

ANATOMICAL STUDY OF MORPHOLOGY OF CORONARY OSTIA IN HUMAN CADAVERIC HEART

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Abstract

Background: Aortic root comprises of the bulbar aortic sinus and the proximal ascending aorta. The right and left coronary artery arise from the anterior and left posterior aortic sinus of Valsalva respectively. This is an important area for various diagnostic and surgical interventional cardiac procedures. So, this study was aimed to explore details of morphology of coronary ostia. **Materials and Methods:** This cross-sectional study was conducted in department of anatomy, PDU Government medical college, Rajkot, Gujarat. 50 human cadaveric hearts were studied for number of coronary ostium and its location in relation to sinotubular junction. Specimens having accessory ostia were studied in detail for the course of artery arising from that ostium. **Result:** The right coronary ostium located in the anterior aortic sinus and left coronary ostium in left posterior aortic sinus in all 50 hearts. In all the hearts ostia were present below the sinotubular junction except in four hearts; in that, right coronary ostium was present at the level of sinotubular junction. Out of 50 hearts, 8 hearts were having two ostia in anterior aortic sinus and one heart had two ostia in left posterior aortic sinus. In anterior aortic sinus one ostium was giving rise to the right coronary artery while another ostium present left to main ostium was giving rise to right conus artery. In left posterior aortic sinus one ostium was giving rise to the left coronary artery while another ostium was giving rise to left conus artery. **Conclusion:** Aortic root is the area of great anatomic variability. End of this study concludes that variation in the location and number of coronary ostia should be kept in mind while performing various vascular interventions at the aortic root.

INTRODUCTION

Coronary artery disease (CAD) is one of the leading causes of death. A non-surgical, invasive procedure like percutaneous coronary intervention (PCI) is performed to relieve the narrowing or occlusion of the coronary artery. To delineate the anatomy, coronary arteries are engaged using different catheters for the right and left coronary arteries with the use of intravenous contrast.^[1]

Coronary arteries arise from the aortic sinus present at the aortic root. The Aortic root comprises of the bulbar aortic sinus and the proximal ascending aorta. Three semilunar cusps form the tricuspid aortic valve. Three aortic sinuses are as follows – anterior aortic sinus (AAS), left posterior aortic sinus and right posterior aortic sinus. The ostium of the right coronary artery (RCA) lies in the anterior aortic sinus. The ostium of the left coronary artery (LCA) lies in the left posterior aortic sinus. No artery arises from the right posterior aortic sinus (noncoronary sinus).^[2] The tubular structure separating the aortic root from the ascending aorta, formed by the distal

part of the sinuses towards the ascending aorta and commissures is called the sinotubular junction (STJ). The position of the coronary ostium can be described concerning the sinotubular junction.^[3]

The study of coronary ostia is essential for cardiac interventional procedures done for diagnostic and therapeutic purposes. The advances in coronary artery bypass surgeries and modern methods of revascularization make it necessary to have exhaustive knowledge of coronary arteries.^[4] So certainly, the present study was aimed to study the location and number of coronary ostia in aortic sinuses and the arteries arising from the ostia.

MATERIALS AND METHODS

This cross-sectional study was carried out on 50 formalin-fixed human cadaveric hearts in the Department of Anatomy, PDU Government medical college, Rajkot, after approval from the institutional ethical committee. Hearts were already procured from cadavers during routine dissection, so sex is not determined.

The hearts were further dissected to identify the aortic root, aortic sinuses and coronary arteries. The ascending aorta was transversely sectioned approximately 1 cm above the aortic leaflets. After that, the aorta was longitudinally cut open from the right posterior aortic sinus.^[5] The specimens were thoroughly washed under running tap water to enable the visualization of coronary ostia.

The sinotubular junction was identified at the commissures of the aortic cusps; the position of the coronary ostium was noted in relation to the sinotubular junction as below STJ, at STJ and above STJ. The Numbers of coronary ostia in their respective sinuses were noted. The arteries arising from the ostia were traced and identified on the base of their course. [Figure 1]

The findings were checked by three individual observers. The collected data were compiled and analyzed for standard statistical methods with Microsoft excel 2016 and epi info TM software.

RESULTS

In the present study of 50 cadaveric hearts, the following observations were recorded under the following headings:

1. The location of ostia

2. The number of ostia

3. Artery arising from the accessory ostium

Location of ostia

The right coronary artery ostium in all 50 hearts was present in the anterior aortic sinus. In 46 Out of 50 specimens, right coronary artery ostia were below the level of sinotubular junction, while in four specimen ostium was present at the level of sinotubular junction. [Figure 2]. The left coronary artery ostium in all 50 hearts was present in the left posterior aortic sinus below the level of the sinotubular junction. [Table 1]

No. of ostia

Out of 50 hearts, 42 hearts showed one ostium in the anterior aortic sinus, whereas 8 hearts had two ostia in the anterior aortic sinus. [Figure 3] In 49 hearts one ostium was present in the left posterior aortic sinus, whereas in 1 heart two ostia were present in the left posterior aortic sinus. In all 50 hearts, the ostium was absent in the right posterior aortic sinus. [Table 2]

Artery arising from the accessory ostium

In 8 hearts, two ostia were present in the anterior aortic sinus. The right coronary artery was arising from the main ostium while the right conus artery was arising from the accessory ostium [Figure 4]. In one heart accessory ostium was found in the left posterior sinus and the left conus artery was arising from that ostium.

Table 1: Location of Coronary Ostium in aortic sinus

Ostium in Aortic sinus	AAS	LPS	RPS
RCO	50	0	0
LCO	0	50	0
Accessory Ostium	8	1	0

Table 2: No. of ostia in aortic sinus

No. of ostium	AAS	LPS	RPS
0	0	0	50
1	42	49	0
2	8	1	0

Table 3: Comparison of location of ostia with various studies in relation to STJ

S.no.	Study	RCO			LCO		
		Below STJ	At STJ	Above STJ	Below STJ	At STJ	Above STJ
1	Joshi SD et al (n=105)	94	7	4	84	16	5
2	Parimala, Sreelatha (n=100)	62	11	26	44	19	36
3	JP Kulkarni (n=90)	24	51	15	27	47	16
4	Hima bindu et al (n=80)	52	19	9	42	31	7
5	Ranjana agrawal (n=50)	39	5	6	34	8	8
6	Present study (n=50)	46	4	0	50	0	0

Table 4: Comparison of Number of ostium with various studies

S.no.	Study	No. of ostium	AAS	LPS	RPS
1	Kalpana R et al (2003) (n=100)	0	0	0	100
		1	75	100	0
		2	25	0	0
2	Subhash D joshi et al (2010) (n=105)	0	0	0	105
		1	65	103	0
		2	31	2	0
		3	8	0	0
		4	1	0	0
3	Gajbe U L et al (2010) (n=30)	0	0	0	30
		1	25	30	0
		2	2	0	0
		3	3	0	0
4	Parimala, Sreelatha (2012) (n=100)	0	4	1	98

		1	74	97	2
		2	19	2	0
		3	3	0	0
5	JP kulkarni (2015) (n=90)	0	0	0	90
		1	68	90	0
		2	22	0	0
6	D'souza M. R. et al (2015) (n=51)	0	2	1	48
		1	40	49	1
		2	5	1	2
		3	2	0	0
		4	2	0	0
7	Hima bindu nalluri et al (2016) (n=80)	0	0	0	0
		1	63	80	0
		2	14	0	0
		3	2	0	0
		4	1	0	0
8	Ranjana agrawal (2018) (n=50)	0	2	0	50
		1	39	48	0
		2	8	2	0
		3	1	0	0
9	Present study (2023) (n=50)	0	0	0	50
		1	42	49	0
		2	8	1	0

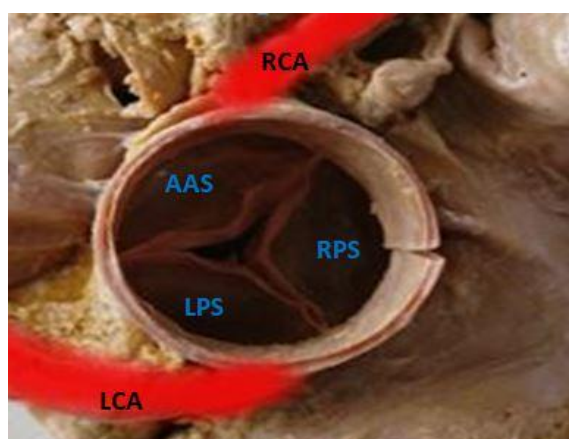


Figure 1: Transversely sectioned aorta, showing aortic sinuses and right & left coronary arteries

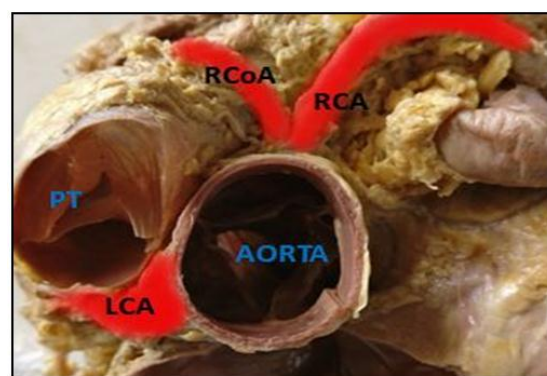


Figure 4: Right conus artery arising from accessory ostium

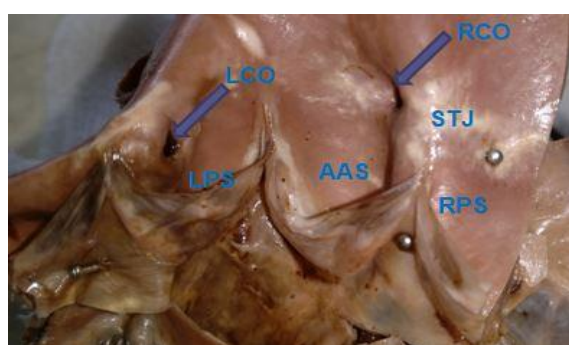


Figure 2: RCO present at STJ

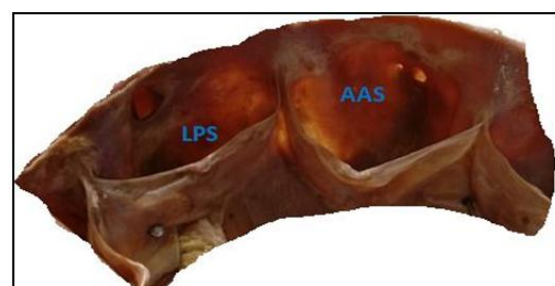


Figure 3: two ostium in AAS

DISCUSSION

The aortic root is an important area for various valvular repair and reimplantation surgery in case of failure of any component at the aortic root.^[6] As the coronary arteries are arising from the ostium present in the aortic sinuses this is an area of interest for the cardiologist for percutaneous coronary interventions.^[1] Various studies reported the anomalous origin of the coronary arteries instead of its respected aortic sinus.^[5,7-10] Anomalous origin of a coronary artery can lead to sudden cardiac death in young adults. Steinberger J et al. reported it as one of the causes of sudden unexpected cardiac death in the first two decades of life.^[11,12] Parimala sirikonda observed in her study that RCA arose from the left posterior aortic sinus in two specimens out of 100 hearts.^[5] As per the study done by Ashwini Vijay bhele et al on 50 hearts, RCO was in the anterior aortic sinus in all hearts, while in one heart LCA takes anomalous origin from the right posterior aortic sinus.^[9] Ranjana Agrawal reported the origin of RCA and LCA both from the left posterior aortic sinus in two hearts.^[10] The present study does not inconsistent with the finding of any anomalous origin of right and left coronary arteries.

The study done by Joshi SD et al, Jyoti and Vaishali, Gajbe U L et al and Kalpana R noted that RCA arising from RCO present in AAS and LCA arising from LCO present in the left posterior aortic sinus in all the formalin-fixed hearts similar with present study.^[4,13-15]

Various studies reported variations in the location of coronary ostium as at STJ, Below STJ and above STJ.^[4,5,8,10,13] [Table 3] shows a comparison of various studies with the present study for the findings of the location of ostium in relation to the STJ. The present study does not agree with these findings as we noted the location of ostium below STJ, only four specimens had RCO at the STJ.

Any surgical procedures involving the aortic root, like Bentall's procedure, require preoperative knowledge about the course of coronary arteries as well as accessory coronary ostia or arteries.^[16] [Table 4] shows a comparison of the present with other studies for the numbers of accessory ostia. A study done by Joshi SD et al, D'souza M. R. and Hima bindu nalluri et al found multiple openings, varying from one to four in the anterior aortic sinus.^[4,7,8] A similar study done by Ashwini vijay bhele et al on 50 hearts found 15 hearts with multiple ostia in the anterior aortic sinus and 3 hearts showed multiple openings in the left posterior sinus.^[4] Jyoti P. Kulkarni (2015) reported 22 specimens with two ostia in the anterior aortic sinus out of 90 hearts. The right conus artery was arising independently from the accessory ostium.^[13]

As per the report of the prevalence of anatomical variants and coronary anomalies studied with 64-slice CT coronary angiography, the right conus artery arises from the RCA in 64%, in proximity with the RCO in 22% or from the anterior aortic sinus in 12%.^[17] The present study also finds much similar prevalence of origin of the right conus artery from AAS in 8 (16%) hearts. Gajbe U L et al also reported separate origins of the right conus artery in 5 (16.6%) hearts, out of their three hearts show three ostia, third one is for the vasa vasorum to pulmonary trunk.^[14] In a study by Kalpana R et al, 24 specimens out of 100 showed the right conus artery arising from a separate ostium in AAS; in 1 specimen sinoatrial nodal artery (SANA) arising from the separate ostium near the ostium of the right coronary artery.^[15] The present study keeps up these findings as the most common artery arising from accessory ostium was the right conus artery. The right conus artery usually forms an anastomosis with the corresponding branch of LCA on the distal part of the truncus arteriosus known as Vieussen's arterial ring. It is an important collateral pathway between the right and left coronary arteries.^[18]

Accessory ostium was also noted in the left posterior aortic sinus by various authors.^[5,9,10] Out of 100 hearts Parimala sirikonda, Sreelatha S. reported two specimens having two ostia in the left posterior aortic sinus. That one specimen had a separate ostium for the left anterior descending artery and left circumflex artery and in one specimen RCA and LCA arose from

separate ostium.^[5] These findings were discrete from the present study as we find the left conus artery arising from the accessory ostium present in the left posterior aortic sinuses.

CONCLUSION

Present study was conducted at anatomy department, PDU Government medical college, Rajkot. Study samples were 50 human cadaveric hearts. In all hearts right coronary ostium found in anterior aortic sinus and left coronary ostium found in left posterior aortic sinus. Four hearts showed right coronary ostium at the sinotubular junction, rest of the ostia was below the sinotubular junction. In 8 hearts, accessory ostium was present in the anterior aortic sinus give rise to right conus artery and in one heart accessory ostium was present in the left posterior aortic sinus give rise to left conus artery.

Aortic root is the area of great anatomic variability. End of this study concludes that variation in the location and number of coronary ostia should be kept in mind while performing various intravascular interventions at the aortic root.

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