		Najma M et al. 2021 (n=110)[16]		Rohini Devsi G. 2022 (n=40)[17]		Present study, 2023 (n=40)	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
Diameter of coronary ostia	3.46	4.2	3.6	4.1	2.5	2.8	3.43	4.2	3.43	3.6	3.5	4.2	3.7	4.1
Diameter of root of coronary arteries	2.9	3.7	-	-	-	-	3.00	3.7	-	-	3.01	3.7	3.12	3.84

Table 4: Comparison of frequency of coronary ostia in aortic sinus with previous studies.

Authors	Anterior aortic sinus				Left posterior aortic sinus		
	0	1	2	≥3	0	1	≥2
Joshi SD et al. 2010 (n=105)[2]	-	61.90%	29.52%	7.62%	-	98.10%	1.90%
Vaishaly KB et al. 2012 (n=50)[10]	-	74%	22%	4%	-	100%	-
Jyothi SR et al., 2017 (n=49) [15]	2.04%	87.75%	10.20%	-	-	98%	2%
Dakhane PS et al. 2018 (n=50)[8]	-	82%	18%	-	-	98%	2%
Saminathan S. 2020 (n=50)[18]	-	78%	17%	5%	-	98%	2%
Sharma SK et al. 2022 (n=100)[11]		82%	17%	1%	-	100%	-
Present study (n=40)	2.5%	92.5%	2.5%	2.5%	-	97.5%%	2.5%

Right and left coronary arteries emerge from the anterior and left posterior aortic sinuses, respectively. According to majority of studies, there are often two coronary ostia in the anterior aortic sinus after a single ostium and a single coronary ostium in the left posterior aortic sinus (2, 8, 10, 11, 15, 18). Similar findings were made in the current investigation,

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which discovered single coronary ostia in 97.5% of hearts in the left posterior aortic sinus and 92.5% of hearts in the anterior aortic sinus (Table 4). The present study has limitation in terms of less sample size and evaluated morphometry and topography of coronary ostia in the cadaveric specimen only. Further comparative imaging studies are required to evaluate morphometry and topography of coronary ostium and correlate with cadaveric specimens.

CONCLUSION

The present study made it easier to comprehend the anatomical variations of the coronary ostia that may help during cardiosurgical procedures, interpret the results of angiography, and the significance of assessing such variations before surgical procedures.

Competing interest: None
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