Section: Anatomy

Original Research Article

A CADAVERIC STUDY ON THE ORIGIN OF CORONARY ARTERIES IN ADULT HEART SPECIMENS

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ABSTRACT

Background: Coronary artery disease remains a leading cause of morbidity and mortality globally. An understanding of the anatomical variations in coronary artery origin, particularly at the level of the aortic sinuses, is crucial for cardiologists, interventional radiologists, and cardiothoracic surgeons to plan diagnostic and therapeutic interventions effectively. **Aim:** To study the site of origin, number of ostia, inner and outer diameters of coronary arteries, and the level of ostia in relation to the supravalvular ridge in adult human heart specimens. **Materials and Methods:** This observational study was conducted on 100 formalin-fixed adult human heart specimens obtained from routine cadaveric dissections at Government Medical Colleges in Rajamahendravaram and Ongole. The number and location of coronary ostia were recorded, and the inner and outer diameters were measured using vernier calipers. The vertical level of ostia in relation to the supravalvular ridge was also assessed. Descriptive statistical analysis was performed. **Result:** All specimens had coronary ostia located in the anterior and left posterior aortic sinuses; no ostia were found in the right posterior sinus. The right coronary artery originated from the anterior sinus and the left coronary artery from the left posterior sinus. The mean inner diameters were 2.82 ± 0.82 mm (right) and 3.88 ± 0.92 mm (left). The mean outer diameters were 4.37 ± 0.83 mm (right) and 5.79 ± 0.83 mm (left). The right coronary ostium was located below the supravalvular ridge in 82% of specimens, at the level in 4%, and above in 14%. The left coronary ostium was below the ridge in 86% of specimens, at the level in 6%, and above in 8%. **Conclusion:** A consistent pattern of coronary artery origin was observed, with the right coronary artery arising from the anterior aortic sinus and the left from the left posterior aortic sinus. No ostia were observed in the right posterior sinus. The left coronary artery exhibited a larger outer diameter than the right, and most coronary ostia were located below the supravalvular ridge. These findings are clinically significant for improving the safety and precision of diagnostic and interventional cardiovascular procedures.

INTRODUCTION

Coronary artery disease (CAD) is a major global health burden, increasingly affecting both developed and developing nations. The rise in CAD incidence, particularly among younger populations, has been attributed to lifestyle changes, urbanization, and an increasing prevalence of comorbidities such as hypertension and diabetes mellitus. An in-depth understanding of coronary artery anatomy is essential for clinical interventions, as variations in origin and morphology can influence the success and safety of diagnostic and therapeutic procedures.[1]

Typically, the right coronary artery arises from the anterior aortic sinus, and the left coronary artery originates from the left posterior aortic sinus. However, several studies have documented anatomical variations, including anomalous origins and the presence of accessory or third coronary arteries.[2,3] These variations can complicate

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procedures such as coronary angiography, bypass grafting, and aortic valve replacement.

Cadaveric studies provide valuable baseline data on coronary artery morphology, which is critical for interpreting imaging studies and planning surgeries. For instance, understanding the dominance pattern of the coronary arteries can aid in assessing myocardial perfusion and risk stratification.[4] Additionally, morphometric analysis of coronary artery trunks helps delineate regional anatomical differences, which may have implications in both anatomical education and clinical practice.[5]

Given the clinical significance and frequent variability in coronary anatomy, this study was undertaken to examine the number, site of origin, morphometry, and supravalvular ridge relationship of coronary artery ostia in adult human cadaveric heart specimens, with particular attention to the anterior, right posterior, and left posterior aortic sinuses.

MATERIALS AND METHODS

Study Design:

This study was designed as an observational, descriptive cadaveric study.

Study Setting and Duration:

The study was conducted in the Department of Anatomy at Government Medical College, Rajamahendravaram, and Government Medical College, Ongole, over a period of 30 days.

Sample Size and Source of Data:

A total of 100 formalin-fixed adult human heart specimens were collected from nonspecific cadavers allotted for routine dissection to first-year MBBS students. Specimens were included only if they were free from gross pathological or congenital anomalies.

Inclusion Criteria:

Adult human heart specimens with no observable gross or congenital abnormalities.

Exclusion Criteria:

Specimens with congenital heart disease or gross anatomical deformities.

Data Collection Procedure:

Each heart specimen was carefully examined to identify the number and location of coronary ostia within the aortic sinuses. The following parameters were recorded:

Number of ostia in each of the three aortic sinuses (anterior, posterior right, and posterior left).

Location of origin of the right and left coronary artery ostia.

Inner diameter of the ostia, measured using precision vernier calipers.

Outer diameter of the right and left coronary arteries, also measured using vernier calipers.

Vertical relationship of the coronary ostia to the supravalvular ridge (categorized as above, at the level of, or below the ridge).

Statistical Analysis:

Data were compiled and analyzed using descriptive statistical methods. Frequencies and percentages were calculated for categorical data, while means and standard deviations were used for continuous variables. Results were presented in tabular format for clarity.

Ethical Considerations:

The study was approved by the Institutional Ethics Committee, Government Medical College, Rajamahendravaram (Approval No: IEC/GMC-RJM/2025/22).

RESULTS

A total of 100 adult human heart specimens were examined to analyze the origin, location, and morphometry of coronary artery ostia.

The distribution of ostia within the aortic sinuses revealed that all specimens had ostia in the anterior and posterior left sinuses, while no ostia were observed in the posterior right sinus (Table 1). This finding demonstrates a consistent pattern in which the right and left coronary arteries originate from the anterior and posterior left aortic sinuses respectively. The location of ostial origin was further confirmed, with all right coronary artery ostia arising from the anterior sinus and all left coronary artery ostia from the posterior left sinus. No ostia were found in the posterior right sinus, indicating a uniform anatomical configuration across all specimens (Table 2).

Figure 1: Inner Diameter of Left Posterior Aortic Sinus

The inner diameter of the ostia showed variation. The anterior sinus ostia (right coronary) had a mean diameter of 2.82 ± 0.8227 mm. The posterior left sinus ostia (left coronary) had a mean diameter of 3.88 ± 0.9239 mm. No ostia were observed in the right posterior sinus (Table 3).

Figure 2: Outer Diameter of the Left Coronary Artery

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Regarding the outer diameter of the coronary arteries, the left coronary artery had a larger mean diameter (5.786 ± 0.8344 mm) compared to the right coronary artery (4.372 ± 0.8295 mm), indicating a larger caliber for the left-sided vessel (Table 4).

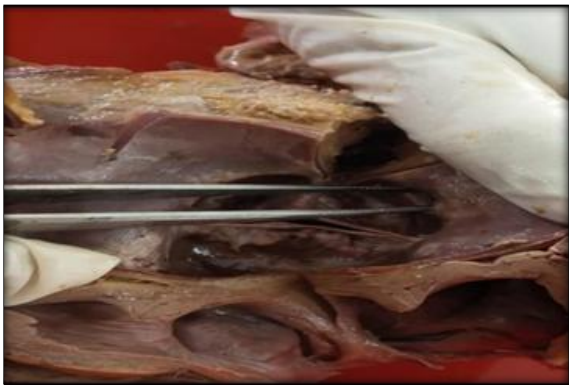

Figure 3: Left Inner Ostium below the supravalvular ridge

Assessment of the vertical relationship of the right coronary ostium to the supravalvular ridge showed that it was located below the ridge in 82% of specimens, at the level in 4%, and above the ridge in 14% (Table 5). Similarly, the left coronary ostium was located below the ridge in 86% of specimens, at the level in 6%, and above the ridge in 8% (Table 6). These positional variations may have clinical significance during diagnostic or interventional cardiovascular procedures.

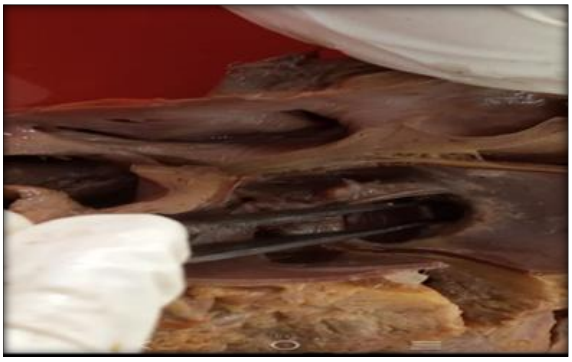

Figure 4: Right Inner Ostium below the supravalvular ridge

Figure 5: Double Coronary Ostia in Right Anterior Aortic Sinus

Table 1: No of ostia in the Aortic sinus

Specimen no:	No of Ostia
100	Right - 100 Left - 100

Table 2: Location of Origin of ostia

Specimen no:	Right Anterior	Right Posterior	Left Posterior
100	100	nil	100

Table 3: Measurement of Inner diameter (mm) of the ostia

Specimen no:	Right Anterior	Right Posterior	Left Posterior
100	Mean - 2.82 ±0.8227 mm	nil	Mean - 3.88±0.9239 mm

Table 4: Measurement of Outer diameter (mm) of right and left coronary arteries

Specimen no:	Right coronary artery	Left coronary artery
100	Mean -4.372 ± 0.8295 mm	Mean -5.786 ± 0.8344 mm

Table 5: Relation of the Right Coronary Ostium level with Supravalvular ridge

Specimen no:	Above	At the level	Below
100	14	4	82

Table 6: Relation of the Left Coronary Ostium level with Supravalvular ridge

Specimen no:	Above	At the level	Below
100	8	6	86

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Figure 5: Measurement of Outer diameter (mm) of coronary arteries

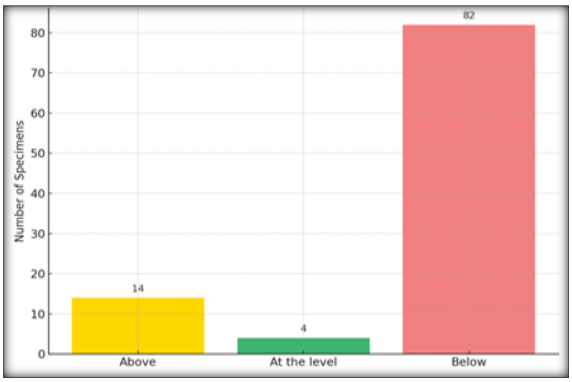

Figure 6: Relation of the Right Coronary Ostium level with Supravalvular ridge

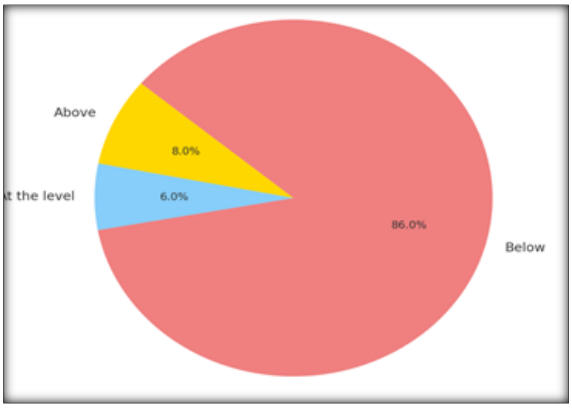

Figure 7: Relation of the Left Coronary Ostium level with Supravalvular ridge

DISCUSSION

The present cadaveric study provides valuable insights into the origin and morphometry of coronary artery ostia in adult human hearts. A consistent pattern was observed in all specimens, with the right coronary artery originating from the anterior aortic sinus and the left coronary artery from the left posterior aortic sinus. No coronary ostia were found in the right posterior aortic sinus, revising classical descriptions and offering a region-specific anatomical perspective that differs from several earlier studies.[10]

Understanding coronary artery variations is vital for clinical and surgical planning. Unusual configurations, such as double right coronary arteries or ectopic high-origin coronary arteries, although rare, have been documented in literature and carry significant implications for interventional cardiology and surgical procedures.[6,7] High-origin coronary arteries may pose challenges during catheterization and require modified techniques for cannulation and stent placement.[7] These anomalies, if unrecognized, can increase the risk of procedural complications or misdiagnosis during imaging.

Our findings also emphasize the morphometric differences in coronary arteries. The left coronary artery exhibited a larger mean outer diameter compared to the right, which corresponds to its greater myocardial perfusion territory. Similar observations have been reported in large-scale anatomical and radiological studies.[11]

Positional analysis in our study revealed that the majority of coronary ostia were located below the supravalvular ridge 82% for the right and 86% for the left coronary artery. Ostia positioned at or above the ridge were relatively uncommon. This finding aligns with previous reports highlighting notable variability in coronary ostial anatomy. For instance, Sahni and Jit,[12] (1989) documented additional openings in 34.8% of male and 27.8% of female hearts, while Wolloscheck et al.[13] (2001) observed extra ostia in 65% of cases using anatomical and echocardiographic assessments. In our series, double ostia were present in 8 out of 100 cadaveric hearts, all located in the right anterior aortic sinus. Such structural and positional variations are clinically significant, as they may affect the precision of catheter cannulation during coronary angiography or aortic valve interventions.[9]

The consistent pattern observed in our study highlighting origin from the anterior and left posterior sinuses, along with detailed morphometric data and ostial positional relationships complements existing anatomical literature and may assist clinicians in improving procedural accuracy and reducing complication rates.[8]

Our study adds to the growing anatomical evidence that highlights the need for careful evaluation of coronary artery origin and morphology in both preclinical and clinical settings. Although cadaveric studies have inherent limitations, such as the lack of correlation with in vivo imaging, they remain fundamental for understanding baseline anatomical configurations, especially in regions with limited access to advanced diagnostic modalities.

CONCLUSION

This cadaveric study revealed a consistent anatomical pattern in the origin of coronary arteries, with the right coronary artery arising from the anterior aortic sinus and the left coronary artery originating from the left posterior aortic sinus. No ostia were observed in

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the right posterior aortic sinus. The left coronary artery exhibited a larger outer diameter compared to the right, reflecting its broader myocardial distribution. The majority of coronary ostia were located below the supravalvular ridge. These findings are clinically significant, especially for cardiologists and cardiothoracic surgeons performing diagnostic or interventional procedures. A thorough understanding of coronary artery anatomy and its variations is essential to minimize procedural complications and enhance patient safety.

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