Original article

A cadaveric study of coronary artery dominance on West Bengal population

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Abstract:

Introduction – Coronary heart disease is one of the greatest killers in today's world. Knowledge of coronary dominance is important to understand coronary artery diseases, interpret the findings and plan the treatment of cardiovascular diseases. The aim of the present study is to observe the pattern of coronary dominance and variations of posterior interventricular artery in cadaveric human heart.

Methods: The study was done on 50 formalin fixed adult cadaveric heart specimens in the Department of Anatomy, Medical College and Hospital, Kolkata irrespective of age, sex. The coronary arteries were examined by gross dissection and analyzed statistically.

Observations: In 'right dominance' heart posterior interventricular artery arises from the right coronary artery , in 'left dominance' heart it arises from the left circumflex artery and when both the right coronary artery and Left circumflex artery give origin to posterior interventricular artery ,is expressed as 'Balanced type'.

Results: Right preponderance was seen in 35(70%) hearts, left preponderance in 11 (22%) hearts and balanced or codominance was seen in 4(8%) hearts. Statistical analysis of the results was done in the form of z score and p value to compare with the previous studies done in India.

Conclusion : Coronary dominance has an impact on prognosis of the patient with acute coronary disease. So the present study would be of use to the cardiologist and interventional radiologist to predefine the abnormalities by invasive and non invasive studies.

Key Words : coronary artery, coronary dominance, left dominance, right dominance, posterior interventricular artery.

Introduction

Ischaemic heart disease alone caused 7 million deaths worldwide in 2010, an increase of 35% since 1990.[1] South Asians, especially India have a high prevalence of risk factors, and have ischaemic heart disease at an earlier age than the people in developed countries. So recently India has the highest burden of acute coronary syndromes in the world.[2] Whatever the aetiology and pathophysiology of coronary artery disease is, coronary artery remains the seat of disease process. The increasing use of diagnostic and therapeutic interventional procedures necessitates that a sound basic knowledge of coronary artery pattern with dominance is essential.[3]

The heart is normally supplied by two coronary arteries, namely Right coronary artery (RCA) and Left coronary artery (LCA). The RCA arises from anterior aortic sinus of Valsalva, and LCA arises from left posterior aortic sinus of Valsalva. The term 'dominant' is used to refer to the coronary artery giving off the posterior interventricular (descending) artery (PIVA or PD), which supplies the posterior part of the ventricular septum and

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often part of the posterolateral wall of the left ventricle. If PIVA arises from the RCA it is termed as 'Right dominance' (in 60% cases). The posterior interventricular artery is produced by the RCA near the crux of heart, in 70% cases and passes along the posterior interventricular groove. If it arises from the Left circumflex artery (LCX), which is a branch of left coronary artery, it is termed as 'Left dominance'. The circumflex artery, curves left in the atrioventricular groove, continuing round the left cardiac border into the posterior part of the groove and ending left of the crux in most hearts, but sometimes continuing as a posterior interventricular artery. When both the RCA and LCX give origin to PIVA, is expressed as 'Balanced type', where branches of both arteries run in or near the posterior interventricular groove.[4] A study conducted by Eren et al indicated that, although right dominance circulation is more common in general population, both the coronary diseases and coronary artery variations are more common in individuals with left dominance circulation.[s5] In patients with acute coronary syndrome, left dominance is a significant and independent predictor of increased long-term mortality according to Goldberg et al.[6] It was also reported that atherosclerotic involvement of the RCA and the Left circumflex artery is more common in right dominant heart.[7]

Left dominance seems to be associated with higher mortality due to acute infarction and a higher incidence of atherosclerosis.[8] So, with rising burden of coronary heart diseases and its antecedent morbidity and mortality, study of the gross anatomy of coronary arteries has become a necessity from the diagnostic evaluation of coronary heart disease and planning for subsequent treatment.

Aims and objectives

The aim of the present study is to evaluate the coronary dominance pattern which will help the cardiac physicians and surgeons for better diagnosis and management of coronary artery diseases. The objective of the present study is to statistically compare the observations of present study with similar studies done in the past to find out the significance factor.

Materials and methods

A total of 50 formalin fixed adult cadaveric heart specimens were collected from the department of Anatomy, Medical College and Hospital, Kolkata irrespective of age, sex. Visceral pericardium was stripped and subepicardial fat was removed to study the coronary artery and its branching pattern. The branches were dissected manually and carefully. The coronary artery which gives the PIVA and determines the coronary predominance was examined in detail. Photographs were taken; required data were noted and analyzed statistically.

Observations & results

In our study right coronary artery dominance was seen in most of the cases irrespective of age and sex. The PIVA or posterior descending (PD) artery arose from RCA in 35 hearts (70%). These were called 'Right dominant'. (fig: 1) It arose from left circumflex artery in 11 hearts(22%), called 'Left dominant' (fig: 2) and in 4 hearts(8%) both the arteries gave origin to the PIVA or PD. (fig: 3) These hearts were called 'Balanced type'. (Table: 1 and Fig: 4) In balanced type there were two PIVA seen lying within posterior interventricular sulcus. (fig: 3). The PIVA was terminated by anastomosing with the terminal part of anterior intervetricular artery.

Table 1: Origin of PIVA(Dominance) (total specimen = 50)

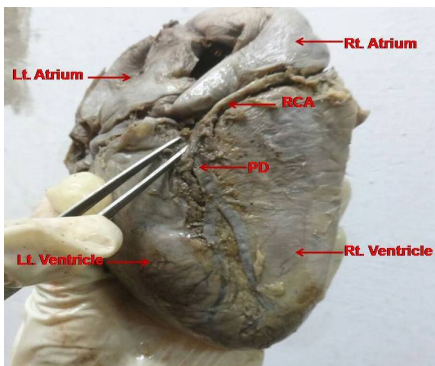| Origin of Posterior interventricular artery(PIVA)	No specimens	%
Right dominace	35	70%
Left dominance	11	22%
Balanced type	4	8%

Fig 1: Heart showing Right dominance pattern where posterior descending artery (PD) arose from Right coronary artery (RCA).
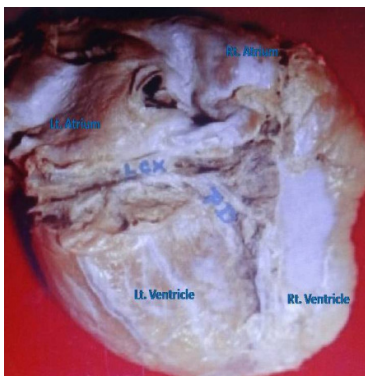

Fig 2: Heart showing Left dominance pattern where posterior descending artery (PD) arose from left circumflex artery (LCX).
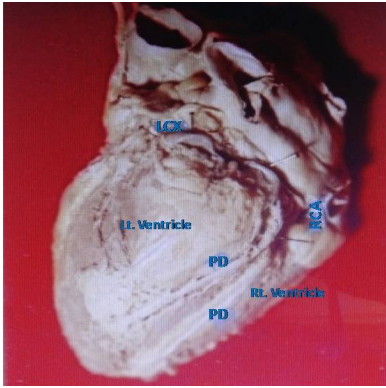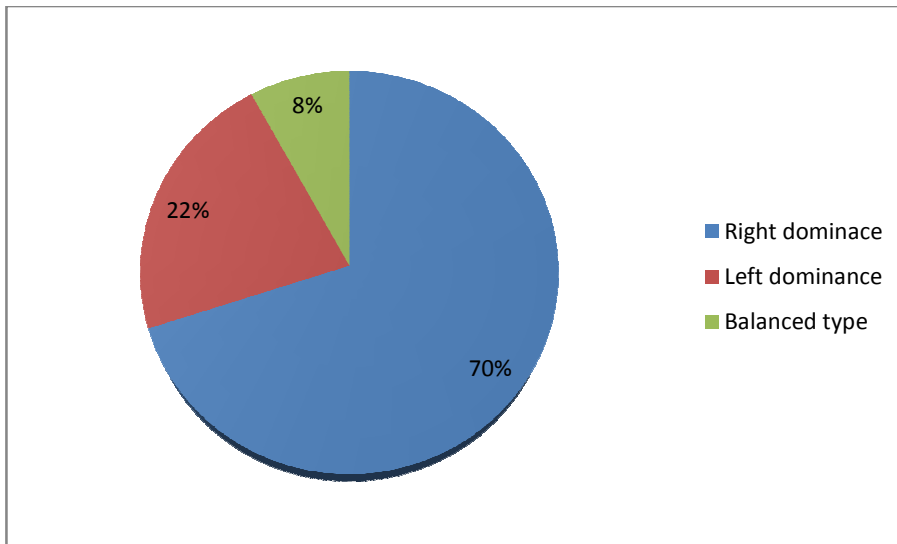
Fig 3: Heart showing Balanced pattern where posterior descending artery (PD) arose from both Right coronary artery (RCA) and left circumflex artery (LCX), and both PD lying within posterior interventricular sulcus.

Fig 4 : PIE DIAGRAM SHOWING TYPES OF DOMINANCES

Discussions

The present study showed higher percentage of right dominance (70%). All the authors also reported that the right dominance was more common than left dominance and balanced type (Table 2).

Table 2 : Dominance pattern compared with other authors (total specimen = 50)

Authors	Right dominance (in %)	Left dominance (in %)	Balanced type (in %)
Kalpana R[9] (2003)	89	11	-
Venkateshu KV[10] (2005)	68.75	16.66	14.58
Das H [3](2010)	70	18.57	11.43
Bhimali S [11] (2011)	60	23.33	16.66
Reddy V [12] (2013)	86.25	11.25	2.5
Vinitha G[13] (2015)	62	22	16
Gohain N[14] (2015)	64.44	24.45	11.11
Agrawal R[15] (2016)	86	8	6
Present study	70	22	8

The percentage of right dominance of the present study (70%) was comparatively less than the findings of Kalpana R[9] (89%), Reddy V[12] (86.25%) and Agrawal R[15] (86%), but it corroborated with the study of Venkateshu KV[10] (68.75%) and Das H[3] (70%). The percentage of the left dominance of this study (22%) was closed to the observation of Bhimali S[11] (23.33%) and Gohain N[14] (24.45%), but a little bit higher than some other studies. But the percentage was similar with the study of Vinitha G[13] (22%). Balanced type, however presented wide variations. Study of Kalpana R[9] revealed a 0% of prevalence while study of Bhimali S[11] showed the prevalence of 16.66%. In present study, balanced type was seen in only 8% of cases, which was lower than the values of other studies except the study of Reddy V[12] (2.5%) and Agrawal R[15] (6%).

Dominance pattern of heart has an important clinical significance. It has an impact on coronary blood flow volume in the left circumflex and right coronary arteries but not in the left anterior descending (LAD) coronary artery. These findings suggest that the extent of myocardial perfusion area is associated with coronary blood flow volume.[16] LAD artery in left coronary dominance is usually long wrapping around the apex of the heart supplying major portion of myocardium, and angiographic interventions in such cases have important clinical implications. Ilia et al has concluded in his study that lesions in LAD would have more profound clinical importance in left dominant heart than right dominant heart.[17]

The study done by Vasheghani-Farahani et al demonstrates a relationship between angiographic coronary artery disease (CAD) severity, and the involved arterial territory and dominancy patterns. The right dominant patients tend to have three-vessel disease, stenosis of more than 50% in right coronary artery and left circumflex territories, more than the left-dominant patients.[7]

Makarovic et al had confirmed in his study that the relevance of left coronary artery dominance in the outcome and prognosis of obstructive CAD. Therefore, it is conceivable that the type of coronary artery dominance also has an effect on the occurrence and outcome of non obstructive CAD.[18]Murphy et al has noted in their study that patients with left dominance have a shorter left main coronary artery than patients with right dominance. The increased prevalence of a dominant left coronary arterial system in aortic stenosis suggests that this may be part of a developmental complex. They also have an increased risk of perioperative myocardial

infarction if there is associated obstructive coronary artery disease.[19]

In patients with ST-segment elevation myocardial infarction (STEMI), a left-dominant coronary artery system is linked with higher risk of 30-day mortality and early reinfarction compared with right dominance, according to a study published by Veltman et al.[20] In right dominant heart RCA usually supplies AV node. Hence any inferior wall infarct caused by occlusion of the RCA will have higher risk of AV block ,approximately in 30% of cases.[21]

Statistical analysis of the results was done in the form of z score and p value. The findings were randomly compared statistically with a study, done on the whole population of India by Kalpana R[9] and with another study, done on population of Assam, nearest to West Bengal by Hirak Das et al.[3] When compared to Kalpana R[9] (n-100) results were found to be statistically significant[right dominance (z=2.92, p<0.05), left dominance (z=1.774, p<0.05), balanced type (z=2.876, p<0.05)]. But when compared with Hirak Das et al[3] (n-70) the results were found to be insignificant [right dominance (z=0, p>0.05), left dominance (z=0.463, p>0.05), and balanced type (z=0.6178, p>0.05)].

Conclusions

Preoperative information about the coronary arterial anatomy and extent of coronary artery disease may be helpful in planning the use of coronary perfusion and other myocardial preservation techniques during surgery in order to reduce the incidence of myocardial infarction. Dominance can be a significant determinant of prognosis in acquired coronary artery disease. This study revealed right dominance in 70% of the specimens in which PIVA originated from the RCA, left dominance in 22% of the specimens in which PIVA arose from the Left circumflex artery, and balanced type (8%) in which both the RCA and Left circumflex artery gave origin to PIVA. While performing angioplasty and coronary artery bypass grafting, knowledge of dominance of artery becomes very helpful. The degree of severity of myocardial infarction is more and may lead to death in single attack if there is obstruction in the left coronary artery. So, anatomy of the coronary arteries is to be studied more enthusiastically for a better understanding, evaluation and management of the disease.

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