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Original research article

Study of left coronary artery

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Abstract

The primary objective of this study was to evaluate the prevalence of various anatomical alterations of the left coronary artery (LCA). The occurrence rate of the left coronary artery (LCA) branching pattern was seen to be 27 out of 30 cases for bifurcation, 2 out of 30 cases for trifurcation, and 1 out of 30 cases for tetrafurcation. The dissection technique will be employed in this research endeavour with the objective of ascertaining the prevalence of quadrifurcation of the coronary artery in a sample of 30 adult human hearts. During the course of our investigation, it was determined that the occurrence rate of quadrifurcation of the left coronary artery was 1 in 30. This study holds significance in ensuring accurate interpretation of coronary angiograms, appropriate care of patients undergoing percutaneous coronary intervention, and surgical revascularization of the myocardium. Given the fact that coronary artery disease is a prominent contributor to mortality rates in developing economies. The predominance of coronary artery patterns is crucial for enhancing the effectiveness of diagnostic and therapeutic interventional procedures.

Keywords: Coronary artery, branching pattern, quadrifurcation, left coronary artery, bifurcation

Introduction

In 2010, there was a significant increase of 35% in global mortality attributed to ischemic heart disease, resulting in a total of 7 million deaths. Irrespective of the aetiology and physiological processes of coronary artery disease, it is crucial to acknowledge that the coronary artery functions as the principal locus of disease advancement. An in-depth comprehension of the coronary artery pattern with dominance is crucial in light of the increasing use of diagnostic and therapeutic interventional procedures.

The documentation of the anatomical characteristics of the coronary arteries has been recorded for a period of at least three centuries. Nevertheless, a significant portion of the research is based on viewpoints and perspectives obtained from macroscopic specimens.

The heart is supplied with blood by the right and left coronary arteries. The veins under consideration are located inside the interstitial area between the epicardium and myocardium. Arising from the bulbous region of the aorta, these branches become evident as two distinct entities that emerge from the ascending portion of the aorta. The left main coronary artery originates from the left coronary sinus of Valsalva. The morphological characteristics of the left coronary artery have been extensively studied, particularly in relation to its length, diameter, and pattern of branching. The arterial trunk demonstrates several divisions, which can manifest by either bifurcation into the left anterior descending (LAD) and circumflex (CX) branches, or trifurcation into the LAD, CX, and median or ramus intermedius (RI) arteries. The observation of tetra-and pentafurcation patterns in branching structures has also been documented. The bifurcation pattern has been identified as the most commonly occurring pattern.

In contemporary times, significant progress has been made in computed tomography (CT) technology, leading to improved image resolution, expanded diagnostic potential and heightened precision within the domain of coronary CT angiography (CCTA). The implementation of dose-reduction techniques has proven to be successful in mitigating radiation exposure to a degree that is considered acceptable, beyond the levels associated with conventional coronary angiography. The utilisation of three-dimensional coronary computed tomography angiography (CCTA) has shown to be an effective noninvasive imaging modality for visualising complex anatomical features and identifying alterations in the coronary arteries.

Cardiac catheterization is universally recognised as the premier diagnostic modality for the identification of coronary artery anomalies. The main objective of angiocardiography is to determine the structural integrity and source of the coronary arteries.

The emergence of the left main coronary artery occurs via the left posterior aortic sinus. The first segment of the left main coronary artery, ranging from a few centimetres to a few millimetres in length, does not exhibit any branching. The first portion of the left coronary artery is surrounded by adipose tissue located underneath the epicardium. Upon reaching the atrioventricular groove, the artery will bifurcate into two branches: the left anterior descending artery, also referred to as the left anterior

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interventricular artery, and the left circumflex artery. Subsequently, the anterior interventricular artery gives rise to the branches supplying the right and left ventricles. The nomenclature of the diagonal artery is derived from its anatomical characteristic, wherein the left ventricular branches, ranging from 2 to 9 in number, traverse the anterior aspect of the left ventricle in a diagonal arrangement [1]. Typically, the first diagonal artery of the subject under consideration exhibits considerable magnitude. The branch might undergo independent development from the main stem, known as trifurcation, or it can undergo replication resulting in four branches, known as quadrifurcation. In their study, Baptista *et al.* (year) observed that the left coronary artery exhibited three distinct patterns of division, namely bifurcation, trifurcation and quadrifurcation. The division of the left coronary artery leads to the emergence of two distinct branches, namely the left anterior descending artery and the left circumflex artery. The arterial vessel originates three distinct branches, namely the left anterior descending artery, the left circumflex artery, and a tertiary branch that is a derivative of the left circumflex artery. The term "ramus diagonals" is used to refer to the arterial structure. The median in Quadrifurcation was comprised of two branches known as ramus diagonalis I and ramus diagonalis II [2]. Besides the left anterior interventricular artery and the left circumflex artery, an additional branch referred to as the middle or intermediate artery has been identified by Suruca H.S. *et al*. The user's text does not provide any information to rewrite in an academic manner. As per Banchi [4], the arterial branch that arises between the left circumflex artery and the left anterior descending artery is commonly known as the intermediate artery. The term "arterial diagnostic" was assigned by Crainicianu [5]. This artery is sometimes referred to as the ramus obliquus, ramus lateralis, Marginal ramus and intermediate artery. All of the aforementioned designations pertain to a singular architectural entity [9]. The utilisation of Ramus diagonalis is advocated by a majority of writers, as well as often employed by physicians and medical professionals. Based on the research conducted by Verna E. and her colleagues, it has been shown that the diagonal branches, referred to as the ramus diagonalis, have an anatomical trajectory that deviates from the conventional path inside the heart groove. Typically, these entities have a zigzag trajectory and are distributed extensively throughout the ventricular surface [10].

Materials and Methods

In order to investigate the clinical significance of the branching patterns of human left coronary arteries, a sample of 30 human heart tissues was obtained from the Department of Anatomy. The thoracic cavity was dissected in order to investigate the middle mediastinum. Subsequently, the pericardium was extracted, along with a heart that included a little section of the ascending aorta. The heart specimens underwent a thorough cleaning process to remove any clots, ensuring the branches of the coronary arteries were free from obstruction. Subsequently, the coronary arteries were dissected from their origins at the coronary Ostia through their distal course, to the fullest degree feasible. The dissection of both coronary arteries was performed until their terminal branches, and an observation was made on the diversity in the branching patterns of these arteries. The current investigation documented the observed changes in the coronary arteries.

Results

Image 1: Quadrifurcation of left coronary artery

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Table 1: Frequency

Total	Type	Frequency	Percentage
30	Bifurcate	27	90
	Trifurcate	2	6.66
	Quadrifurcate	1	3.33

Discussion

Cardiovascular illnesses are the primary contributor to global mortality rates, accounting for approximately one-third of all fatalities. Medical specialists have conducted investigations on the intricate structure of coronary arteries in response to the rising prevalence of coronary heart ailments.

Anomalies of the coronary arteries are defined as modifications in the trajectory and composition of the coronary arteries that are congenital in nature [5, 6]. The diverse array of coronary artery topologies might arise due to disturbances in the normal regression of vascular sprouts originating from the interconnected network of arteries in the interventricular and atrioventricular grooves during the initial phases of embryonic development [7-9]. The functional significance of additional arteries lies in their capacity to provide a substantial portion of the myocardium within a given location. This is the rationale behind their significance. In such circumstances, these vessels provide a substantial component of the collateral circulation, serving as an alternative pathway in case of occlusion in the left anterior descending (LAD) or left circumflex (LCX) arteries [10]. The prevalence of additional arteries at a high frequency indicates that the process of catheterizing the left coronary artery (LCA) is more complex. Furthermore, the existence of these additional arteries alters the angle at which the bifurcation occurs, hence heightening the susceptibility to atherosclerosis [11]. Furthermore, the existence of these entities induces a modification in the bifurcation angle, hence augmenting the susceptibility to atherosclerosis. The prevalence of branching patterns in the left coronary artery, including bifurcation, trifurcation, and quadrifurcation, is shown to be greater in the Indian population compared to previous research findings. In the present study, no evidence of a pentafurcation of the left coronary artery or any alterations related to the right coronary artery were seen. The left coronary artery has a higher susceptibility to variations in its branching pattern and the findings of the present study align with previous literature sources [12, 13]. The left coronary artery exhibits a higher susceptibility to variations in its branching pattern. The observed alterations in this study may potentially stem from embryological defects. However, it is crucial for surgeons to be aware of these variances when they strategize interventions pertaining to the heart.

Conclusion

It is important to recognise the branching patterns of coronary arteries while doing coronary angiography by catheterization.

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