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RESEARCH ARTICLE

MORPHOLOGICAL STUDY OF CORONARY OSTIA

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Abstract

Objective: To study the normal and variant anatomy of the coronary artery ostia in south Indian population.

Introduction: Sudden cardiac deaths, especially in young are on the rise in recent days. Of all causes for sudden cardiac death, anomalous origins of coronary arteries also comprise a significant percentage. A cadaveric study of the origin of coronary arteries in an unsuspected population in south India paves way for understanding the normal variants & to determine the prevalence of anomalies and the need for screening for such anomalies.

Methods: Fifty adult heart specimens of unknown age and sex were dissected. The number of ostia and their positions within the respective sinuses were observed. Vertical and circumferential deviations of the ostia were observed.

Results: Of all hearts,the coronary arteries arose from the aortic sinuses in 99 hearts; no openings were present in the pulmonary artery or the non-coronary sinus. In one heart, the left coronary artery was absent, wherein the anterior inter ventricular artery and the left circumflex artery had independent origins from the aortic sinuses.The number of openings in the aortic sinuses varied from 2-3 in the present study; multiple ostia were seen in the right posterior sinus. The majority of the ostia lay below the sinutubular ridge (89% for RCA & 92% for LCA) and at or above the level of the upper margin of the cusps (84%). Left ostial openings were mainly centrally located (80%), whereas the right coronary ostia were often shifted towards the right posterior aortic sinus (59%).

Discussion: The usual location of the ostia was within the sinus and above the cusps, but below the sinutubular ridge. On occasion, normal variants like multiple ostia, vertical or circumferential shift in the position, and slit-like ostia may create confusion in interpreting the images and pose a difficulty during procedures like angiography, angioplasty, and coronary artery bypass surgery.

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Introduction:-

The coronary arteries originate from the aortic sinuses of Valsalva. The initial portion of the aortic root, which has the leaflets of the aortic valve, is occupied by the aortic sinuses, also called the sinuses of Valsalva.[1] The aortic sinuses reach beyond the upper border of the cusp and form a well-defined, complete, and circumferential sinutubular ridge/junction. These sinuses are named according to their position as the anterior, left posterior, and right posterior aortic sinuses. The right coronary artery arises from the anterior coronary sinus and the left coronary artery from the left posterior aortic sinus. Recently, coronary artery anomalies are increasingly diagnosed to be the cause of coronary heart disease.one of the frequently encountered coronary artery anomalies is the anomalous origin. This anomaly has important clinical presentations, including sudden death, especially in young athletes.[3-5] Some authors have indicated the need to establish diagnostic screening protocols for athletes and other young individuals subjected to extreme exertion.[6-8] according to Loukas et al. (2009), it is desirable to determine the incidence of the variations, which are potentially capable of inducing sudden cardiac death, in order to analyze the value of screening.[8]

Most anomalies of origin have been reported as case reports.[9-13] The available studies in the literature that report the incidence of anomalous origin of the coronary arteries have drawn their samples either from an autopsy population of congenital heart disease[4] or from an angiographic series performed for the work-up of chest pain evaluation.[14-16] Therefore, such studies do not provide data on the frequency of occurrence of variations in an unsuspected population. Few systematic studies have described the normal and variant anatomy of coronary artery ostia in an unsuspected population.[17- 20]

Genetic and geographic variations in the coronaries are a known fact.[8,21-23] Garg et al. (2000)[23] and Harikrishnan et al. (2002)[24] have reported the incidence of coronary artery anomalies in angiographic studies of the Indian population. The present study describes the normal and variant anatomy of the ostia of the coronary arteries in adult cadavers of Indian origin.

Material and Methods:-

The study was carried out on 100 embalmed heart specimens preserved in the department of anatomy. These heart specimens were obtained from adult cadavers dissected for undergraduate teaching. The aortic root was opened and the origins of the coronaries were observed. The positions of the ostia were noted with reference to the sinutubular ridge and the cusps.positions of the ostia were also observed withreference to the commissures. Figure 1a & b show schematic representations of the aortic root and aortic sinuses.

Results:-

No coronary arterial openings were observed in thesinuses of the pulmonary trunk or in the right posterior aortic sinus. Table 1 shows the total number of openings in various aortic sinuses. In approximately 22% of the cases, multiple openings were seen in the anterior aortic sinus.(table 1)only in two cases double openings were observed in the left posterior aortic sinus, where the left coronary artery was absent with independent origins of anterior interventricular artery & left circumflex artery.

No.of ostia	Anterior aortic sinus	Left posterior aortic sinus	Right posterior aortic sinus
1	78	98	0
2	17	2	0
3	5	0	0
4	0	0	0

Table 1:- showing number of ostia.

Fig 1:- Coronary ostium at sino tubular junction.

Fig 3:- Coronary ostium below sino tubular junction.

	Position of the ostium with respect to sino tubular junction		
	At	Above	Below
Right ostium	6	5	89
Left ostium	8	0	92

Table 2:- showing the position of ostium with respect to sino tubular junction.

Discussion:-

The origins of the coronary arteries show great variability[2]occasional cases documenting the anomalous origins of the coronary arteries from the pulmonary artery[14,25,26] and from the right posterior (non-coronary) sinus[13]have been documented in the literature. A common single ostium or multiple ostia in the right and left anterior interventricular and circumflex branches of the anterior aortic sinus have also been reported.[9-11]in an angiographic study of an Indian population, grag and tiwari (2000) observed anomalous coronaries in 0.95% of individuals. Of these cases, about 90% were anomalies of origin.[23] Harikrishnan et al. (2002) reported an incidence of 0.45%.[24] in a dissection study on heart specimens received from medicolegal autopsies and performed by Sahni and Jit (1989), no case of anomalous origin of any coronary artery was found.[17]in the present study, we did not find any coronary artery arising from the pulmonary or right posterior aortic sinus.

The right coronary sinus had multiple openings. The extra openings were minute and varied in number from one to three. These openings are of the first branch of the right coronary artery, the infundibular branch. In approximately 8% of hearts, the openings were three or more in number. In such cases, one of the extra ostia may be that of the SA nodal artery. In 50% of cases, the SA nodal artery arises as a branch of the initial part of the right coronary artery. Schlesinger et al. (1949)[27]and James (1961)[28]have described the origin of the SA nodal artery directly from the aortic sinuses in some instances. Standring et al. (2005) have reported the incidence of extra openings in the right aortic sinus in 36% of individuals.[2]Sahni and Jit (1989) reported extra openings in 34.8% of male hearts and 27.8% of female hearts.[17]Wolloscheck et al. (2001) reported extra ostia in 65% of cases in an anatomic and transthoracic echocardiographic study.[29]

In a majority of the cases, the positions of the ostia were below the sino tubular junction. Valodaver et al. (1975)[1] reported a 44% incidence of ostia being present above the sino tubular junction, while Pejkovic et al. (2008)[20]reported a very high incidence of ostia at or above the level of the sinutubular junction (82% left and 90% right). Turner and Navratnam (1996) found that 62 of the 74 main coronary ostia lay either at or immediately below the sino tubular junction.[19] of the 100 hearts studied, we found two cases of an absent left main coronary artery (i.e., separate ostia for the left anterior descending and circumflex arteries). In a large angiographic series, Topaz et al. (1991)[15]found the incidence to be 0.4%. They also observed that, in 39% of such patients, difficulties in selectively cannulating the separate ostium of the circumflex artery and adequately opacifying this vessel resulted in the need to change the diagnostic catheter size. They also suggested that recognition of this coronary anomaly is necessary to ensure accurate angiographic interpretation and is important for patients undergoing cardiac surgery for selectively perfusing these separate vessels during cardiopulmonary bypass.

Conclusions:-

The present study describes the normal and variant anatomy of the ostia of the coronary arteries in an unsuspected population. It provides a basis for understanding the normal variants, for determining the incidence of anomalies, and for evaluating the value of screening for such anomalies.

No openings were observed in the pulmonary sinuses or the right posterior aortic sinus. The number of openings in the aortic sinuses varied from 2 - 5 in the present series; multiple ostia were mostly seen in the right sinus. The majority of the ostia lie below the sinutubular ridge (89% for RCA & 92% for LCA) and at or above the level of the upper margin of the cusps (84%).

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