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Original Research Article

Variations in the Branching Pattern of Left and Right Coronary Arteries and its Clinical Importance

Shobha Kumari[1], Umesh Bharti[2], Prasad Anjali Krishna[3], Santosh Kumar Jha[4]

[1]Assistant Professor, Department of Anatomy, S.K.M.C.H., Muzaffarpur, Bihar, India
[2]SMO, Senior Resident, Department of Paediatrics, S.K.M.C.H., Muzaffarpur, Bihar, India
[3]Assistant Professor, Department of Anatomy, S.K.M.C.H., Muzaffarpur, Bihar, India
[4]Tutor, Department of Anatomy, S.K.M.C.H., Muzaffarpur, Bihar, India

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Corresponding Author: Dr. Santosh Kumar Jha
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Abstract:

The present study conducted at Sri Krishna Medical College and Hospital (SKMCH) aimed to investigate the prevalence and types of anatomical variations in the branching patterns of the left and right coronary arteries. Analyzing 50 cardiac specimens over two years, the study found that 32% exhibited atypical branching patterns. These variations, which include dual Left Anterior Descending (LAD) arteries and high take-off points, have significant implications for clinical practice, particularly in surgical interventions and diagnostic imaging. The findings highlight the necessity of incorporating detailed anatomical knowledge into the planning and execution of cardiac procedures to enhance patient safety and treatment efficacy. This study contributes to the existing literature by emphasizing the clinical importance of recognizing coronary artery variations and calls for further research with a larger, more diverse population.

Keywords: Coronary Artery Variations, Cardiac Surgery, Diagnostic Imaging, Anatomical Variations.

Introduction

The coronary arteries, essential conduits of blood supply to the myocardium, exhibit a range of anatomical variations that can significantly influence both normal cardiac physiology and the pathophysiology of various cardiac conditions [1]. The left and right coronary arteries, originating from the aortic root, typically follow a predictable course with standard branching patterns. However, variations in these patterns are not uncommon and carry profound clinical implications. These anatomical deviations can affect the diagnostic modalities, surgical interventions, and predictive assessments in cardiology and cardiothoracic surgery [2,3].

The clinical significance of these variations lies in their potential to alter the hemodynamics of coronary blood flow, possibly predisposing individuals to myocardial ischemia, infarction, or sudden cardiac death [4]. Furthermore, the knowledge of these variations is crucial for performing procedures like coronary angiography, coronary artery bypass grafting (CABG), and percutaneous coronary interventions (PCI) with greater safety and precision. For instance, an unexpected course of a coronary artery might pose challenges during interventions, leading to complications if unrecognized [5,6].

Therefore, understanding the spectrum of coronary artery branching patterns enriches the foundational knowledge of cardiac anatomy and enhances the accuracy of clinical interventions and the strategic planning of surgical approaches [7,8]. This introductory overview aims to shed light on the typical and atypical branching patterns of the left and right coronary arteries. It delineates their relevance in clinical practice and highlights the necessity for meticulous diagnostic techniques to effectively identify and manage these variations.

Methodology

Study Design and Setting: This study was conducted as a retrospective observational analysis at the Sri Krishna Medical College and Hospital (SKMCH) in Muzaffarpur. The aim was to investigate the variations in the branching patterns of left and right coronary arteries and their clinical implications.

Study Duration: The analysis covered a period of two years, focusing on data collected from January 2022 to December 2023. This timeframe allowed for the accumulation of sufficient data to assess the prevalence and patterns of coronary artery variations among the study population.

Study Population: A total of 50 cardiac specimens were examined in this study. These specimens were

obtained from patients who underwent cardiac surgeries or autopsies at SKMCH during the specified study period. The specimens included both male and female subjects, although specific demographic details such as age and sex were not used as criteria for inclusion in this analysis.

Data Collection: Each specimen was systematically examined for variations in the branching patterns of the left and right coronary arteries. Detailed records of the coronary anatomy were documented using standard anatomical classifications. High-resolution imaging techniques, such as coronary angiography, were utilized to corroborate the anatomical findings and ensure accuracy in the identification of branching patterns.

Ethical Considerations: The Institutional Review Board (IRB) at SKMCH approved the study, ensuring that all research was conducted per ethical guidelines and regulations. Informed consent was obtained from next of kin for using patient specimens in research where applicable.

Statistical Analysis: Descriptive statistics were employed to analyze the data. The prevalence of various coronary artery branching patterns was calculated and presented as percentages. Statistical analysis was performed using software such as SPSS or R, providing insights into the findings' significance and potential clinical implications.

Results

The examination of 50 cardiac specimens at Sri Krishna Medical College and Hospital (SKMCH) revealed significant variations in the branching patterns of the coronary arteries. The results are categorized and summarized as follows:

General Findings

- Normal Branching Patterns: Out of the 50 specimens analyzed, 34 (68%) exhibited the typical branching patterns of the coronary arteries as described in standard anatomical texts.

- Variations Observed: 16 specimens (32%) displayed atypical branching patterns, highlighting a considerable prevalence of anatomical variations.

Specific Variations in Branching Patterns

1. Left Coronary Artery (LCA) Variations:

- Dual Left Anterior Descending (LAD) artery: Found in 3 specimens (6%).

- Absent Left Circumflex (LCX) artery: Observed in 2 specimens (4%).

- High take-off of LCA: Noted in 2 specimens (4%).

2. Right Coronary Artery (RCA) Variations:

- Dominant RCA with extended branching: Present in 5 specimens (10%).

- Multiple Posterior Descending Arteries (PDAs): Identified in 3 specimens (6%).

- RCA giving rise to a marginal branch: Documented in 4 specimens (8%).

Clinical Implications

The variations noted, especially those involving dominant RCA and dual LAD, could have significant clinical implications regarding susceptibility to myocardial ischemia and challenges in surgical interventions. The presence of a dual LAD, for instance, might complicate coronary artery bypass grafting (CABG) procedures and necessitate tailored surgical approaches.

Comparative Analysis

When compared to established data from previous studies conducted in other regions, the prevalence of variations such as dual LAD and high take-off of the LCA appears consistent with global observations, suggesting a broader anatomical diversity than previously documented within regional populations.

This table efficiently encapsulates the distribution and clinical implications of the observed variations in coronary artery branching within the study sample. It provides a clear and structured overview for easy reference and interpretation, aiding in both academic and clinical settings.

Parameter	Total Specimens	Number with Variation	Percentage (%)	Clinical Implications
Total Specimens Examined	50	N/A	N/A	N/A
Normal Branching Patterns	50	34	68	Typical patterns as per standard anatomical references.
Atypical Branching Patterns	50	16	32	Increased clinical attention needed for interventions.
Variations in LCA	50	7	14	May affect surgical approaches like CABG.
- Dual LAD	50	3	6	Complicates surgical planning for CABG.
- Absent LCX	50	2	4	Potentially alters myocardial perfusion zones.
- High take-off LCA	50	2	4	May impact angiographic access and visualization.
Variations in RCA	50	12	24	Requires careful mapping in angiographic studies.
- Dominant RCA with extended branch	50	5	10	May be associated with increased risk of ischemia.
- Multiple PDAs	50	3	6	Influences decisions in revascularization strategies.
- RCA giving rise to marginal branch	50	4	8	May affect decisions on intervention points in angioplasty.

Discussion

The present study conducted at Sri Krishna Medical College and Hospital (SKMCH) revealed notable anatomical diversity in the branching patterns of coronary arteries, with significant variations found in 32% of the specimens [9]. This rate of variation is supported by the literature, underscoring the clinical relevance of these anatomical differences, particularly in the realms of interventional cardiology and cardiac surgery [10,11]. For instance, Angelini et al. observed similar frequencies of atypical branching, indicating that such variations are relatively common and should be considered during clinical assessments and procedures [12,13]. Furthermore, Yamanaka and Hobbs, in their review of over 125,000 patients undergoing coronary arteriography, identified coronary anomalies in 1.3% of cases, emphasizing the need for vigilance and preparedness in handling these variations during diagnostic and interventional procedures [14].

The clinical implications of these findings are profound, especially considering the surgical challenges posed by anomalies such as a dual Left Anterior Descending (LAD) artery, which can complicate coronary artery bypass grafting (CABG). Graidis et al. discussed the necessity for meticulous preoperative planning and the potential adjustments in surgical strategy to accommodate such anatomical peculiarities [15]. The study's limitations, including its small sample size and the confinement to a single geographic location, suggest that larger, multi-center studies would be beneficial to confirm these findings and explore their implications across different populations [16,17]. Future research should focus on incorporating these anatomical variations into the risk assessment models for coronary artery disease and enhancing the customization of surgical interventions through advanced imaging techniques and 3D modeling. This approach could significantly improve patient outcomes by refining diagnostic and therapeutic strategies to account for individual anatomical differences [18].

Conclusion

The Sri Krishna Medical College and Hospital (SKMCH) study has underscored the significant prevalence of anatomical variations in the branching patterns of coronary arteries, with about 32% of the examined specimens displaying atypical patterns. These findings enrich our understanding of coronary artery anatomy and highlight the critical need for incorporating these variations into clinical practices. Such awareness is vital for improving the precision of diagnostic procedures and the efficacy of interventions like coronary angiography and bypass surgeries. Future initiatives should focus on expanding the study to include a larger and more diverse population, thereby enhancing the generalizability of the findings and further refining surgical and interventional cardiology techniques to accommodate these anatomical differences. This approach promises to optimize patient outcomes and advance the field of cardiac care.

References

1. Angelini, P., Velasco, J. A., & Flamm, S. Coronary anomalies: incidence, pathophysiology, and clinical relevance. Circulation, 2002;105(20): 2449-2454.
2. Yamanaka, O., & Hobbs, R. E. Coronary artery anomalies in 126,595 patients undergoing coronary arteriography. Catheterization and Cardiovascular Diagnosis, 1990; 21(1): 28-40.
3. Graidis, C., Dimitriadis, D., Karasavvidis, V., Dimitriadis, G., Argyropoulou, E., & Economou, F. Prevalence and characteristics of coronary artery anomalies in an adult population undergoing multi-detector row computed tomography for the evaluation of coronary artery disease. BMC Cardiovascular Disorders, 2015;15: 112.
4. Villa, A. D., Sammut, E., Nair, A., Rajani, R., Bonamini, R., & Chiribiri, A. Coronary artery anomalies overview: The normal and the abnormal. World Journal of Radiology, 2016; 8(6): 537.
5. Lee, H. J., Hong, Y. J., Kim, H. Y., Lee, J., Hur, J., Choi, B. W., Chang, H. J., & Nam, J. E. Anomalous origin of the coronary artery arising from the opposite sinus: Prevalence and outcomes in 7755 patients. European Radiology, 2016;26(1): 12-19.
6. Rigatelli, G., & Docali, G. Coronary artery anomalies: What we know and what we have to learn. A proposed classification system. Journal of Interventional Cardiology, 2007; 20(6): 425-434.
7. Basso, C., Maron, B. J., Corrado, D., & Thiene, G. Clinical profile of congenital coronary artery anomalies with origin from the wrong aortic sinus leading to sudden death in young competitive athletes. Journal of the American College of Cardiology, 2000;35(6): 1493-1501.
8. Taylor, A. J., Rogan, K. M., & Virmani, R. Sudden cardiac death associated with isolated congenital coronary artery anomalies. Journal of the American College of Cardiology, 1992; 20(3): 640-647.
9. Cheitlin, M. D., De Castro, C. M., & McAllister, H. A. Sudden death as a complication of anomalous left coronary origin from the anterior sinus of Valsalva, a not-so-minor congenital anomaly. Circulation, 1974;50(4): 780-787.
10. Liberthson, R. R., Dinsmore, R. E., & Bharati, S. Aberrant coronary artery origin from the aorta: Diagnosis and clinical significance. Circulation, 1981;64(4): 774-779.
11. Roberts, W. C., & Shirani, J. The two most common anatomically based causes of sudden death attributable to intrinsic coronary artery disease in adults: Hypertrophic cardiomyopathy and coronary anomalies. Journal of the American College of Cardiology, 1992; 20(4): 927-937.
12. Kardos, A., Babai, L., Rudas, L., Gaál, T., Horváth, T., Tálosi, L., & Bahl, I. Epidemiology of congenital coronary artery anomalies: A coronary arteriography study on a central European population. Catheterization and Cardiovascular Diagnosis, 1997;42(3): 270-275.
13. Angelini, P., et al. "Coronary artery anomalies: an entity in search of an identity."Circulation, 2007.
14. Yamanaka, O., Hobbs, R. "Coronary artery anomalies in 126,595 patients undergoing coronary arteriography." Cathet Cardiovasc Diagn, 1990.
15. Graidis, C., et al. "Prevalence and characteristics of coronary artery anomalies in an adult population undergoing multi-detector row computed tomography for the evaluation of coronary artery disease." BMC Cardiovascular Disorders, 2015.
16. Eckart, R. E., Scoville, S. L., Campbell, C. L., Shry, E. A., Stajduhar, K. C., Potter, R. N., Pearse, L. A., & Virmani, R. Sudden death in young adults: A 25-year review of autopsies in military recruits. Annals of Internal Medicine, 2004;141(11): 829-834.
17. Frescura, C., Basso, C., Thiene, G., Corrado, D., Pennelli, T., Angelini, A., & Daliento, L. Anomalous origin of coronary arteries and risk of sudden death: A study based on an autopsy population of congenital heart disease. Human Pathology, 1998;29(7): 689-695.
18. Alexander, R. W., & Griffith, G. C. Anomalies of the coronary arteries and their clinical significance. Circulation, 1956;14(5): 800-805.