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Study on topographic relations of coronary ostia with sinotubular junction, commissure of aortic leaflets and aortic sinuses in human cadavers

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Abstract

Objectives: The coronary angiography can be performed successfully by having knowledge on the location and level of coronary ostia. The morbidity and mortality of invasive procedures may be reduced by studying the topographical relations of coronary orifices. The present study is undertaken

1. To observe the relations of coronary ostia to Sinotubular junction.
2. To measure the distance of coronary ostia from commissures of aortic leaflets.
3. To measure the distance between coronary ostia and bottom of corresponding aortic sinus.

Materials and Method: The present study was done on 49 formalin fixed human cadaveric hearts and the position of coronary ostia with respect to sinotubular junction and commissure was noted. The distance between coronary ostia and the bottom of the aortic sinus was measured.

Results: It was observed that the incidence of various locations of coronary ostia in relation to STJ was in 44 (89.8%) specimens right coronary ostium was below STJ and in 26 (53.1%) specimens left coronary ostium was at STJ which was statistically significant (p-value<0.0001). The distance of right coronary ostia from its right and left commissures was 9.73mm and 14.55 mm respectively. The distance of left coronary ostia from its right and left commissures was 11.74mm and 11.27 mm respectively. The right coronary ostium was deviated to right commissure which is towards right posterior aortic sinus and the left coronary ostium was almost near the centre of aortic sinus which was statistically significant (p-value<0.001). The mean distance of right coronary ostium from the bottom of aortic sinus was (14.1mm) greater than left coronary ostium (12.7mm) which was statistically significant (p-value=0.001).

Conclusion: One of the difficult challenges to cardiac surgeons is selective insertion of catheter tips which requires awareness on anomalous coronary ostia.

Keywords: Aortic leaflets, Aortic sinus of Valsalva, Coronary arteries, Coronary ostia, Sinotubular junction

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Introduction

The smooth-walled outflow tract of left ventricle, the aortic vestibule terminates at the aortic orifice and its associated aortic valve. The general construction of aortic valve consists of fibrous annulus, three semilunar cusps or valves attached to annulus and three dilatations of aortic wall termed aortic sinuses corresponding to the cusps. The positions of cusps in mature heart are anterior, left posterior and right posterior. Corresponding name apply to the SINUSES. Zone of apposition of each cusp is commissure. Based on relation of sinuses to origin of coronary arteries the anterior termed – right coronary sinus, the left posterior – left coronary sinus and the right posterior – non coronary sinus. The right and left coronary arteries arise from the anterior and left posterior aortic sinuses respectively.(1) The right and left coronary ostia are located in relation with sinus of valsalva close to aortic root which is an important landmark for cardiac surgeons and radiologist.(2) The surgical and radiological attempts requires a detail study on the location of coronary orifices to aortic valve.(3) Surgical procedures such as aortic valve replacement also requires an awareness about variations in the location of coronary ostia.(4)

The only anatomical feature that could account for the selective origin of the coronary arteries from the two juxta pulmonary sinuses is the saddle shape or catenoidal configuration of these two sinuses that differs from other aortic sinus and the three pulmonary sinuses.(5,6)

Best planning of surgeries and to understand coronary artery diseases a good knowledge on topographical relations is important. The procedures like aortotomy incision for aortic exposure and preparing a coronary button might get disturbed if there are changes in topographical relations of coronary orifices as it affects coronary blood flow.(7)

Materials and Method

The present study was conducted on 49 hearts of human cadavers fixed with 10% formalin, collected from the department of Anatomy and Forensic Medicine, Mysore Medical College and Research Institute, Mysore.

The ascending aorta was sectioned transversely approximately 1 cm above the commissure of aortic leaflets. Next the aorta was longitudinally opened at the level of right posterior aortic (non coronary sinus) to enable the visualisation and analysis of right and left aortic leaflets and their respective coronary ostia.

Measurements were made with help of Vernier callipers and exact measurements were noted in millimetres. Statistical methods employed in present study were descriptive statistics and inferential statistics. All the statistical calculations were performed using the software SPSS (Statistical Package for Social Sciences) for windows version 14.0 evaluation version. Based on data obtained topographic characteristics of coronary ostia were analysed.

Observations

It was observed that the right coronary ostium was more commonly located below the sinotubular junction and the left coronary ostium was more commonly located at the sinotubular junction (Fig. 1, 2 & 3).

The right coronary ostium was deviated to the right commissure which was towards right posterior aortic sinus and left coronary ostium was almost near the centre of aortic sinus (Fig. 4, 5).

The mean distance of right coronary ostium from bottom of aortic sinus was greater than left coronary ostium which was statistically significant (Fig. 6, 7).

The probable explanation for the mean distance of right coronary ostium from bottom of aortic sinus to be greater than left, eventhough the right coronary ostium was below is the mean diameter of left coronary ostium(4.3mm) was greater than right coronary ostium(3.4mm) which was statistically significant($p < 0.0001$).

The distance of coronary ostia from bottom of aortic sinus also depends on total height and width of the corresponding aortic sinus.

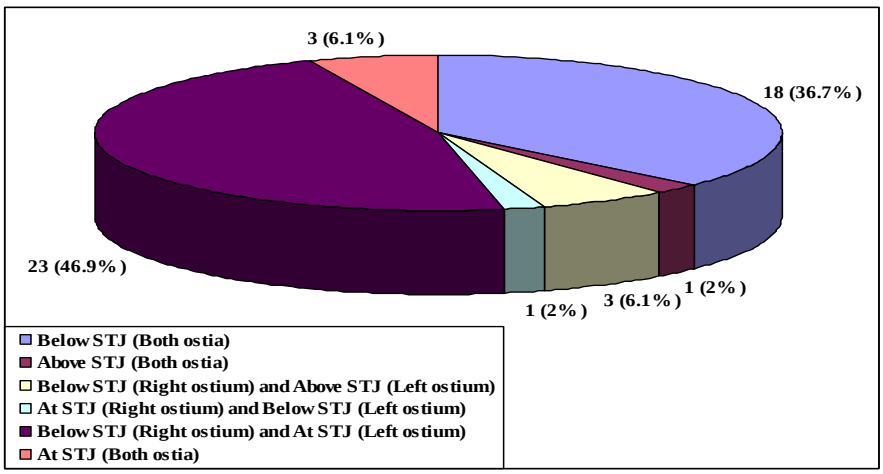

Fig. 1: Location of coronary ostia in relation to sinotubular junction

In 23 specimens (46.9%) right ostium was below STJ and left ostium was at STJ followed by 18 specimens (36.7%) in which both ostia were below STJ.

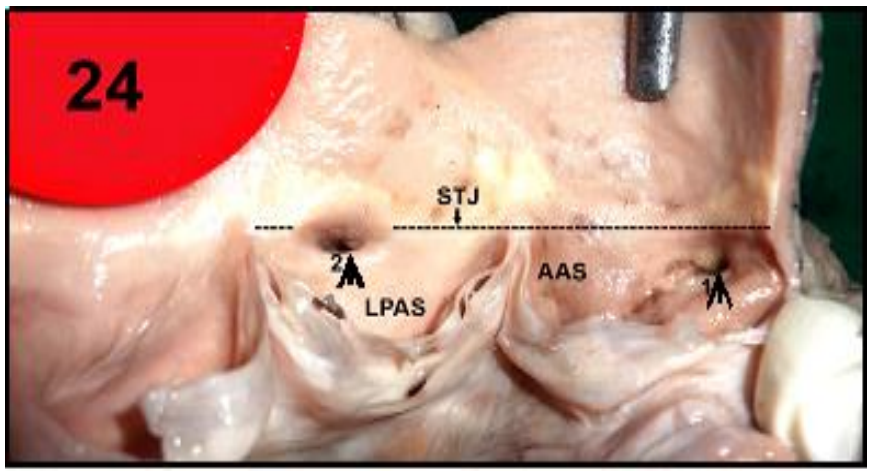

Fig. 2: Location of coronary ostia with respect to sinotubular junction 1. Right coronary ostium below sinotubular junction 2. Left coronary ostium at sinotubular junction

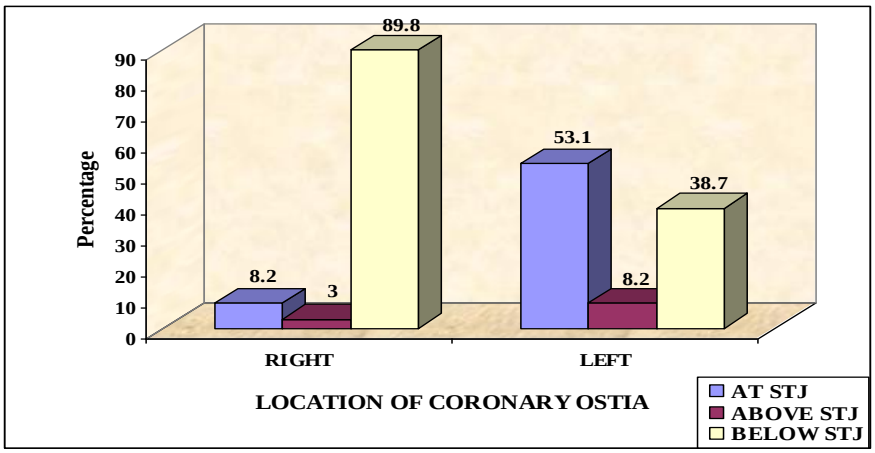

Fig. 3: Incidence of various locations of coronary ostia

In 44 (89.8%) specimens location of right coronary ostium was below STJ and in 26 (53.1%) specimens left coronary ostium was at STJ which was statistically significant (p-value<0.0001).

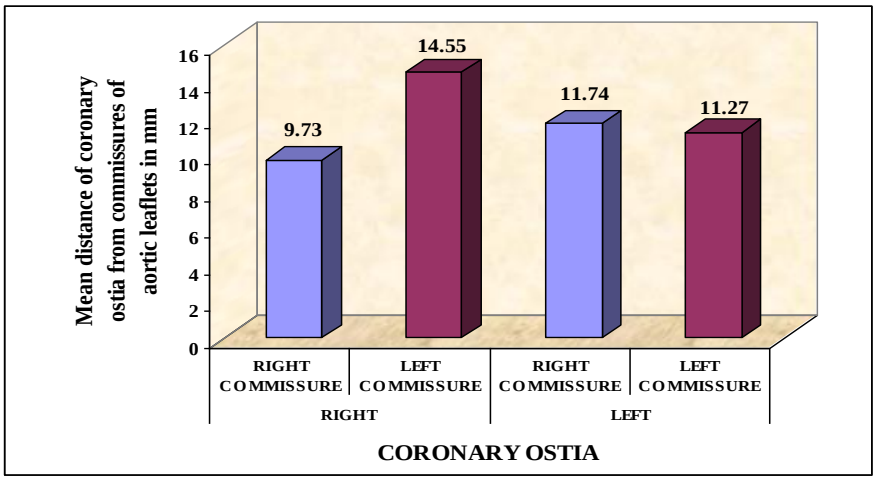

Fig. 4: Distance of coronary ostia from commissures of aortic leaflets

The right coronary ostium is deviated to right commissure which is towards right posterior aortic sinus and the left coronary ostium is almost near the centre of aortic sinus which was statistically significant (p-value<0.001).

Zone of apposition of each cusp is COMMISSURE.[1]

Fig. 5: Right coronary ostium deviated towards the commissure on its right i.e. towards right posterior aortic sinus (non coronary sinus) and left coronary ostium almost near the centre of aortic sinus 1. Right coronary ostium, 2. Left coronary ostium Red arrows indicating the commissure to the right and left of left coronary ostium

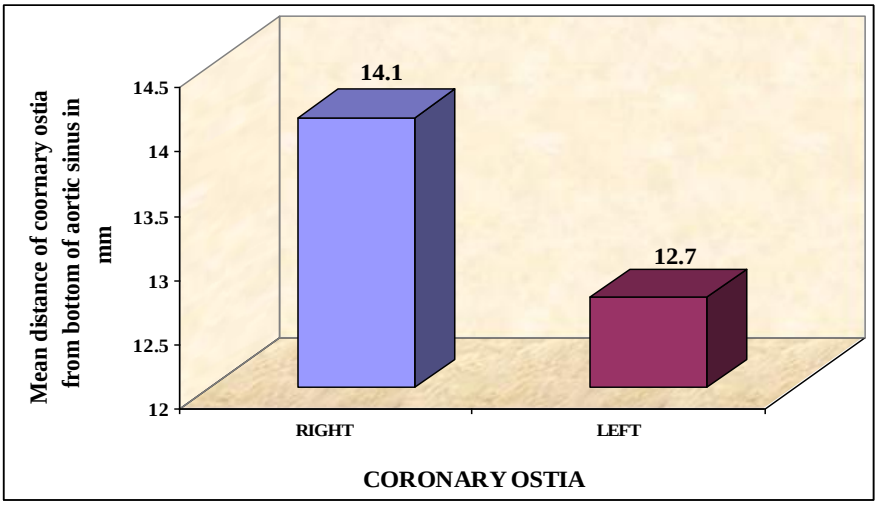

Fig. 6: Distance of coronary ostia from bottom of aortic sinus

The mean distance of right coronary ostium from the bottom of aortic sinus was greater than left coronary ostium which was statistically significant (p-value=0.001).

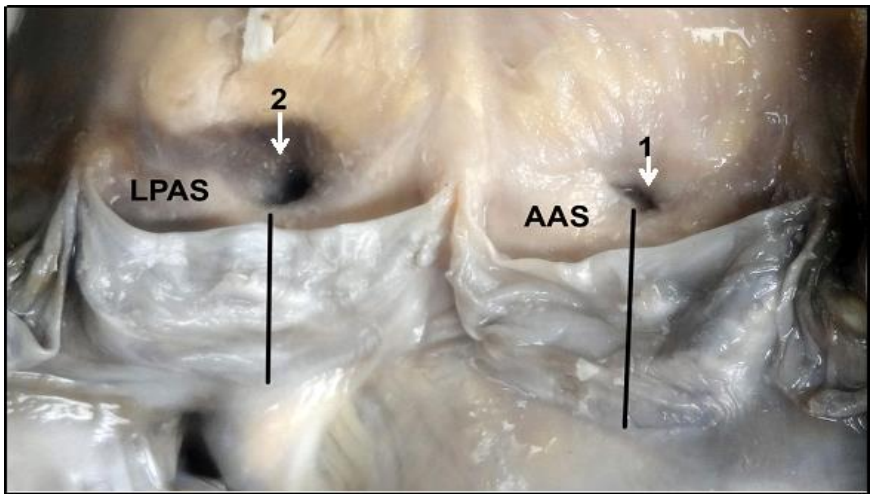

Fig. 7: Distance of right coronary ostium was more than left coronary ostium from bottom of aortic sinus 1. Right coronary ostium, 2. Left coronary ostium

Discussion

During ventricular diastole coronary filling can reach its maximum when both coronary ostia are present within aortic sinuses or at junction of sinus and tubular portion of aorta**.** Malformation of the position of ostia and origin of coronary arteries lead to high risk of sudden death.[8] In the present study 1heart presented right coronary ostium above the STJ and in 4 hearts left coronary ostium was above the STJ, but all measured only few millimeters from STJ and in none of them the distance was more than 10mm which is pathologically significant. The potential clinical disadvantage of high origin of the coronary orifice lying above sinotubular junction is myocardial ischemia. That is distance from the coronary orifice to sinotubular junction > 10mm is considered pathologically significant.[8]

The aortic root is a frequent site of interventional procedures in both adults and children. The procedures such as percutaneous and transcatheter therapeutic techniques requires a precise knowledge on the components of aortic root which includes coronary orifices.[8]

In present study, a statistical significance was observed in location of coronary ostia in relation to sinotubular junction, where in, right coronary ostium was more commonly located below sinotubular junction, whereas the left coronary ostium was more common at the sinotubular junction. The present study was compared with other studies (Table 1 & 2).

Performing coronary angiographies and interpreting the same requires a detailed knowledge on topographic relations of coronary ostia. The procedures like insertion of catheter tips might pose difficulty in

patients with ostium above the level of sinotubular junction.[9]

In present study, it was observed that right coronary ostium was deviated to right commissure which is towards right posterior aortic sinus. And the left coronary ostium was almost near the centre of aortic sinus. Table 3 represents the comparison of present study with other studies. The interpretation of coronary angiogram by radiologist and while performing angiography and angioplasty by cardiac surgeons requires an awareness about circumferential deviation of coronary ostia.[7]

In the present study, the distance of right coronary ostium from bottom of aortic sinus was more than the distance of left coronary ostium which was statistically significant. This was in accordance with findings of other studies shown in Table 4. The selection of grafts for ascending aortic valve sparing techniques including non-coronary cusp extension requires a feedback about relation of coronary ostia to aortic sinus.[7] Coronary catheterisation an important step in diagnostic and therapeutic interventions has led to many studies on coronary ostia. [13] The circumferential shift in position may confuse interpretation of images and may pose difficulty during procedures such as angiography, angioplasty and coronary artery bypass grafting.[14]

Table 1: Comparison of incidence of various locations of coronary ostia with other studies

Studies	Right coronary ostium			Left coronary ostium		
	At	Above	Below	At	Above	Below
Present study	4(8.2%)	1(3%)	44(89.8%)	26(53.1%)	4(8.2%)	19(38.7%)
Onan B[9]	9%	13%	78%	13%	29%	58%
Ullah QW et al.[11]	8 (26.7%)	3 (10%)	19 (63.3%)	8 (26.7%)	1(3.3%)	21(70%)
Prajapati B et al.[12]	0%	9%	91%	0%	6%	94%
Muriago M et al.[15]	2(9%)	3(13%)	18(78%)	2(9%)	5(22%)	16(69%)

Table 2: Comparison of location of coronary ostia in relation to sinotubular junction with other studies

Relation to STJ		Present study		Cavalcanti et al.[10]	
Right	Left	Frequency	%	Frequency	%
Below	Below	18	36.7	16	32
Above	Above	1	2.0	9	18
Above	Below	0	0	3	6
Below	Above	3	6.1	8	16
At	Below	1	2.0	2	4
Below	At	23	46.9	6	12
At	Above	0	0	3	6
Above	At	0	0	2	4
At	At	3	6.1	1	2
Total		49	100	51	100

Table 3: Comparison of mean distance of coronary ostia from commissures of aortic leaflets with other studies

Studies	Mean distance of coronary ostia from commissures of aortic leaflets			
	Right coronary ostium		Left coronary ostium	
	Right Commissure	Left Commissure	Right Commissure	Left Commissure
Present study	9.73	14.55	11.74	11.27
Cavalcanti et al.[10]	10.4	14.7	11.2	11.5
Sirikonda P and Sreelatha S[7]	9.53	12.65	11.11	10.84

Table 4: Comparison of mean distance of coronary ostia from bottom of aortic sinus with other studies

Studies	Mean distance of coronary ostia from bottom of aortic sinus	
	Right	Left
Present study	14.1	12.7
Cavalcanti et al.[10]	13.2	12.6
Onan B[9]	13.1	11.8

Conclusion

As procedures like coronary angiogram, angioplasty, coronary artery bypass grafting and coronary artery stenting are becoming more common, an attempt has been made to study the topography of coronary ostia. Knowledge of topographical relations of coronary orifices is important in percutaneous and transcatheter therapeutic techniques. It helps cardiac surgeons to carry out coronary angiographies and to interpret them. It helps radiologists in interpreting images of coronary angiogram.

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