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A Systemic Review on Anatomical Variations of Coronary Artery Dominance

[1]Kanyoni.J, [2]Kweri.J, [3]Karuguti .F, [4]Kasyoki J, [5]Malik.A, [6]Mwangi.A

Department of Human anatomy Jomo Kenyatta university of Agriculture and Technology
Jomo Kenyatta university of Agriculture and Technology, Nairobi, Kenya

Abstract: **The coronary artery disease is on rise in both developed and developing countries, and is associated with high mortality and morbidity in the globe. Coronary dominance is one of the key indicator of patient outcomes in coronary artery disease. The coronary dominance is also key in interpretation of the coronary arteries investigations and in the management plan of coronary artery diseases. A recent study showed that patient with left coronary dominance are at risk of developing coronary artery disease, therefore this systemic review is crucial in assessment of the anatomical know how on coronary dominance in different geographical regions. The average occurrence of the Right coronary dominance was 71.4%, with left coronary dominance at 15.5% and codominance at 12.8%. However there was a great variation of the dominance among different populations in different geographical region assessed.**

Keywords: **Coronary artery, dominance, Codominance, anatomical variation, posterior interventricular branch (PIB).**

I. INTRODUCTION

The coronary arteries that supply blood to the heart are unique in their origin and branching. They are comprise the right and the left coronary arteries which are the first branches of the ascending aorta, supplying the myocardium and epicardium of the heart [1,2]. The right coronary artery (RCA) arises from the anterior right aortic sinus, it descends in the coronary sulcus. It gives off a right marginal branch that runs towards the apex of the heart, before arching to the posterior aspect of the heart, where it passes through the crux of the heart and gives rise to the posterior interventricular branch (PIB) or Posterior descending artery (PDA), before its termination [1,3]. The Left coronary artery (LCA) takes origin from the left posterior aortic sinus of Valsalva. It is generally short common stem which bifurcates, trifurcates, quadrifurcates or even pentafurcates [4,5].

The coronary artery from which the PIB/PDA arises is referred to as the dominant or preponderance coronary artery [1,6,7] When the RCA supplies the PIB/PDA, the circulation is referred as right-dominance, and left dominance if the left circumference (LCx) artery, a branch of LMCA, supplies the PIB/PDA. When both branches of (RCA and LMCA) run in or near the posterior interventricular groove, the circulation is referred as co-dominant [7,8].

The term coronary dominance is commonly misinterpreted to mean that, it is the artery that supplies the greater part of the heart, but that is not the case because the LCA supplies the greatest part [9].

Recent studies indicates that individual with the left coronary dominance are at high risk of developing coronary artery diseases (CAD) [9], therefore dominance is a major determinant in prognosis in acquired CAD[10] Although right dominance circulation is commonest, CAD is more frequent on left dominant circulation [11]

Several studies shows that there a decrease in incidence of left dominance and codominance with advancing age, this is hypothesized to be due to poor prognosis associated these variants [6].

Diseases of the coronary artery one the most important causes of fatality worldwide, the prevalence of coronary artery disease is sky rocketing today in third world countries, because of lifestyle diseases [9,12].

Different geographical regions, race and ethnicity shows varying patterns of dominant vessel [13,14]The dominance patterns has clinical significance in coronary heart diseases [7,11]

Anatomical know how on coronary dominance is crucial in understanding coronary artery disorder, interpretation of the investigations and in the management plan of coronary artery diseases [7,12,15]

With the ever rising cases of coronary heart disease, the need for a rigorous systemic review on the coronary dominance is important. Coronary arteries show wide variations in terms of dominance among different populations. These regional based variations have not been dealt with enough in literature. The knowledge of these variations are of paramount importance in interpreting the investigation and management coronary artery disease as well as association of left dominance to high incidence of coronary artery disease. This review will therefore aims to focus coming up with aggregate data on occurrences on dominance coronary artery and its clinical significance.

II. METHODOLOGY

Methods:

The following databases were searched Hinari, Ajol, PubMed, Google Scholar, Science Direct and Ardi. The following key words were used during the search "anatomical variations of coronary artery dominance" alternative terms used were "preponderance of coronary arteries"

Inclusion and exclusion criteria:

The eligibility criteria of the studies included only cadaveric & angiography studies, describing the variations in dominance and in branching patterns of the coronary artery. Only those studies that were available in full text and in English language were included. Studies conducted globally were included.

The studies that were excluded were those that were not available in full text not in English language. Those that were done on animals were excluded.

For the first level of relevance screening, 22,146 studies were generated from the electronic databases following the key terms entry. After a topical screening and 22,102 were found to be irrelevant and were dropped. Database search results for topic under review were as follows Science direct 492, Ajol 42, Pubmed 179, Google scholar 21,400, Hinari 32 and Ardi 1. Abstracts of the The 44 studies that passed the topical screening were subjected to the second level of relevance evaluation, which involved screening according to the PICO (Population Intervention Comparison and Outcome). Twenty four articles that attained a score of six out of 10 and above were selected for methodological quality assessment.

Methodological quality assessment:

All the 24 studies were cross-sectional surveys. The "critical thinking tool for cross-sectional studies"[16] was therefore used to assess the methodological quality of each article. For this appraisal, those studies that that answered yes to 7 and above questions out of the possible eleven were considered to be of high quality and therefore qualified for data analysis.

III. SUMMARY OF SEARCH RESULTS

	Article	Database Source	Level of evidence	Methodological quality
1.	A study in Coronary Dominance in the Population in Assam[13]	Science Direct	Cross-section studies	9/11
2.	Anatomic variations and anomalies of the coronary arteries: 64-slice CT angiographic appearance[17]	Science Direct	Cross-section studies	5/11
3.	Study of Coronary Dominance in the Population of Hyderabad Karnataka Region [12]	Google Scholar	Cross-section studies	8/11
4.	A study on principal branches of coronary arteries in humans[18]	Google Scholar	Cross-section studies	11/11
5.	Anatomical variations of coronary artery and frequency of median artery: A cadaveric study from Northern India[2]	Google Scholar	Cross-section studies	9/11
6.	A Study of Coronary Dominance in Preserved Human Cadaveric Heart Specimens in Kolhapur Region of Western Maharastra: A Dissection Method[14]	Google Scholar	Cross-section studies	10/11
7.	Variations in Origin and Course of the Right and Left Coronary Arteries in Autopsied Hearts at the University Teaching Hospital, Lusaka, Zambia[19]	Google Scholar	Cross-section studies	6/11
8.	Branching Pattern of the Left Anterior Descending Coronary Artery in a Black Kenyan Population[20]	AJOL	Cross-section studies	7/11
9.	Anatomy and Pathology of Coronary Artery in Adult black Kenyan[21]	AJOL	Cross-section studies	7/11
10.	Coronary artery variations and median artery in Turkish cadaver hearts[22]	Google Scholar	Cross-section studies	9/11
11.	A study on coronary dominance patterns in the human heart and its clinical significance [9]	Google Scholar	Cross-section studies	8/11
12.	Anatomic study of the morphology of the right and left coronary arteries [23]	Google Scholar	Cross-section studies	3/11
13.	A Study of Arterial Dominance in Human Hearts by Perfusion Method[24]	Google Scholar	Cross-section studies	7/11
14.	Coronary anatomy, anatomic variations and anomalies: a retrospective coronary angiography study[15]	PubMed	Cross-section studies	7/11
15.	Variation in the Number and Location of Coronary Ostia – A Cadaveric Study[25]	PubMed	Cross-section studies	5/11
16.	Coronary arteries of the European bison (*Bison bonasus*)[26]	PubMed	Cross-section studies	3/11
17.	Origin and course of the coronary arteries in normal mice and in iv/iv mice[27]	PubMed	Cross-section studies	4/11
18.	Coronary artery anomalies overview: The normal and the abnormal[28]	PubMed	Cross-section studies	5/7
19.	Anatomical Variation in Branching Pattern and Dominance in Coronary Arteries: A Cadaveric Study[29]	HINARI	Cross-section studies	11/11
20.	Termination and Dominance of Coronary Arteries: On Telangana Population[30]	HINARI	Cross-section studies	10/11
21.	Prevalence of left and balanced coronary arterial dominance decreases with increasing age of patients at autopsy. A postmortem coronary angiograms study[6]	Science Direct	Cross-section studies	10/11
22.	A cadaveric study on coronary preponderance[7]	Google scholar	Cross-section studies	10/11
23.	Coronary Artery Dominance: What pattern exists in Pakistani Population?[11]	Google scholar	Cross-section studies	9/11
24.	Pattern of coronary artery dominancy in kurdish population and its correlation with the extent of coronary artery disease[31]	Google scholar	Cross-section studies	8/11

11 Studies were eliminated through the methodological quality appraisal leaving 14 to proceed for data analysis.

IV. RESULTS

Table 1: showing coronary artery dominance

	Coronary dominance in percentage						
	Study	Method	Demographic origin	No. participants	Right Dominance	Left Dominance	Codominance
1.	Termination and Dominance of Coronary Arteries: On Telangana Population[30]	Dissection	Asia	80	(70%)	15	15
2.	Anatomical Variation in Branching Pattern and Dominance in Coronary Arteries: A Cadaveric Study[29]	Dissection	Asia	30	83.3	13.3	3.3
3.	Coronary anatomy, anatomic variations and anomalies: a retrospective coronary angiography[15]	Angiography	Asia	5548	81.6	12.2	6.2
4.	A Study of Arterial Dominance in Human Hearts by Perfusion Method[24]	Dissection	Asia	15	73.33	26.67	0
5.	A study on coronary dominance patterns in the human heart and its clinical significance[9]	Dissection	Asia	60	90	10	0
6.	Coronary artery variations and median artery in Turkish cadaver hearts[22]	Dissection	Europe	50	42	14	44
7.	A Study of Coronary Dominance in Preserved Human Cadaveric Heart Specimens in Kolhapur Region of Western Maharastra [14]	Dissection	Asia	50	88	10	2
8.	Anatomical variations of coronary artery and frequency of median artery: A cadaveric study from Northern India[2]	Dissection	Asia	40	40	17.5	42.5
9.	A study on principal branches of coronary arteries in humans[18]	Dissection	Asia	100	89	11	0
10.	Study of Coronary Dominance in the Population of Hyderabad Karnataka Region[12]	Dissection	Asia	76	83	14.5	2.5
11.	A study in Coronary Dominance in the Population in Assam[13]	Dissection	Asia	70	70	18.57	11.43
12.	Prevalence of left and balanced coronary arterial dominance decreases with increasing age of patients at autopsy. A postmortem coronary angiograms study[6]	Angiography	Europe	1620	81.2	9.1	9.7
13.	A cadaveric study on coronary preponderance[7]	Dissection	Asia	50	62	22	16
14.	Coronary Artery Dominance: What pattern exists in Pakistani Population?[11]	Angiography	Asia	200	60.5	19.5	20
15.	Pattern of coronary artery dominancy in kurdish population and its correlation with the extent of coronary artery disease[31]	Angiography	Asia	200	57	23	20
	Mean				**71.4**	**15.5**	**12.8**

V. DISCUSSION

Due to the clinical significance of the coronary artery dominance, several studies have been carried out all over the globe. Several method have been applied in studying the coronary dominance which includes dissection, angiography and perfusion. This review found that most of studies were done on Asian population of different ethnicity and very few studies in Africa and Europe were found.

Study done on Asian population of Telangana in India revealed that,70% of population had right coronary dominance, while the left coronary dominance and co-dominance were equal at 15% this study found that the degree of severity of myocardial infarction was more common in subjects with left coronary artery dominance [30], the same study result were also reflected by study done in London by[10]

Ravi et al 2017, observed 83.3% of right coronary dominance, 13.3% left dominance and 3.3% co-dominance of specimens which was almost similar to a study done by Kalpana et al 2003 and Jaishree et al 2015,which also observed low occurences of left dominance and co-dominance.

Prafulla S et al 2016, noted that right dominance occurred 82.4% subjects which closely resembled a studies of Jaishree et al and Knaapen et al. Left dominance was noted 13.3% subject which closely resembled studies of Fazliogullari et al., 2010 .Co-dominance was noted in 4.3% of the subjects studied and it was least noted resembling studies of Kalpana, 2003 and Bhavana et al., 2015.

VI. CONCLUSION

The prevalence coronary heart disease is pretty high in developing countries. High prevalence of cardiovascular risk factors only implies a rising risk of cardiovascular morbidity and mortality, therefore knowledge in coronary artery dominance is crucial in prediction of patient's outcome in coronary artery disease

Coronary artery dominance patterns has great variation in terms of geographical, ethnic and race.

Sound anatomical knowledge is required for accurate interpretation of coronary angiogram and success in surgical management coronary artery disease

Due to its significance in clinical field the coronary artery dominance should be determined in the different geographical regions.

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