

## Coronary Ostia: A Cadaveric Study

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### Abstract

**Background:** Coronary ostia are the openings in the aortic sinus from which the coronary arteries arise. Coronary ostia may be situated at variable levels in the aortic sinus, at or below the sinutubular junction and also in the tubular part of ascending aorta. Knowledge of location of coronary ostia is essential is helpful in determining the blood flow in coronary vessels. **Purpose of the study:** Knowledge of coronary ostia is important, as procedures like coronary angiograms, angioplasty, bypass graftings and coronary artery stentings are becoming common. Accurate knowledge of coronary ostia is important for aortic graft repair or root replacement. **Results:** A total of 50 hearts were studied. Among them all 50 right coronary artery (RCA) arose from the anterior aortic sinus, 43 of left coronary artery (LCA) from left posterior aortic sinus and 7 LCA from right posterior aortic sinus. In 1 heart there was 2 openings in the anterior aortic sinus. 70% of RCA and 66% of LCA were below sinu tubular junction, 6% of RCA and 10% of LCA were at the sinu tubular junction, 24% of RCA and 24% of LCA were above sinu tubular junction. The width of right coronary ostia (RCO) was  $2.90 \pm 1.1$  and left coronary ostia (LCO) was  $3.2 \pm 0.88$ . The distance of RCO from the bottom of sinus is  $12.41 \pm 2.82$  and LCO is  $12.32 \pm 2.77$ . The mean distance of RCO from commissures of right side is 9.5 and from the left side 12.39 and that of LCO from commissures of right side is 10.8 and from left side 11.8 respectively. **Conclusion:** Due to the recent advances in coronary artery by pass grafts and modern methods of myocardial revascularisation a thorough knowledge of the morphology and morphometric analysis of coronary ostia is essential.

**Keywords:** Coronary Ostia; Sinutubular Junction; Commissures; Coronary Angiograms.

### Introduction

The first system to function in the embryo is the cardiovascular system as early as 4<sup>th</sup> wk. Since then it undergoes rhythmic contractions and relaxation completing the cardiac cycle which never stops until cardiac death [1]. The heart is supplied by right and left coronary arteries. Each artery is a vasa-vasorum of ascending aorta [2]. The aortic root consists of

leaflets of aortic valve which consists of aortic sinuses also called as sinuses of valsalva. The aortic sinuses reach beyond the upper border of cusp and forms well defined complete circumferential sinutubular ridge. These are named as anterior, right and left posterior aortic sinuses respectively. The right coronary artery arises from the right anterior aortic sinus and the left coronary from the left posterior aortic sinus through the coronary ostia [3]. Coronary ostia are orifices located within the aortic sinus from which coronary arteries arise. Coronary ostia may be situated at variable levels in the aortic sinus, at or below the sinutubular junction and also in the tubular part of ascending aorta [4].

The peculiarity of coronary artery is that the blood flows in diastole. Knowledge of location of coronary ostia is essential is helpful in determining the blood flow in coronary vessels. If the location of ostia is below the sinutubular junction blood flows in coronary ostia only in diastole as the ostia remains

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closed by the valves. If they remain above the sinutubular junction it remains open both in contraction and diastole of the heart and coronary blood flows continuously. These people suffer less from coronary insufficiency [5]. The anomalous origin of coronary arteries among coronary artery disease leads to sudden death among young athletes. Knowledge of coronary ostia is important, as procedures like coronary angiograms, angioplasty, bypass graftings and coronary artery stentings are becoming common [3]. Knowledge of location and size of coronary ostia is vital for radiologists performing angiographies for diagnostic purposes and cardiac surgeons implementing interventional and therapeutic measures when managing cardiovascular disease. Size of coronary ostium is important as it gives insight for designing or acquiring of catheters for coronary angiography suitable for that particular population [4]. Accurate knowledge of location of coronary ostia in relation to aortic root is important for aortic graft repair or root replacement and percutaneous or transapical aortic valve replacement for symptomatic aortic valvular disease [6]. Since the coronary ostia is useful for various interventional and surgical procedure the present study was undertaken wherein topography, morphology and morphometry of the coronary ostia has been studied.

## Materials and Methods

This study was conducted on 50 formalin fixed human hearts. The specimens were obtained during routine undergraduate dissection from the department of anatomy in Pondicherry Institute of Medical Sciences. The hearts were dissected, the pericardium involving the root of aorta was removed and the origins of right and left coronary artery identified. Then the ascending aorta was

sectioned approximately 3 cms above the commissures of aortic leaflet. Next the aorta was longitudinally opened at the level of right posterior aortic leaflet to enable the visualisation and analysis of aortic leaflet and the respective coronary ostia. The following observations and measurements were made.

1. Origin of the right and left coronary arteries.
2. Number of coronary ostia in various aortic sinuses.
3. Location of coronary ostia in relation to sinu-tubular junction.
4. The width and height of right and left coronary ostia.
5. Distance of the coronary ostia from the bottom of sinus.
6. Distance of coronary ostia from commissures of aortic leaflets.
7. Location of coronary ostia whether in central or peripheral part of aortic sinus was recorded.

## Results

The origin of right coronary artery was taken from anterior aortic sinus in 50 hearts out of 50 hearts. Left coronary artery was originated from left posterior aortic sinus 43 hearts and 7 hearts it was from right posterior aortic sinus (Table 1 and Figure 1). In all hearts the number of coronary ostia in aortic sinuses was one, but only in one heart it was two openings at anterior aortic sinus (Table 2 and Figure 2). The following observations were measured and tabulated, location of coronary ostia in relation to sinu tubular junction, diameter of coronary ostia, distance of coronary ostia from commissures, distance from bottom of sinus to coronary ostia, location of coronary ostia in relation to aortic sinus (Table 3,4,5,6,7).

**Table 1:** Origin of right and left coronary arteries

Heart	Anterior aortic sinus	Left posterior aortic sinus	Right posterior aortic sinus
Right coronary ostia	50	-	-
Left coronary ostia	-	43	7

**Table 2:** No. of coronary Ostia in various aortic sinuses

No. of openings	Anterior aortic sinus	Left posterior Aortic sinus	Right posterior Aortic sinus
0	0	0	50
1	49	43	7
2	1	0	0

**Table 3:** Location of coronary ostia in relation to sinu tubular junction (stj)

Level of Ostium	Right coronary ostia		Left coronary Ostia	
	Frequency	Percentage	Frequency	Percentage
Below STJ	35	70%	33	66%
At STJ	3	6%	5	10%
Above STJ	12	24%	12	24%

**Table 4:** Diameter of coronary ostia

Height	Right coronary ostia		Height	Left coronary ostia	
	Width			Width	
1.31-5 (2.58+ 0.81)	1.72-5.66 (2.90+1.1)		1.34-6 (2.85+0.90)	1.29-5.39 (3.2+0.88)	

**Table 5:** Distance of coronary ostia from commissures

Coronary Ostia	Commissures of Aortic Leaflet	Mean	S.D
Right	Right Commissures	9.5	2.83
	Left Commissures	12.39	3.67
Left	Right Commissures	10.8	2.57
	Left Commissures	11.8	3.71

**Table 6:** Distance from bottom of sinus to coronary ostia

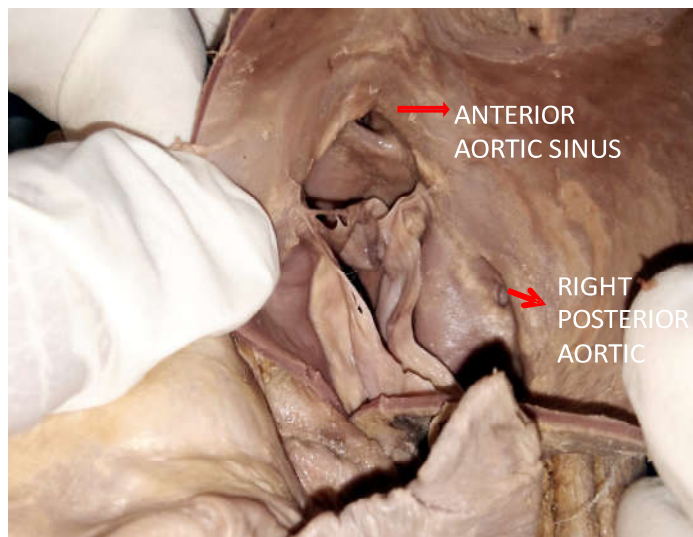
Coronary Ostia	Mean + S.D	Distance
Right Coronary Ostia	12.41+2.82	7.05-18.08
Left Coronary Ostia	12.3+2.77	5.03-20

**Table 7:** Location of coronary ostia in relation to aortic sinus

Coronary ostia	Central	Peripheral
Right Coronary ostia	10	40
Left coronary ostia	11	39

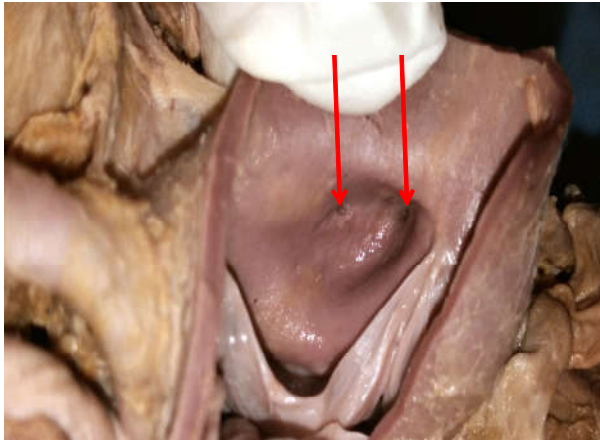
**Table 8:** Mean Diameters of Right and Left Coronary ostias

Study	RCO	LCO
Cavalcanti et.al.2003	3.46+ 0.94	4.75+0.73
Bhimali et.al.2011	2.38+1.33	3.17+0.34
Nalluri et.al.2016	3.17+0.87	4.1+0.83
Kohlar et.al	3.83	4.83
Present study	2.9+1.1	3.2+0.88

**Fig. 1:** Anomalous origin of left coronary artery from right posterior aortic sinus

**Table 9:** Location of coronary ostia in relation to sino tubular junction(stj)

	Relation to STJ	Cavalcanti et.al 2003	Muriago et.al1997	Gosva F et.al 2010	Nalluri et.al	Present study
RCO	Above	28%	13%	13%	11.25%	24%
	Below	60%	78%	78%	65%	70%
	At	12%	2%	9%	23.75%	6%
LCO	Above	40%	13%	29%	8.75%	24%
	Below	42%	78%	58%	52.50%	66%
	At	18%	2%	13%	38.75%	10%

**Fig. 2:** Anterior aortic sinus showing 2 ostia

## Discussion

The awareness of anatomic variants in topography and morphology of coronary ostia may decrease the morbidity and mortality associated with various invasive procedures. The root of aorta is the frequent site for interventional procedures. So understanding the precise nature and relations of anatomical structure at the aortic root is valuable in percutaneous and transcatheter therapeutic techniques for valve or device implantation.<sup>1</sup>

In the present study out of the 50 hearts studied the right coronary artery arose from the anterior aortic sinus in all the 50 heart whereas 43 left coronary artery arose from the left posterior aortic sinus and 7 LCA arose from the right posterior aortic sinus. It was slightly different from the studies conducted by Dombé et.al where out of 65 heart studied RCA arose from anterior aortic sinus and LCA arose from left posterior aortic sinus. In a study conducted by Nalluri et.al out of 78 heart studied RCA originated from anterior aortic sinus in 77 heart and 1 from left posterior aortic sinus. LCA from left posterior aortic sinus in all 77 heart and 1 from right posterior aortic sinus. This knowledge may be helpful for various procedures at the aortic root like aortotomy incision for aortic exposure, preparing a coronary button in root replacement, delivery of

cardioplegia through coronary orifices and approach for aortic root enlargement (Table 8). The mean diameter of the left coronary ostia is higher when compared to the right coronary ostia. This observation was in agreement with the work done by Cavalcanti et.al, Bhimali et.al, Nalluri et. al and Kohlar et. al. Knowledge of coronary ostial diameter is helpful in designing the perfusion cannula which is used to administer cardioplegic solution into right and left coronary arteries in aortic insufficiency (Table 9).

The location of the coronary ostia in relation to the sinotubular junction varies widely. In the present study about 70% of the right coronary ostia and 66% of the left coronary ostia is below the sino tubular junction. 24% of both RCO and LCO lies above and 6% of RCO and 10% of LO lies at the sinotubular junction. It is similar to the study conducted by Gosva et.al, Muriago et.al. A coronary ostia is considered ectopic if it lies 0.5 cm above the ST junction. It is difficult to insert the catheters in patients with ostium above the level of ST junction, and in open heart surgeries difficult to cannulate the vessels [3] (Table 10).

In the present study the mean distance between the coronary ostia and bottom of coronary sinus is more or less equal in both right and left coronary ostia. It is slightly different from other studies where the right ostia is at a higher level when compare to left ostia. This knowledge is essential in percutaneous and transcatheter therapeutic techniques for repair or replacement of aortic valve [7] (Table 11).

In the present study about 80% of RCO and 75% of LCO were peripherally located. The rest of the ostias were centrally located. In the present study it is seen that right coronary ostium is deviated more towards the right and even left coronary ostium towards right side. This is similar to the work done by cavalcanti et. al, Srikonda et. al and jyotiet.al. This circumferential deviation of coronary ostia is helpful for radiologists in interpreting images of coronary angiograms.

## Conclusions

Due to the recent advances in coronary artery bypass grafts and modern methods of myocardial revascularisation a thorough knowledge of the morphology and morphometric analysis of coronary ostia is essential. These data may be helpful for surgeons to modify their surgeries involving aortic root and radiologists for interpretation of the results.

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