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Branching Patterns of Human Coronary Vasculature and Its Clinical Importance

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ABSTRACT

Background: Anatomy of the coronary arteries have been widely studied due to its clinical importance. A coronary artery is defined as any artery or arterial branch that carries blood to cardiac parenchyma. Coronary arteries and their variation in branching patterns have a significant role in cardiac deaths in recent years. **Objective:** To study the branching patterns of human coronary vasculature and its clinical importance. **Methods:** This observational study was conducted at Department of Anatomy, Diabetic Association Medical College, Faridpur, Bangladesh, Faridpursadar hospital and Bangabondhu Sheikh Mujib Medical College, Faridpur, Bangladesh, from January to December 2021. A total of 30 Human heart specimens were collected to study the branching patterns of human coronary arteries and their clinical importance. The variations in branching patterns like Trifurcation, Quadrifurcation of the coronary arteries were noted in the present study. **Results:** The termination of left coronary artery showed a branching pattern as bifurcation in 21 (70%) specimens, Trifurcation in 5(16.7%), Quadrifurcation in 4(13.3%) out of 30 specimens in our study. We observed 30% of the variations in branching patterns of left coronary artery, whereas right coronary artery branching pattern was normal in the present study. **Conclusion:** Various branching patterns of coronary arteries should be acknowledged during the catheterization for coronary angiography.

Key Words: *Coronary Arteries, Specimens, Anatomy, Coronary Angiography.*

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INTRODUCTION

Anatomy of the coronary arteries have been widely studied due to its clinical importance [1]. A coronary artery is defined as any artery or arterial branch that carries blood to cardiac parenchyma. The coronary arteries supply blood to the musculature of the heart. The blood provides nutrients and oxygen to the tissue and also carries metabolic and catabolic waste, hence fully functional heart and circulation is a vital part of life. The heart contracts about 3 billion times in a lifetime, 3.7 million times in a year and 1, 00,000 times in a day [2,3]. The heart is supplied by two coronary arteries, a right and a left one. Right coronary artery originates from the anterior aortic sinus at the root of the ascending aorta and left coronary artery from the left posterior aortic sinus at the root of the ascending aorta. Understanding and diagnosis of coronary artery anomalies are important in considering the severity of coronary artery stenosis, particularly during therapeutic maneuvers such as angioplasty and bypass surgery. The most common cause of sudden cardiac death in young athletes is coronary artery anomalies. The coronary arteries begin to develop in utero at the start of the third week of embryogenesis, the arteries pass through several complex steps during their development in utero, some of which are unique to the development of the arteries in the coronary circulation. Variant cardiac anatomy has great importance to understand and manage cardiac diseases [1]. The main trunk of left coronary artery terminates into a left anterior descending artery (LAD) and Left Circumflex artery (LCx) [2]. Branching pattern of left coronary artery is important in determining the complexity and effects of arterial occlusive disease, in haemodynamics, procedures of handling cardiac trauma, their implication in heart surgery, proper interpretation of coronary angiography, surgical myocardial revascularization, and Interventional cardiac procedures [3, 4].Knowledge of coronary artery pattern and variations is essential. The knowledge of coronary circulation is not only important for anatomists but also for radiologists and cardiologists performing angiographies and shunt surgeries in diagnosis and treatment of congenital, inflammatory, metabolic and degenerative diseases involving the coronary arteries.

MATERIALS AND METHODS

This observational study was conducted at Department of Anatomy, Diabetic Association Medical College, Faridpur, Bangladesh, FaridpurSadar Hospital and Bangabondhu Sheikh Mujib Medical College, Faridpur, Bangladesh, from January to December 2021. A total of 30 Human heart specimens were collected to study the branching patterns of

human coronary arteries and their clinical importance. We dissected the thoracic cavity to explore the middle mediastinum and removed the pericardium along with a heart with a small portion of ascending aorta. All the heart specimens were cleaned to free from clots and the branches of the coronary arteries were dissected from the coronary Ostia to their distal course up to the possible extent of the arteries. Both the coronary arteries were dissected till their terminal branches and noted the variation in the branching patterns of both the coronary arteries. The variations in branching patterns like Trifurcation, Quadrifurcation of the coronary arteries were noted in the present study.

RESULTS

We observed normal branching pattern of right coronary artery in all the heart specimens in the present study. The right coronary artery arose from the anterior aortic sinus and the left coronary artery in all the specimens arose from the left posterior aortic sinus of ascending aorta in all the specimens (Figure-1). The left coronary artery terminates, usually as bifurcation into the left anterior descending (LAD) and left circumflex artery (LCx) (Figure-2). In Trifurcation, we observed one intermediate ramus branch along with LAD and LCx originating from the main trunk of left coronary artery (Figure-3). Two intermediate rami branches along with LAD branch and LCx branches observed in our study considered as Quadrifurcation of left coronary artery (Figure-4). The termination of left coronary artery showed variation in branching pattern as Bifurcation in 21 (70%), Trifurcation in 5(16.7%), Quadrifurcation in 4(13.3%) out of 30 specimens in our study. The incidence of bifurcation was more in our study when compared to Tri and Quardifurcation of left coronary artery. We observed 30% of the variations in branching patterns of left coronary artery, whereas right coronary artery branching pattern was normal in the present study.

Fig-1: Normal branching pattern of Right Coronary artery (RCA).

Fig-2: Left coronary artery with Bifurcation (1-Left Anterior Descending artery; 2-Left Circumflex artery).

Fig-3: Left Coronary Artery with Trifurcation (1-Left Anterior Descending artery; 2- Intermediate branch; 3-Left Circumflex artery).

Fig-4: Left Coronary Artery with Trifurcation (1-Left AnteriorDescending artery; 2- Intermediate branch; 3-Intermediate branch; 4-Left Circumflex artery).

Table-1: Incidence of branching patterns of coronary arteries (N=30)

Pattern	Left Coronary Artery (LCA)	Right Coronary Artery (RCA)
Bifurcation	21 (70%)	Normal Pattern was observed
Trifurcation	5(16.7%)	
Quadrifurcation	4(13.3%)	
Total	30	30

DISCUSSION

Heart act as a vital organ in terms of performance because it pumps the blood for the entire tissue in the human body through the aorta. However, the myocardium of the heart is supplied and get its nutrition through coronary arteries (large vasa vasora). We observed normal branching pattern of right coronary artery in all the heart specimens in the present study. The right coronary artery arose from the anterior aortic sinus and the left coronary artery in all the specimens arose from the left posterior aortic sinus of ascending aorta in all the specimens (Figure-1). The left coronary artery terminates, usually as bifurcation into the left anterior descending (LAD) and left circumflex artery (LCx) (Figure-2). Anomalies of coronary arteries are congenital alterations in the course and structure of the coronary arteries [5, 6]. The varying patterns of coronary arteries due to disturbances in usual regression of vascular sprouts from the network of vessels in the interventricular and atrioventricular grooves during early development [7-9]. The additional arteries are functionally important because of their potential to supply a significant territory of the myocardium. In such cases, they constitute an important source of collateral circulation in case of occlusion of LAD or LCX [10]. The high frequency of additional arteries implies that catheterization of LCA is more complicated and since their presence alters the angle of bifurcation

they increase vulnerability to atherosclerosis [11]. In Trifurcation, we observed one intermediate ramus branch along with LAD and LCx originating from the main trunk of left coronary artery (Figure-3). Two intermediate rami branches along with LAD branch and LCx branches observed in our study considered as Quadrifurcation of left coronary artery (Figure-4). The termination of left coronary artery showed variation in branching pattern as Bifurcation in 21 (70%), Trifurcation in 5(16.7%), Quadrifurcation in 4(13.3%) out of 30 specimens in our study. The incidence of bifurcation was more in our study when compared to Tri and Quardifurcation of left coronary artery. The incidence of the branching pattern in the left coronary artery like Bifurcation, Trifurcation and Quadrifurcation is higher when compared with previous literatures mentioned in the Indian population. We have not found pentafurcation of left coronary artery and no variations related to right coronary artery in the present study. The Left coronary artery is more prone to variations in the branching pattern and the incidence of the present study was in agreement with previous literature [12]. The variations in the present study may be due to embryological malformations, but the knowledge of such variations is important to surgeons before planning a heart surgery

CONCLUSION

Various branching patterns of coronary arteries should be acknowledged during the catheterization for coronary angiography.

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