A Study of Origin of Coronary Arteries in Human Cadaveric Hearts of Southern Karnataka Region

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Abstract
Introduction: The coronary arteries take origin from the aortic sinuses. The aortic sinuses are located in the initial portion of the aortic root, which presents the leaflets of the aortic valve. The aortic sinuses reach beyond the upper border of the cusp. These sinuses are named according to their position as the anterior, left posterior, and right posterior aortic sinuses. The right coronary artery originates from the anterior coronary sinus and the left coronary artery originates from the left posterior aortic sinus. Recently, anomalous origin of coronary arteries as a cause of coronary heart disease is gaining significance. This presents with significant clinical features, including sudden death, especially in young athletes. **Methods:** 52 Cadaveric heart specimens were dissected. The ascending aorta was divided at the origin and the location of the coronary artery opening at anterior and posterior aortic sinuses was identified. The number of openings was noted. The diameter of the coronary artery openings were measured using digital vernier callipers. **Results:** The right coronary artery opening was located at a distance of 11.5mm from the right anterior aortic sinus. The mean diameter of the right coronary artery opening was 3mm. The left coronary artery opening was located at a distance of 10.4mm from the left posterior aortic sinus. The mean diameter of the left coronary artery opening was 4mm. There were no accessory openings. **Conclusions:** The right coronary artery opening was located at a greater distance from the corresponding right aortic sinus compared with that of the left coronary artery arising from left aortic sinus. The diameter of left coronary artery opening was greater than the right coronary artery opening. The location of the coronary artery opening is important for interventional cardiologists before performing procedures like coronary artery bypass grafting, coronary angiography, coronary angioplasty. The diameters of the coronary artery ostia are also necessary for the above procedures. This study will throw light on the dimensions of coronary artery ostia and will be helpful for cardiologists to select the required catheter to perform interventional procedures on heart.

Keywords: Coronary artery, ostia, aortic sinus.

Introduction

The arterial supply to the heart is accomplished by the right and left coronary arteries. The right coronary artery takes origin from the right aortic sinus and the left coronary artery from the left aortic sinus of the proximal ascending aorta[1]. The aortic sinuses are located in the initial portion of the aortic root, which presents the leaflets of the aortic valve[2].

The aortic sinuses reach beyond the upper border of the cusp. These sinuses are named according to their position as the anterior, left posterior, and right posterior aortic sinuses. The right coronary artery originates from the anterior coronary sinus and the left coronary artery originates from the left posterior aortic sinus.

Anatomic variations in origin, course, branching pattern and anomalies of coronary arteries, reported in literature can affect blood supply, hemodynamic characteristics, and clinical features and could be a risk for atherosclerosis[3].
The coronary artery anomalies are also considered as causative factors for other coronary heart diseases. One of the significant anomalies is at the origin of the coronary arteries. Recently, anomalous origin of coronary arteries as a cause of coronary heart disease is gaining significance.

Sudden unexpected cardiac death due to anomalous origin of coronary arteries in the younger age groups is documented[4]. This presents with significant clinical features, including sudden death, especially in young athletes[5]

The variations and anomalies of coronary arteries may lead to complications during a procedure[6]
Knowledge of the variations in coronary arteries is essential for the Cardiothoracic and Interventional radiologists for avoiding inadvertent vascular trauma during the procedures[7]

The coronary ostium, located at the lower aspect of the coronary sinus, is called the low origin, and the coronary ostium located 5 mm from the valvular attachment point of the aortic annulus is called the coronary commissure ostium. A high-origin coronary ostium refers to an origin more than 10 mm away from the sinotubular junction. It is more common for the right coronary artery to have a high ostium of origin, which can be hemodynamically significant[8]

Anomalies in the origin of coronary arteries, particularly at the ostial level, are recognized as potential causes of coronary artery disease (CAD) and sudden cardiac death (SCD),

especially in younger individuals and athletes. Recent studies highlight the significance of detecting these anomalies early to reduce cardiovascular risks. However, data on the anatomical variability of coronary artery origins in the Southern Karnataka region remain sparse. The study addresses this gap by examining cadaveric heart specimens to analyze the location, diameter, and positional relationships of coronary artery openings. The findings aim to enhance the understanding of coronary anomalies and their clinical implications.

Methods

52 Cadaveric heart specimens were dissected in the Department of Anatomy, Sri Devaraj Urs Medical College, Kolar. The heart specimens were preserved in 10% formalin solution.

The ascending aorta was divided at the origin and the location of the coronary artery opening at anterior and posterior aortic sinuses were identified. The numbers of opening were noted. The diameters of the coronary artery openings were measured using digital vernier calipers.

Figure 1: division of ascending aorta to expose the aortic sinuses

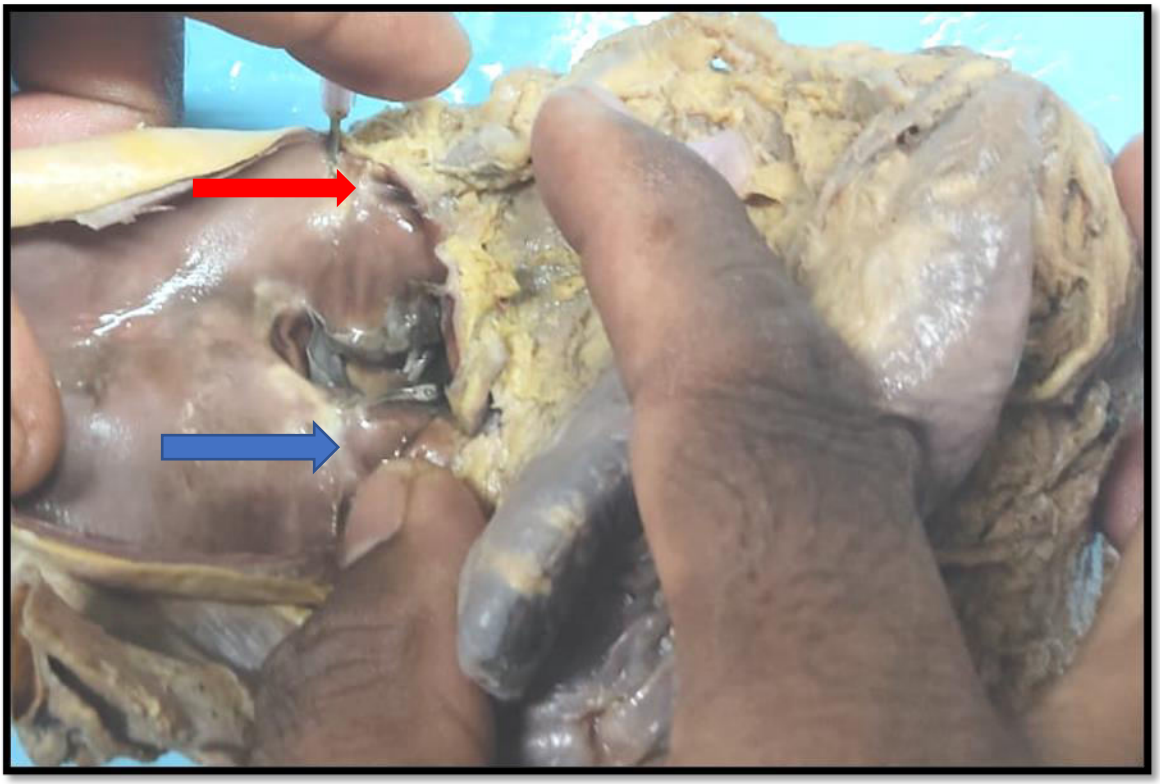


Figure 2: identification of left coronary ostia (red arrow) and right coronary ostia (blue arrow)

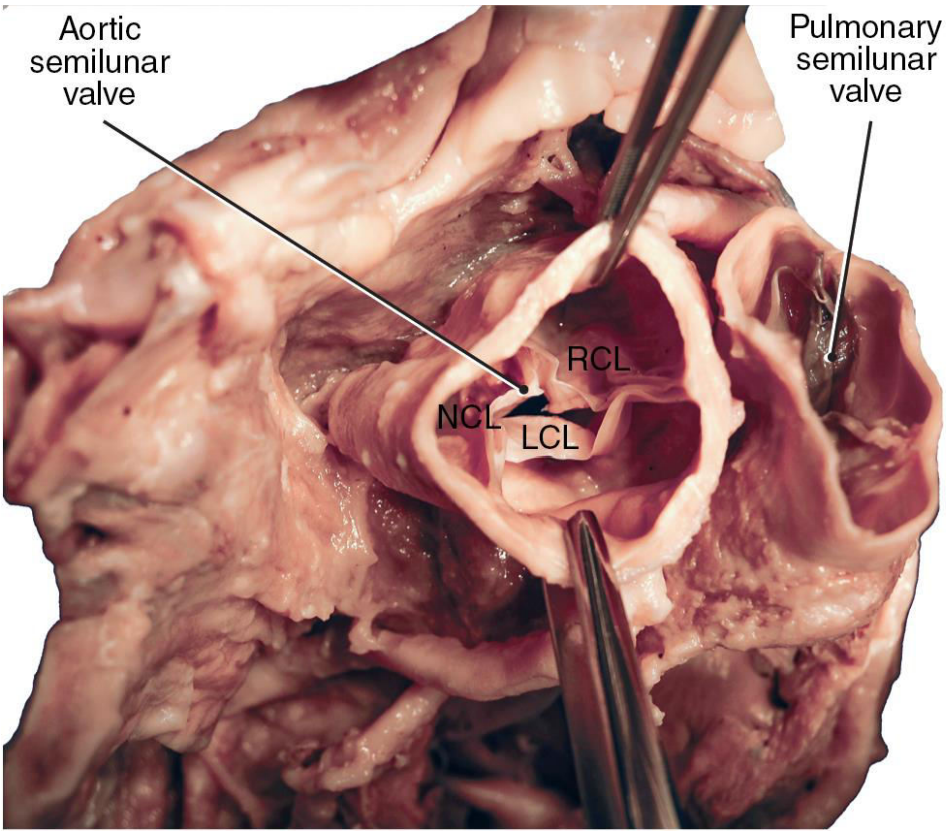
Statistical Analysis

The data on coronary artery ostial diameter and location were analyzed using descriptive statistics, including mean and standard deviation.

Results

The left coronary orifice is usually central in location on the sinus, with the initial segment of the artery directed posteriorly, leftwards and slightly inferiorly.

The right coronary orifice is usually located more towards the right and the non-coronary sinus commissure



The right coronary artery opening was located at a distance of 11.5mm from the right anterior aortic sinus.
The mean diameter of the right coronary artery opening was 3mm.
The left coronary artery opening was located at a distance of 10.4mm from the left posterior aortic sinus.
The mean diameter of the left coronary artery opening was 4mm.
There were no accessory openings.

	Location (Mean distance)
Right Coronary artery	11.5mm
Left coronary artery	10.4mm

Discussion:

The origins of the coronaries show great variability[9]. Joshi SD et al found multiple openings in the anterior aortic sinus – 40 out of 105 hearts.

The position of the sinuses was above the valve cusps in a majority of cases – 87 out of 105 for right coronary and 82 out of 105 for left.

The distance from the bottom of the sinus was 11.8mm and 11.6mm for right and left coronary arteries respectively[10].

The present study did not have any accessory openings. The mean distance from the bottom of the sinus to the coronary ostia was 11.5mm for the right coronary artery and 10.4mm for the left coronary artery. The findings of the present study are similar to the mentioned study.

Ketan Ajit Ambardekar identified anomalous coronary artery origins in a study on 24 patients admitted in Cardiology department. Further there were anomalous origin of right coronary artery from left aortic sinus in 9 patients and anomalous origin of Left circumflex artery from Right Coronary Sinus seen in 2 patients[11]. The present study did not have anomalous origin of coronary arteries.

Jennecy Sales Cavalcanti et al, found the mean distance from the left coronary ostium to the bottom of the corresponding sinus was 12.6±2.61 mm and the mean distance from the right coronary ostium to the bottom of the corresponding aortic sinus was 13.2±2.64 mm and the mean diameters of the left and right coronary ostia were 4.75±0.93 mm and 3.46±0.94 mm[12].

The present study had much lower values for position of the origins of right and left coronary arteries whereas the diameters of the coronary ostia measured as similar to the above study.

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.[13]

Conclusions:

The right coronary artery opening was located at a greater distance from the corresponding right aortic sinus compared with that of the left coronary artery arising from left aortic sinus.

The diameter of left coronary artery opening was greater than the right coronary artery opening. The location of the coronary artery opening is important for interventional cardiologists before performing procedures like coronary artery bypass grafting, coronary angiography, coronary angioplasty.

The knowledge of origin of the coronary arteries is necessary while operating on the right coronary button during aortic root operations.
The diameters of the coronary artery ostia are also necessary for the above procedures.
During aortic valve replacement, the placement of the prosthesis should be carefully done without obstructing the left coronary artery orifice.
If the distance from the coronary sinus to the coronary orifice is less than10mm, a Transcatheter aortic valve implantation (TAVI) becomes a high risk procedure.
This study will throw light on the dimensions of coronary artery ostia and will be helpful for cardiologists to select the required catheter to perform interventional procedures on heart.

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