Angiographic Assessment of Coronary Artery Dominance

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Abstract:
Aim of study: To assess the dominance pattern of coronary arteries and whether it has got any clinical and therapeutic implications.
Materials and method: Coronary angiography reports of 225 patients were analyzed to find dominance pattern and its correlation with severity of clinical presentation if any .
Observations: Out of 225 patients , 151 presented with right dominant circulation , 46 had left dominance , 23presented with features of co-dominance, while in 5patients dominance could not be ascertained .
Discussion: Dominance is decided by posterior interventricular(PIV) and posterolateral ventricular(PLV) branches . Coronary artery giving off these branches is considered to be dominant . In co-dominant circulation PIV branch comes from right coronary artery while the PLV branches are given off by circumflex branch of left coronary artery. Left dominant circulation is associated with poor treatment outcomes and worse prognosis compared to right dominant circulation in patients affected by coronary heart diseases .
Conclusion: Since dominance pattern can affect treatment outcome and prognosis , so prior knowledge of coronary arterial dominance pattern can help cardiologists formulate better management protocols and explain prognosis to patients and attendants before starting treatment .
Keywords: Balanced / co-dominant circulation , coronary angiography , left coronary artery dominance , right coronary artery dominance .

I.   Introduction

Coronary arterial distribution territory determines the dominance of either right or left coronary artery . The dominance pattern can affect treatment outcome and prognosis in patients with coronary heart diseases due to which several researchers have tried to assess the dominance of coronary arteries in cardiac wall blood supply . There is wide variation in observations and findings of different workers with right coronary artery (RCA) dominance varying from 60% in some works to as high as 90% in others . So we thought of assessing the dominance pattern in patients of our region (South Bihar , India) , which can help the treating cardiologists and physicians take better decision regarding management protocol and in assessing the prognosis as well .

II. Materials And Method

Our study is based on coronary angiography reports of 225 patients whose angiography was done in cardiology section of medicine department of our College between June 2017 to January 2019 . We collected the reports from cardiology section and analyzed the reports for information pertaining to our study , to find out dominance pattern in different patients and then categorized them into right coronary artery (RCA) dominant , left coronary artery (LCA) dominant or balanced circulation type . We counted the number of patients having either of these presentations and used this data to calculate the absolute number of patients in each category and then percentage of dominance pattern in our study group .
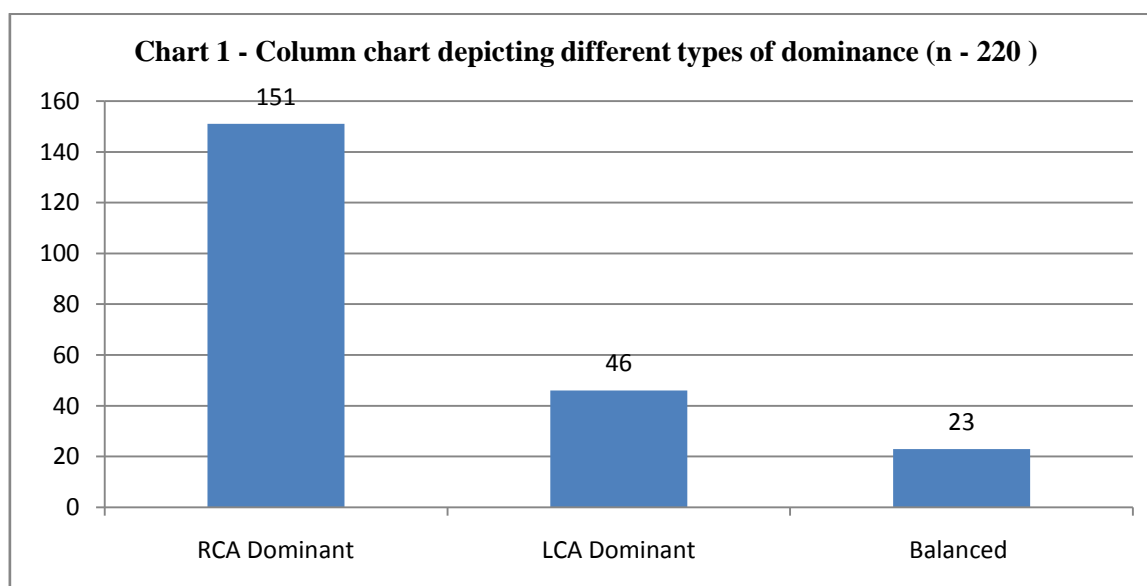
We used this data to prepare table , column chart and pie chart included in our work . We compared findings of our study with data in standard textbooks and data of previous workers to assess whether there was any significant difference in our observation and interpretation with regards to the previous works conclusion .
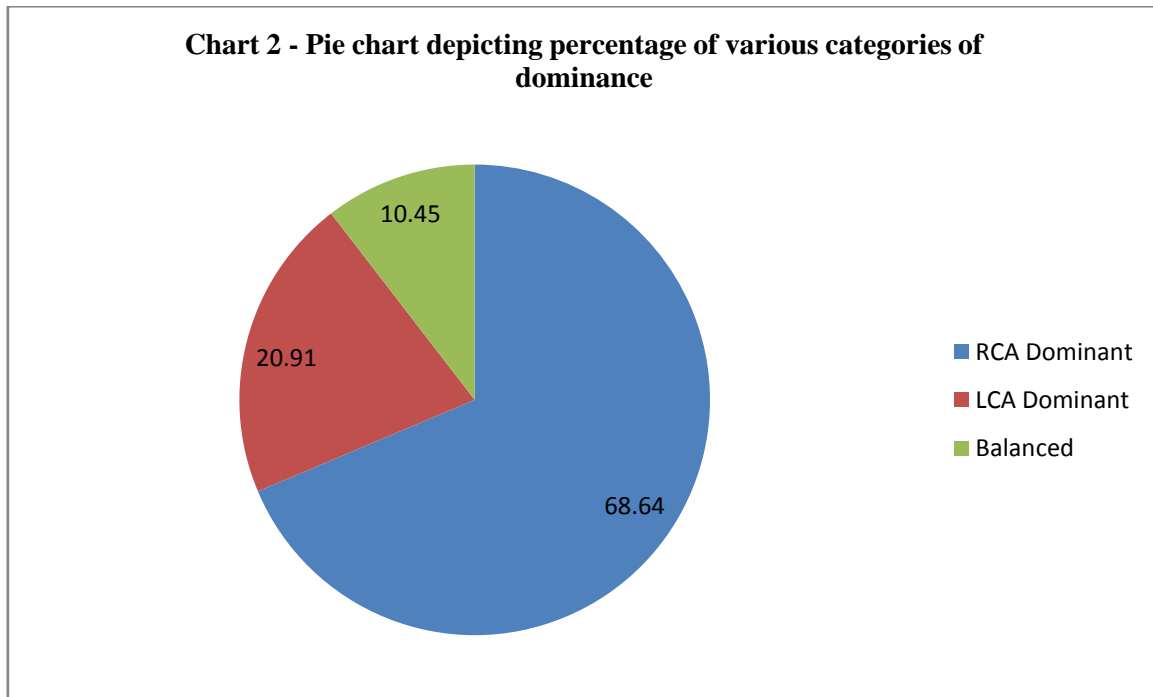
III. Observations

Out of 225 patients , 151 patients presented with right dominant circulation , 46 had left dominant circulation , 23 presented with balanced / co-dominant coronary circulation . In 5 patients out of 225 the dominance pattern was not clear . Analysis of reports of these patients showed that they were having subtotal / total occlusion of right coronary artery and left circumflex artery (these patients had triple vessel coronary artery disease) and this prevented filling of posterior interventricular and posterolateral ventricular branches with dye and hence these vessels were not visualized , so dominance pattern could not be made out in these cases . We excluded these 5 patients from our study group and calculated the dominance proportions of different type taking 220 as the total number .

Table 1. Dominance pattern of coronary arteries (n -220)

Type	Number	Percentage
RCA Dominant	151	68.64
LCA Dominant	46	20.91
Balanced	23	10.45

Chart 1 - Column chart depicting different types of dominance (n - 220)

Chart 2 - Pie chart depicting percentage of various categories of dominance

IV. Discussion

Myocardium requires a continuous supply of blood to meet its oxygen requirement , imbalance in oxygen demand and supply can lead to transient ischemic changes in myocardium or full blown ischemic heart disease. The blood supply to myocardium comes from right and left coronary arteries which arise from anterior and left posterior aortic sinuses respectively . the main trunks and first and second order branches run subepicardially along the atriventricular(AV) groove , interventrivular (IV) groove or on surface of heart deep to epicardium .

`` Variations in coronary arterial system mainly affect diaphragmatic aspect of ventricles and reflect relative dominance of coronary arterial supply . The term dominance of coronary artery is misleading because left coronary artery almost always supplies a greater volume of tissue than right coronary artery .[1]

Despite this pitfall the dominance pattern assessment is useful because it has got a bearing on treatment outcome and prognosis in patients suffering from coronary heart diseases. A patient having left dominant circulation has poorer prognosis compared to a right dominant person if both are afflicted with coronary artery disease to same extent .

The coronary artery circulation can be categorized into three subsets – right dominant , left dominant and balanced / co-dominant .

In right coronary artery (RCA) dominance , right coronary artery after giving off posterior interventricular (PIV) artery continues beyond the crux as right posterior atrioventricular(RPAV) branch terminating in one or several posterolateral ventricular(PLV) branches that supply diaphragmatic surface of left ventricle .[2]

In left coronary artery (LCA) dominance , posterior interventricular (PIV) artery and posterolateral ventricular (PLV) branhes to diaphragmatic surface of left ventricle come from circumflex branch of left coronary artery . RCA is very small , does not reach the crux and does not supply left ventricular myocardium in this type of coronary circulation .[2]

In balanced / co-dominant coronary circulation , the RCA gives off PIV artery while left circumflex artery provides all posterolateral branches .[2]

At or near crux , dominant artery gives rise to a small atrioventricular (AV) node artery , which passes upwards to supply atrioventricular node .[2]

We found right coronary artery dominance in 68.64% , left coronary dominance in 20.91% and balanced circulation in 10.45% . All authors report much higher incidence of right coronary artery dominance compared to left dominance or balanced type circulation (Table 2 , Table 3) , .

Table 2 Dominance pattern range in percentage in different textbooks

Text books	RCA Dominance	LCA Dominance	Co-dominant
Braunwald's Heart disease[2]	85	7.5	7.5
Harrison's Principles of Internal Medicine[3]	85	5	10
Moore's Clinically Oriented Anatomy[4]	67	15	18
Snell's Clinical Anatomy By Regions[5]	90	10	-
Hurst's The Heart[6]	70	10	20

Our finding RCA dominance in 68.64% is closer to RCA dominance percentage of Moore's textbook(67%) and Hurst's data(70%) . Though RCA is more commonly dominant compared to the other two categories but the percentage of RCA dominance varies from 60%[1] in some text to as high as 90%[5] in others .

We found LCA dominance in 20.95% cases which is higher compared to the data of any of the textbooks which range from 5% - 15% , however percentage of balanced circulation in our study (10.95%) is close to Harrison's balanced pattern percentage of 10% .

Further analysis of data revealed that among left dominance and balanced type there is mixed pattern , some authors consider dominance to be of right or left type only with complete absence of balanced type in their data[5,7], while others report balanced type to be more common than left dominance[3,4,6]and one of them reports equal incidence of left dominance and balanced type circulation[2] .

Our observation says left dominance is more common than balanced type , it is double (20.91%) as prevalent as balanced type which is found in only 10.45% of individuals , here our finding differs from textbook data which consider balanced type to be more common than left dominance .

Table 3. Comparison of dominance pattern percentage of previous workers and our study

Authors	RCA Dominance	LCA Dominance	Balanced	Number of specimens
Present study	68.64	20.91	10.45	220
Raut B K et al [8]	59.83	17.03	23.14	229
Murphy E S et al [9]	73.33	14.67	12	225
Karna A K et al[10]	85.5	10	4.5	220
Ghaffari S et al[11]	78.6	8.9	12.5	183
Kalpana R[12]	89	11	-	100
Khona P et al[13]	83	17	-	100
Amgain K et al[14]	61.34	24	14.67	75
Das H et al[15]	70	18.57	11.43	70
Damor B et al[16]	90	10	-	60
Vinitha G et al[17]	62	22	16	50
Pal M et al[18]	70	22	8	50
Priyadarshi S et al[19]	84	8	8	50
Parikh N I et al[20]	81.67	10.09	8.24	207926
Veltman C E et al[22]	86	9	5	1131

Our findings are closer to findings of Das H et al[15] who did their work on Assamese people and Pal M et al[18] who studied the West Bengal population . These states are in eastern part of India and it is possible that people from similar demographic background have similar dominance pattern , though considering the volume of data available with us we cannot be sure of any such link and more extensive works need to be carried out to look for any such connection between dominance pattern .

From the data of all the workers we can see that right dominance(59.83% - 90%) is much more common compared to left dominance(8% - 24%) or balanced type(0% - 23.14%) . On the other hand balanced type is the least common of the three category , except for study of Raut B K et al in which balanced type(23.14%) is more common than left dominance(14.67%) and study of Priyadarshi S et al[19] in which both left dominance and balanced type are equally prevalent(8%each) , rest of the studies show balanced type to be less common than left dominance .Thus we can say though the absolute percentages in different studies vary but they present similar pattern , right dominance being most common and balanced type least common in most of them including our study .

Now we move on to correlation of dominance pattern with different type of cardiac diseases and whether any particular dominance pattern is associated with poor treatment outcomes and prognosis .

N I Parikh et al[20] did a study on data available with USA observational registry (NCDR Cath PCI registry). They studied relation of left dominance and codominance relative to right dominance with in-hospital mortality in 207926 patients who underwent percutaneous coronary intervention(PCI) for acute coronary syndromes(ACS) between July 1 2009 and June 30 2010 . They found left and codominant circulation are associated with modestly increased risk of in-hospital mortality after PCI for ACS , particularly in lesions in left main /left circumflex artery territory .

T Kuno et al[21] did there study on 4873 acute coronary syndrome(ACS) patients undergoing percutaneous coronary intervention(PCI) at 14 hospitals of Japan participating in Japanese Cardiovascular Database Registry . They found that among ACS patients who underwent PCI , left dominant patients had significantly worse in hospital outcomes compared with right dominant patients and left dominant anatomy was an independent predictor of in hospital mortality .

C E Veltman et al[22] did there study on 1131 patients at a centre in Netherland and found that left dominant coronary system is associated with significantly increased risk of 30 day mortality and early reinfarction after ST segment elevation myocardial infarction (STEMI) .In patients surviving first 30 days post STEMI coronary vessel dominance had no influence on long term outcome . Awareness of prognostic relevance of coronary dominance is important , recognizing a left dominant system as one of risk factors for future adverse events post STEMI .

L Peng et al[23] in their study on data of 2225 patients undergoing coronary angiography at their center in China between January 2011 and November 2014 found that patients with right dominant coronary circulation had a higher prevalence of triple vessel coronary artery disease and significant stenosis in the right coronary artery . They concluded that right dominance positively correlated with triple vessel coronary artery disease compared to left dominance or codominance . Their result suggested that right dominance may serve as a risk factor for triple vessel coronary artery disease and more effective measures should be taken in right dominant patients to prevent fatal cardiovascular events .

In another study that we did we found triple vessel disease in 35.76% patients with right dominant circulation , 30.43% patients with codominant circulation and 21.74%patients with left dominant circulation . Double vessel disease was present in 28.26% patients with left dominant circulation , 26.09% patients with codominant circulation and 18.54% patients with right dominant circulation .

Findings of these workers and others not mentioned here do indicate that predominance type can be correlated with certain coronary diseases and there treatment outcomes but more extensive and exhaustive studies from different part of globe are needed to come to some standardized common finding regarding relation of dominance pattern and coronary artery disease prevalence or treatment outcomes . Still finding of these studies do indicate certain trends and if they are kept in mind by cardiologists or cardiac surgeons during formulation of management protocols and assessing prognosis , they can be of great help to doctors as well as patients .

V. Conclusion

Among three types of coronary arterial circulation , right coronary dominance is most common(60%-90%) , but workers differ in their opinion regarding left dominance or codominance , majority work indicate balanced type

is the least common however a sizeable number found left dominance to be less common than balanced type .

In our study RCA dominance is most common (68.64%) , left dominance stands second common type with 20.91% and codominance is the least common type with 10.45% .

Triple vessel disease is more common with right dominant circulation while double vessel disease is more frequent in left dominant patients . Despite triple vessel disease being more frequent in right dominance cases , left dominant circulation compared to right dominance is associated with more severe disease , poor treatment outcomes and prognosis in patients with coronary artery diseases and cardiologists should keep these fact in mind while formulating management protocols and explaining prognosis to patients attendants as this might help in easing out tension during follow up if treatment outcome is not as per desire and might be of help in preventing unpleasant , bitter situations between doctors and patients which is on rise these days in different parts of world including India .

Acknowledgement

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