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Original article

Morphology and morphometry of Coronary Ostia in South Indian Adult human Cadaveric hearts

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ABSTRACT

The coronary heart disease is the leading cause of death in the developing countries and one of the causes of coronary heart disease is the anomalous origin of coronary arteries. Anatomic knowledge of coronary ostia and its normal variations are important while performing therapeutic and diagnostic procedures for cardiothoracic surgeon and radiologists. The aim of the present study was to analyze the morphology and morphometry of coronary ostia. Material and methods: The present study was done on 77 adult human cadaveric heart specimens from Kasturba Medical College, Manipal. Location and position of each coronary ostium was noted with respect to aortic sinus and sinutubular junction. Horizontal diameter of coronary ostia was measured with the help of vernier caliper. Result: Right coronary artery was arising from anterior aortic sinus in all the heart specimens, left coronary artery was arising from left posterior aortic sinus in all the specimens except in one specimen, in which it was arising from anterior aortic sinus. Minute accessory coronary ostia were observed in anterior aortic sinus in 12 specimens (15.5%). Out of 77 heart specimens; for the right coronary artery, 64 (83%) ostia were located below ST junction, 11 (14%) at the ST junction and 2 (3%) above the ST junction. For the left coronary artery, 60 (78%) ostia were located below ST junction, 12 (15%) at the ST junction and 5 (7%) above the ST junction. In 55 (71.42%) specimens, both right and left coronary ostia were below ST junction. The mean horizontal diameter with SD of right coronary and left coronary ostia was 3.9 ± 1.0 mm (range 3.0-7.0 mm) and 4.6 ± 1.0 mm (range 3.0-7.0 mm) respectively. In majority of specimens left coronary ostia were larger than the right coronary ostia.

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1.Introduction:

The coronary arteries normally provide blood and oxygen to the heart, arise from the aortic sinuses. The aortic valve possesses three semilunar cusps, supported within the three aortic sinuses of valsalva. The aortic sinuses reach beyond the upper border of the cusps and form a well defined, complete circumferential sinutubular ridge when viewed from the aortic aspect. These sinuses are named as anterior, left posterior and right posterior aortic sinuses according to their position. The right and left coronary arteries arise from the anterior and left posterior sinuses respectively [1]. When the coronary arteries of the heart are narrowed or completely blocked, the condition is known as

Coronary heart disease (CHD). CHD is the leading cause of death in India and worldwide. According to study conducted by Gupta in 2008, crude prevalence of CHD between 1990-2007 was 11% to 13% in urban and 6% to 7% in rural areas of south India which was high as compared to other regions [2]. One of the subsets of coronary artery anomalies is the anomalous origin. This subgroup has important clinical manifestations, including sudden death, especially in young athletes [3]. Since procedures like coronary angiograms, angioplasty, coronary artery bypass grafting and coronary artery stenting are becoming more common, an attempt had been made to study the morphology and morphometry of coronary ostia in South Indian adult human cadaveric hearts.

2. Material and Methods:

The study was carried out on 77 adult South Indian human heart specimens fixed in 10% formalin solution. The heart specimens were obtained from autopsy specimens and from adult

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cadavers dissected for undergraduate students in the Anatomy department of Kasturba Medical College Manipal. The specimens were collected without any age, sex, socio-economic status, religion or pathological basis. These specimens were numbered serially from 1 to 77. The aorta and pulmonary trunk were excised about 2 cm above the sinutubular junction. The aortic valve was opened between the two cusps so that each cusp remained intact. The number of ostia within the respective sinus and their position was noted with regard to sinutubular (ST) junction. The horizontal diameter of each ostium was measured in mm with the help of a vernier caliper capable of measuring nearest to 0.01mm. The data was collected, analysed and compared with available data.

3. Results:

It was observed that, in all the 77 heart specimens; three aortic sinuses were present and all the ostia were related to the aortic sinuses. The right coronary artery was found to be arising from the anterior aortic sinus and left coronary artery was arising from left posterior aortic sinus except in one specimen, in which left coronary artery was arising from anterior sinus close to the ostium for right coronary artery (fig1). No ostium was found in right posterior sinus. Accessory ostia were present in 12 specimens (15.5%). All were seen in anterior sinus near the ostium for right coronary artery. No openings were present in the non coronary sinus.

Out of 77 heart specimens; for the right coronary artery, 64 (83%) ostia were located below ST junction, 11 (14%) at the ST junction and 2 (3%) above the ST junction. For the left coronary artery, 60 (78%) ostia were located below ST junction, 12 (15%) at the ST junction and 5 (7%) above the ST junction. In 55 (71.42%) specimens, both right and left coronary ostia were below ST junction.

The mean horizontal diameter with SD of right coronary and left coronary ostia was 3.9 ± 1.0 mm (range 3.0-7.0 mm) and 4.6 ± 1.0 mm (range 3.0-7.0 mm) respectively. In 22 specimens, ostia for right as well as left coronary artery had same diameter; in 7 specimens, ostia for right coronary artery was larger than that of left coronary ostia and in 48 specimens left coronary ostia was larger than the right ostia.

3. Discussion

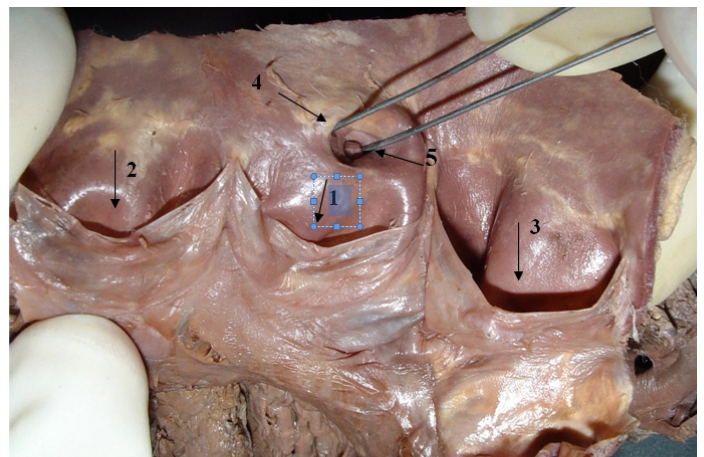
Table 1 comparison of location of coronary ostia with respect to sinutubular junction of present study with other studies

Study	Right coronary			Left coronary		
	Below	At	Above	Below	At	Above
Cavalcanti et al	60	12	28	42	18	40
Kalpana et al	90	9	1	80	20	0
Bhimali et al	84	16	0	93	6.66	3.33
Dattatray et al				79.7	17.2	3.1
Present study	83	14	3	78	15	7

Table 2 showing comparison of mean diameter of right and left coronary ostia of present study with other studies

Studies	RCA	LCA
Kohlar et al	3.83	4.83
Ortale et al		5.0 ± 0.9
Bellestero et al		3.58 ± 0.59
Bhimali et al	2.38 ± 1.33	3.17 ± 0.34
Present study	3.9 ± 1.0	4.6 ± 1.0

Fig 1 : Showing both Coronary Ostia arising from Anterior Aortic Sinus



1 : Anterior sinus , 2 : Left Posterior sinus , 3 : Right Posterior sinus , 4 : Left Coronary Ostium , 5 : Right Coronary Ostium .

4. Discussion

Knowledge of location, position with respect to sinutubular junction and size of coronary ostia is important for performing successful coronary angiography [4]. The origin of coronary arteries show great variability [1], anomalous origin of coronary arteries from the pulmonary artery [5,6,7] and from the right posterior (non-coronary) sinus have been reported in the literature. Anterior interventricular and circumflex arteries arising from anterior aortic sinus either from single or from multiple ostia have also been documented [8, 9]. In the present study, in one specimen (1.3%) right and left coronary arteries were arising from the anterior sinus having separate openings. Hutchins et al proposed the embryological basis of anomalous origin of coronary arteries. According to him coronary arteries ostia originated from the sinuses of valsalva where wall tension was increased by saddle shaped configuration. The unknown factors that interfered with wall tension of the aortic sinuses could promote development of anomalous coronary artery ostia [10].

The most frequent variation is the presence of an accessory orifice for the conal artery which is given a name of its own: the third coronary artery [11]. Different populations showed variations in the incidence of the supernumerary coronary arteries. The lowest incidence of the supernumerary coronary artery was 8% in Iraqi

population [12], while the highest incidence was 50% [12], Kalpana et al [13] reported the incidence of third coronary artery from anterior sinus in 24% of specimens in south India, Stankoic et al [14] observed its incidence in 34.8% of cases in white race. Present study showed the accessory ostia in anterior aortic sinus in 15.5% of cases.

Coronary ostia can be located below, at or above the ST junction. Ostia located just above the aortic sinus were considered variants of the normal origin. A coronary ostium was considered vertically ectopic if it arose more than 0.5 cm above the ST junction of the aorta [15]. It is difficult to insert the catheter tips in patients with the ostium above the level of ST junction [16] and during open aortic surgeries it is very difficult to cannulate the vessels which arise from the anomalous ostia [17]. In the present study majority of the specimens, ostia were located below the sinutubular junction, right coronary ostia was below ST junction in 80% of specimens which coincide with the observations of Bhimali et al [18] and left coronary ostia were below ST junction in 78% of specimens which coincide with the observations of Kalpana et al and Dattatray et al [13,17]. The reason behind it could be the same geographic area because genetic and geographic variations are a known fact in the coronaries [19]. However Cavalcanti et al reported coronary ostia below ST junction in lower percentage who studied coronary ostia in white and non-white population of Brazil [20]. It was also observed that right coronary ostia located below the ST junction in more cases than the left coronary ostia which is in accordance with other authors [20, 13] (Table 1).

Knowledge of Coronary ostia diameter and its variation is also helpful in designing the coronary perfusion cannula which is used to administer cardioplegic solution directly into the left and right coronary arteries in the aortic insufficiency [21]. In the present study mean diameter of right and left coronary ostia were found to be near to size reported by Kohlar et al [22]. Whereas diameter of left coronary ostia measured by Bellesteros LE et al [23] in Columbia and Bhimali et al [18] in south Indians was less than the present study (Table 2). Ortale JR [24] et al carried study on 50 hearts, noted mean diameter of left coronary artery 5.0+/-0.9mm which was more than the present study.

5. Conclusion

Knowledge of location, position with respect to aortic sinus and ST junction; and size of the coronary ostia is mandatory factor while catheterization of coronary arteries for various diagnostic and therapeutic purposes for cardiothoracic surgeons and radiologists.

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