



## ANOMALOUS ORIGINS OF CORONARY ARTERIES- A LITERATURE REVIEW

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### ABSTRACT

Coronary artery is defined as any artery or arterial branch that carries blood to cardiac parenchyma. Heart is responsible for circulation of blood throughout the body and it itself receives arterial blood through coronary circulation.

Because of the critical role of the coronary arteries of supplying blood to the musculature of the heart, thereby providing nutrients and oxygen to the tissue as well as carrying metabolic and catabolic wastes, a fully functioning heart and circulation is highly warranted. Coronary artery disease is one of the major causes of death in developing countries. The increasing use of diagnostic and therapeutic interventional procedures necessitates the availability of a basic and sound knowledge of the coronary artery pattern. Coronary artery anomalies are gaining consideration as one of the cause of coronary heart disease in the diagnostic workup. One of the subsets of coronary artery anomalies is the anomalous origin. This subgroup can produce critical manifestations including sudden death especially in young athletes. In spite of this criticality, this subgroup has been rarely studied in the literature. Present review is dedicated to this topic.

### KEYWORDS :

### INTRODUCTION

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Knowledge of normal and variant anatomy and anomalies of coronary circulation is of utmost importance in identifying and managing congenital and acquired heart disease. Congenital, inflammatory, metabolic or degenerative disease of heart and complex cardiac surgical repairs demand enhanced understanding of the same to improve operative outcomes.<sup>6</sup>

Coronary artery anomalies are congenital alterations in origin, course or structure of the epicardial coronary arteries. These anomalies are mostly asymptomatic. However at the same time, also constitute the second leading cause of sudden death in young athletes who are apparently healthy.<sup>3</sup>

The incidence of coronary artery anomalies widely across the literature. The earliest mention of the incidence was reported by Alexander Griffith in 1956 as

0.3% based on autopsy series<sup>4</sup>. Subsequently, the biggest number of patients were explored by Cieslinski et al in 1993 who reported the incidence of coronary artery anomalies as 0.97% in 4,016 patients undergoing angiography (1985 to 1989).<sup>5</sup>

This incidence around 1% has been corroborated recently by several studies. For example, Abdelmoneim A et al (2009) did the study of coronary artery variations and anomalies by using coronary angiography in 479 patients of Sudan population. He included

patients who had coronary angiography and showed no coronary artery pathology. The mean age of the patients was 54.32 years. Four hundred patients (93%) had normal coronary artery anatomy, 24 (6%) had normal coronary artery variations and 5 (1%) had coronary artery anomalies. Right dominant circulation was found in 77% of the patients, while 15% of subjects had co dominant and 8% left dominant circulation.<sup>38</sup>

In contrast to the incidence values, the classification of coronary artery anomalies has been very varied in the scientific literature. The most comprehensive classification of coronary artery anomalies has been given by Angelini [1999] as follows:

1. Anomalies of origination and course
2. Anomalies of intrinsic coronary arterial anatomy
3. Anomalies of coronary termination
4. Anomalous collateral vessels

In present article, we will be exploring the anomalies in the origin of coronary arteries

### ANOMALIES OF ORIGINS OF CORONARY ARTERIES

**Following the classification of Angelini et al (1999), Anomalies of origination and course of coronary arteries include the following:**

- a. *Absent left main trunk (split origination of LCA)*
- b. *Anomalous location of coronary ostium within aortic root or near proper aortic sinus of Valsalva (for each artery):* High, low, commissural
- c. *Anomalous location of coronary ostium outside normal "coronary" aortic sinuses:* (1) Right posterior aortic sinus, (2) ascending aorta, (3) left ventricle, (4) right ventricle, (5) pulmonary artery variants (6) aortic arch, (7) innominate artery, (8) right carotid artery, (9) internal mammary artery, (10) bronchial artery, (11) subclavian artery, and (12) descending thoracic aorta
- d. *Anomalous origination of the coronary ostium from opposite, facing "coronary" sinus (which may involve joint origination or adjacent double ostia).* Variants of the anomalous origination of the coronary ostium from opposite, facing "coronary" sinus include the following: (1) The RCA arising from left anterior sinus, with anomalous course (2) The LAD arising from right anterior sinus, with anomalous course (3) The Cx arising from right anterior sinus, with anomalous course (4) The LCA arising from right anterior sinus, with anomalous course
- e. *Single coronary artery*

However, the classification in the subsequent studies has not been

classified according to this system as there have been multiple findings of anomalies in these individual studies. Few of the studies have been mentioned here:

The incidence of right coronary arterial dominance reported by different researchers have been almost similar: Jose Roberto Ortale et al (88%), MA El Sayed (80%), Vasudeva Reddy J et al (86.25%). The incidence of left coronary arterial dominance (14.7%) and codominance (2.2%) obtained by Vasudeva Reddy J et al.

The incidence of left coronary arterial dominance (19.5%) and codominance (20%) reported by Fazlul Aziz Mian et al have been reported similarly with other studies

Fazliogullari & Karabulut (2010) studied the coronary artery variations and the frequency of median artery in 50 adult Turkish cadaver hearts. The LCA branched out from the aortic sinus and had an average diameter of  $4.44 \pm 1.79$ mm. Left coronary arteries showed bifurcation in 46% cases, trifurcation in 44 % cases and quadrifurcation in 10% cases. The median artery was identified in 27 hearts, with a mean diameter of 2.00 mm. The RCA branched out from the right aortic sinus and had an average diameter of  $3.32 \pm 0.79$  mm. The conus artery branched out from the RCA in 32% of the hearts and from the right aortic sinus in 68%. Right dominance was observed in 42%, left dominance in 14%, and co-dominance in 44% of the hearts. Myocardial bridges were found on the LCA branches in 22 of the 27 hearts, in which the median artery existed.<sup>42</sup>

Joshi et al (2010) studied the normal and variant anatomy of the coronary artery ostia in 105 heart specimens. The number of openings in the aortic sinuses varied from 2-5, multiple ostia was mostly seen in the anterior sinus. The majority of the ostia were below the sinutubular ridge in 89% and at or above the level of the upper margin of the cusps in 84%. Left ostial openings were mainly centrally located in 80%, whereas the right coronary ostia were often shifted towards the right posterior aortic sinus in 59% cases.<sup>2</sup>

Fazlul Aziz Main et al (2011) studied the dominance pattern of coronary arteries in a Pakistani cohort consisting of 200 patients and correlated the results with age and gender. The whole process was conducted by coronary arteriography. The group observed that out of the study population, 60.5% cases were of right dominant, 19.5% had left dominant and 20% had co-dominant coronary circulations. There was no significant difference in dominance pattern with regards to either gender or age.<sup>43</sup>

Ali H Eid, Ziadltni et al (2009) did an angiographic study of congenital anomalies of the coronary arteries in relation to atherosclerosis in patients of Lebanon. 4650 coronary angiographies were analyzed for anomalous aortic origin. They categorized anomalies into 4 main groups: *Anomalous LCA, Anomalous RCA, Anomalous LCX artery and Anomalous LAD artery*. Thirty four patients had anomalous aortic origin of coronary arteries. Of these, anomalous LCX coronary artery was the most common. The second most common anomaly was anomalous RCA origin. They further explored the incidence of coronary stenosis anomalous as well as in non-anomalous vessels. They found that the incidence of stenosis in non-anomalous vessels was 50% whereas the incidence was significantly smaller (17.46%) in anomalous vessels. Of these six vessels, five were LCX artery arising from right coronary sinus or branch of right coronary artery. The sixth was right coronary artery arising from left coronary sinus.<sup>36</sup>

Sinha et al (2009) studied the histomorphology of coronary artery in 20 heart specimens. In 90% SA nodal artery arose from right coronary artery and 10% from left coronary artery. Trifurcation was present in 15% cases. Histopathological changes like calcification, sub intimal thickening and intimal tear was more prevalent in proximal segment of anterior interventricular artery, distal segment of both coronary arteries were normal.<sup>37</sup>

Gajbe et al (2010) studied 30 heart specimens and reported three

specimens having 3 separate ostia in the anterior aortic sinus i.e. one each for the right coronary artery, the right conus artery and a vasa vasorum to the pulmonary trunk.<sup>39</sup> Fares et al (2010) studied the anatomy, variations and anomalies of coronary arteries in 500 patients by coronary angiography. 55% were females, mean age was 54.32 year. Of these 93% had normal coronary anatomy, 30% had normal coronary artery variations, 1% had coronary artery anomalies. Right dominant was found in 77%, 15% had balanced circulation and 8% have left dominant circulation.<sup>41</sup>

## CONCLUSION

Present review was intended to put up a discussion of coronary artery anomalies which inspite of being an important issue has not been discussed adequately. The incidence of coronary artery anomalies has been more or less stable across the literature being around 1%. However, there is no unanimous opinion about the classification of the coronary artery anomalies. Present review was mainly directed towards understanding the coronary artery origins and course in the view of the current studies.

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