A STUDY OF CORONARY DOMINANCE IN THE POPULATION OF KATHMANDU VALLEY

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ABSTRACT

According to World Health Organization (WHO), Coronary heart diseases constitute the main cause of death worldwide. Variation in the morphological pattern of coronary arteries and their major branches is an important factor in the assessment of coronary heart disease. This study therefore aims to focus on the pattern of coronary dominance in Kathmandu Nepal. A total of 60 formalin fixed adults cadaveric heart specimens irrespective of age and sex were collected from the departments of Anatomy of Nepal Medical College, Nepal. The coronary arteries and their branches were dissected manually and carefully and followed till their termination. The coronary artery which gives the posterior interventricular artery and determines the coronary predominance was examined in detail. The modes of termination of the right coronary artery and the circumflex artery were also found out. In the 60 adults human cadaveric hearts which were dissected, the posterior interventricular arteries were found to arise from the right coronary artery in 51 specimens (85.0%). These were called 'right dominant'. The posterior interventricular arteries arose from the circumflex artery in 3 specimens (5.0%). These were called 'left dominant'. In 6 specimens (10.0%), the posterior interventricular arteries arose from both the RCA and the circumflex arteries. These hearts were called 'balanced'. This study revealed right dominance is the common pattern, right coronary artery supplies to major area of diaphragmatic surface of the heart through posterior interventricular artery so this artery has to be considered while deciding the choice of therapy in right coronary artery occlusion.

KEYWORDS

Balanced, coronary artery, dominance, interventricular artery, left dominant, posterior right dominant

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INTRODUCTION

The heart is supplied by two coronary arteries, namely right coronary artery (RCA) and left coronary artery (LCA). The two coronary arteries form an oblique inverted crown, consisting of an anastomotic circle in the atrio-ventricular sulcus connected by marginal and interventricular loops intersecting at the cardiac apex.[1] The term coronary is derived from the Latin word 'corona' which means crown.[2]

Variations with regard to origin, course, branching patterns and termination of coronary arteries have been reported by some observers.[3] Variability in the origin of the posterior inter-ventricular artery (PIVA) determines the dominance of the coronary circulation or the term dominant is used to refer to the coronary artery giving off the posterior interventricular artery (PIVA) or posterior descending artery.[2,3]

The 'right dominance' is termed when the posterior inter-ventricular artery arises from the right coronary artery,[2-4] which passes along the posterior interventricular groove.[4] If posterior inter-ventricular artery arises from the left circumflex artery which is a branch of left coronary artery, it is termed as 'left dominance'.[2-4] In majority of hearts, 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, but sometimes it continues as a posterior interventricular artery.[4] When both the right coronary artery and left circumflex artery give origin to the posterior inter-ventricular artery, it is termed as 'balanced type.[2-4] The branches of the both arteries run in or near the posterior interventricular groove.[4] Left dominance also seem to be associated with higher mortality due to acute infraction and a higher incidence of atherosclerosis.[3]

According to World Health Organization (WHO), Coronary heart diseases constitute the main cause of death worldwide. Variation in the morphological pattern of coronary arteries and their major branches is an important factor in the assessment and treatment of coronary heart disease.[5]

The knowledge of details of anatomy of coronary arteries and their variations would be helpful in the interpretation of angiograms and various surgical interventions and in the management of coronary artery diseases.[6]

MATERIALS AND METHODS

A total of 60 formalin fixed adults cadaveric hearts specimens without any obvious pathology were collected from the departments of Anatomy of Nepal Medical College, Nepal. The heart were preserved in 10% formalin and dissected at a convenient time later. Visceral pericardium was stripped off and subepicardial fat was removed to study the coronary artery and its branching pattern. The coronary arteries and their branches were dissected manually and carefully and followed till their termination. The arteries which give the posterior interventricular artery and determines the coronary predominance were examined in detail. The arteries were painted with red fabric color to enhance contrast. Photographs were taken, relevant data were noted and analyzed statistically. The modes of termination of the right coronary artery and the circumflex artery were described with the help of following points: At the right border, between the right border and the crux, at the crux, between the crux and the left border, junction of right and inferior border, near the crux, left border. Origin of the posterior interventricular artery was taken as the basis of dominance.

RESULTS

In the 60 adults human cadaveric hearts which were dissected. The posterior interventricular artery was found to arise from the right coronary artery in 51 specimens (85.0%). These were called 'right dominant' (Fig. 1). It arose from the circumflex artery in 3 specimens (5.0%), called 'left dominant' (Fig. 2). In 6 specimens (10.0%), it arose from both the RCA and the circumflex arteries. These hearts were called 'balanced'. In balanced pattern, we could thus see two posterior interventricular arteries (Fig. 3). This results have been shown in Table 1.

The RCA was found to terminate at the right border in 2 hearts (3.3%), between the right border and the crux in 6 hearts (10.0%), at the crux in 19 hearts (31.7 %), between the crux and the left border in 19 hearts (31.7 %) and at the left border in 2 hearts (3.3 %), junction of right and inferior border 3(5.0%) and near the crux 9(15) . This results has been shown in Table 2.

The circumflex artery was found to terminate at the left (obtuse) border in 17 hearts (28.3 %), between obtuse border and crux in 32 hearts (53.4 %), at crux in 9 hearts (15%) and between the crux and right(acute) border in 2 hearts (3.3 %)and right border in 0. This result has been shown in Table 3.

The posterior interventricular artery continued forward for variable distance along the posterior interventricular sulcus towards the apex. It usually terminated by anastomosing with the terminal part of the anterior interventricular artery. Different site of termination of the posterior interventricular artery were crux and apex 19 (31.7%) near the apex 18 (3.0%), at the apex 15 (25.0%), near the inferior border 2 (3.3%) and crux and left border 6 (10%). This results has been shown in Table 4.

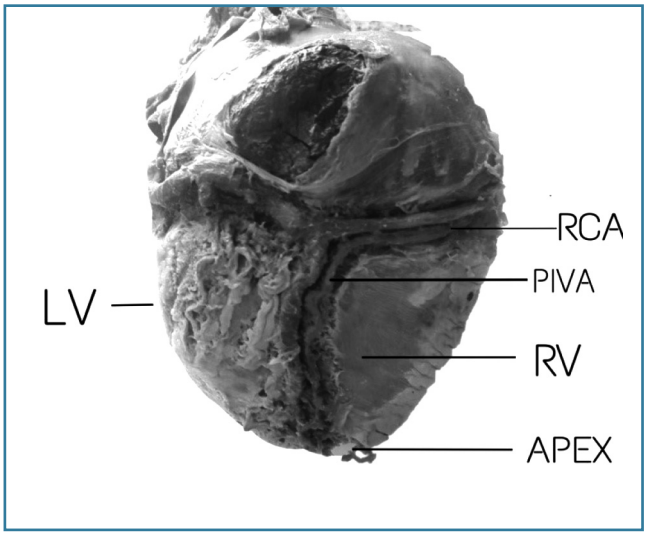

Fig. 1:
specimen of heart showing right dominance.

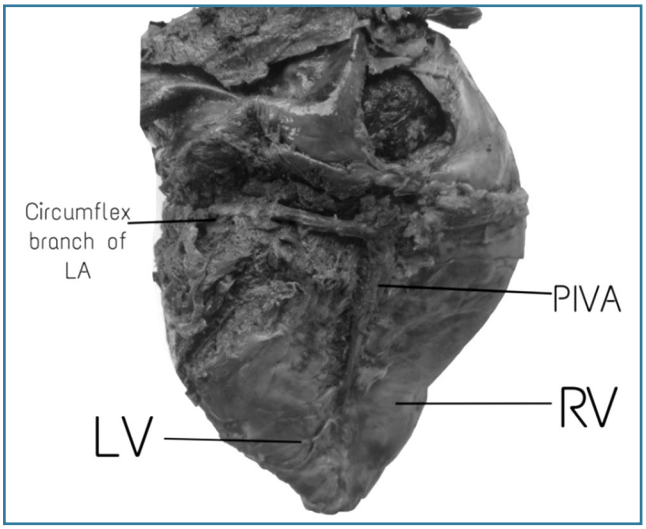

Fig. 2:
Specimen of heart showing left dominance

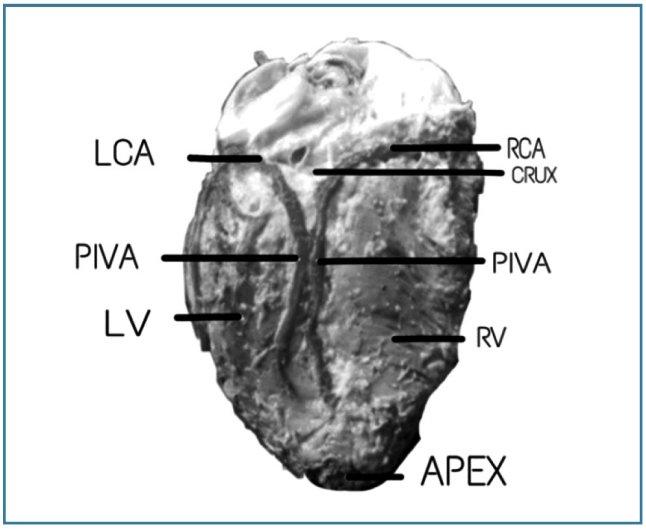

Fig. 3:
Specimen of heart showing balanced pattern.

Table 1: Origin of posterior interventricular artery (Dominance)

Dominance pattern	Number	Percentage
Right dominance	51	85.0
Left dominance	3	5.0
Balanced	6	10.0
Total	**60**	**100.0**

Table 2: Termination of Right coronary artery

S.N.	Site	Number	Percent
1	Right border	2	3.3
2	Between right border and crux	6	10.0
3	At the crux	19	31.7
4	At the crux and left border	19	31.7
5	Left border	2	3.3
6	Junction of right and inferior border	3	5.0
7	Near the crux	9	15.0
	Total	**60**	**100.0**

Table 3: Termination of Circumflex artery

S.N.	Site	Number	Percentage
1	Right border/acute	0	0
2	Right border and crux	2	3.3
3	Crux	9	15.0
4	Left border and crux	32	53.4
5	Left border	17	28.3
	Total	**60**	**100.0**

Table 4: Termination of posterior interventricular artery

S.N.	Site	Number	Percentage
1.	Crux and apex	19	31.7
2.	Near the apex	18	30.0
3.	At the apex	15	25.0
4.	Near the inferior border	2	3.3
5.	Crux and left border	6	10.0
	Total	**60**	**100.0**

DISCUSSION

The branching pattern and distribution of coronary arteries have been studied by various authors.[6] A comparison of coronary arterial dominance found by different investigators in different populations with present study is shown in Table 5.

The present study showed higher percentage of right dominance (85%). All the authors also reported that the right dominance was more common then left dominance and balanced type. The percentage of right dominance of the present study (85%) was comparatively less than the findings of Jyoti P[19] (90%), Damor B,[5] (90%), Kalpana,[9] (89%) and Reddy V[18] (86.25%) but it corroborated with the study of Anbumani T,[21] (84%) and Priyadharshini S,[6] (84%). The percentage of the left dominance of this study (5%) was closed to the observation of Priyadharshini S 6(8%), but slightly lower than some other studies. Balanced type, however presented wide variations. Study of Kalpana,[9] revealed a 0% of prevalence while study of Fazliogullari Z,[15] showed the prevalence of 44%. In present study, balanced type was seen in only 10% of cases, which was lower than the values of other studies except the study of Banerjee A,[22] (0.07%), Reddy V,[18] (2.5%), Dido Li,[7] (7.1%), Priyadharshini S,[6] (8%), and Pal M,[4] (8%). In the present study 19 (31.7%) of right coronary arteries terminates at crux and 19 (31.7%) of right coronary arteries terminates between crux and left border. Whereas study of Das H[2] showed 13(18.57%) of right coronary arteries terminates at crux and 41(58.57%) of right coronary arteries terminates between crux and left border.In the present study 9(15%) of circumflex arteries terminates at crux and 32(53.4 %) of circumflex arteries terminates between crux and left border. Whereas study of Das H,[2] showed 13(18.57%) of circumflex arteries terminates at crux and 37(52.86%) of circumflex arteries terminates between crux and left border. In the present study 52 (86.7%) of the posterior interventricular artery terminates between crux and apex.

Statistical comparisons of our results were done with others countries. We randomly chose two studies to compare the Dominance pattern in our population to those from other countries. We used chi-square test to compare the dominance pattern. Compared to Study from Assam, India by Das H *et al*, (n=70), the variance of dominance pattern was not statistically different (p=0.54), nor was it different compared to study from Portugal by Cavalcanti JS *et al* (n=110) (p=0.72)

Dominance pattern of heart has important clinical significance. Left dominance was found to have significantly higher mortality,[4] than right dominance and mixed types. Dominance also showed a role in left anterior descending (LAD) artery. It was observed that in left dominance, the LAD usually wraps around the apex of the heart, supplying major portion of the myocardium. In contrast, in right dominance, it was the posterior interventricular branch of the right coronary artery that supplied most of the myocardium. As such, lesions in LAD would have more profound clinical importance in a left dominant heart than in a right dominant one.[24] Dominance also plays an important role in inferior infarcts of the heart. Inferior wall infarcts although less extensive than anterior infarcts are more important as they can cause various degrees of atrioventricular block in approximately 30 % of cases. The dominant RCA usually supplies the atrioventricular (AV) node. Therefore an inferior wall infarct caused by occlusion of the RCA will have higher risk of AV block.[25]

In conclusion, this study revealed right dominance is the common pattern, right coronary artery supplies to major

Table 5: Dominance pattern compared with other Authors (Total specimen-60)

Author's Name	Right dominance	Left dominance	Co- dominance
Dido Li *et al* (1975)[7]	73.5%	19.4%	7.1%
Cavalcanti JS *et al* (1995)[8]	69.09%	11.82%	19.09%
Kalpana *et al* (2003)[9]	89%	11%	
Ortale JR *et al* (2004)[10]	62.5%	12.5%	25%
Loukas M *et al* (2006)[11]	55%	33%	12%
Goldberg A *et al* (2007)[12]	16.8%	17%	16.2%
Abuchaim D *et al* (2009)[13]	72%	20%	8%
Kosar P *et al* (2009)[14]	76%	9.1%	14.8%
Fazliogullari Z *et al* (2010)[15]	42%	14%	44%
Hirak das *et al* (2010)[2]	70%	18.57%	11.43%
Knaapen M *et al* (2013)[16]	81.2%	91%	9.7%
Reddy V J *et al* (2013)[18]	86.25%	11.26%	2.5%
Jyoti P *et al* (2013)[19]	90%	10%	
Puli D *et al* (2014)[20]	83.11%	16.88%	
Amgain K *et al* (2014)[3]	61.34%	24%	14.67%
Damor B *et al* (2015)[5]	90%	10%	
Pal M *et al* (2016)[4]	70%	22%	8%
Anbumani TL *et al* (2016)[21]	84%	16%	
Priyadharshini S *et al* (2016)[6]	84%	8%	8%
Banerjee A *et al* (2016)[22]	76.67%	16.67%	0.07%
Present study	85%	5%	10%

area of diaphragmatic surface of the heart through posterior interventricular artery so this artery has to be considered while deciding the choice of therapy in right coronary artery occlusion. Assigning anatomical definition to any coronary artery or its branches by any interventionist demands a sound anatomical knowledge of both normal and variant courses of coronary arteries and their branches. Present study provides data from Kathmandu region regarding prevalence of coronary circulation, which may prove of some help to anatomists, radiologist and interventionists.

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