

## A STUDY OF CORONARY ARTERIAL DOMINANCE PATTERN

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### ABSTRACT

**Background:** The pattern of coronary arterial dominance varies in different populations. The knowledge of dominant pattern of coronary arteries has clinical significance. It is important in the interpretation of findings of cardiovascular diseases and in planning the treatment. Though right dominance is more prevalent, coronary artery disease is more common with those having left dominance circulation. Since adequate literature regarding coronary arterial dominance pattern and its variations in people living in and around Puducherry is not available, a study of coronary arteries in adult cadaveric hearts was undertaken.

**Aim and Objectives:** To study the dominance pattern, variations, the external diameter and the level of termination of coronary arteries and their main branches.

**Materials and Methods:** 50 human cadaveric hearts were studied by dissection. The origin of posterior interventricular artery was taken as the basis of dominance. The level of termination of the right coronary artery and the anterior interventricular artery was studied. The external diameter of the coronary arteries was measured using digital caliper. Variations in the coronary arteries and their branches were noted.

**Results:** In this study the right, left and co dominance were found to be 84%, 8%, and 8% respectively. These results were compared with previous studies and discussed. Myocardial bridge was noted over the anterior interventricular artery in one heart. In one specimen a branch from both right coronary artery and circumflex artery unite to form the posterior interventricular artery.

**Conclusion:** The majority of hearts are right dominant. The left dominance and co dominance are less common.

**KEY WORDS:** Coronary artery, Coronary dominance, Anterior interventricular artery, Posterior interventricular artery, Myocardial bridge.

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DOI: 10.16965/ijar.2016.343

**Web site:** International Journal of Anatomy and Research  
ISSN 2321-4287  
[www.ijmhr.org/ijar.htm](http://www.ijmhr.org/ijar.htm)

Received: 28 Jul 2016      Accepted: 06 Sep 2016  
Peer Review: 29 Jul 2016    Published (O): 30 Sep 2016  
Revised: None                Published (P): 30 Sep 2016

### INTRODUCTION

Coronary artery disease is one of the major causes of death in developed countries. The incidence is increasing because of urbanization, sedentary life style, food habits and co-morbid conditions like hypertension and diabetes. A detailed study of coronary arteries would be of

use to cardiologists and interventional radiologists to predefine the abnormalities by invasive and non invasive studies.

The term 'dominant' is used to refer to the coronary artery giving off the posterior interventricular artery [PIVA] [1]. In the 'right dominance' pattern the right coronary artery

[RCA] gives the PIVA, runs in the atrio ventricular groove past the crux of the heart and gives one or several postero lateral branches to the inferior surface of the left ventricle. The RCA is dominant in 67% of people. In 15% of hearts 'left dominance' is present in that circumflex artery [CX] which is a branch of left coronary artery [LCA] gives the PIVA. In these cases the RCA is small and does not supply the left ventricle. In approximately 18% of people both RCA and CX reach the crux and give rise to branches which course in or near the posterior inter ventricular groove. This is called 'co-dominance' pattern or 'balanced' pattern [2]. The pattern of dominant vessel varies in different populations. The dominant pattern of heart has clinical significance. Though right dominance is more prevalent, Coronary Artery Disease (CAD) is more common with those having left dominance circulation [3].

The knowledge of details of anatomy of coronary arteries and their variations would be helpful in the interpretation of angiograms and in the management of CAD. Since adequate literature regarding coronary dominance, their variations, external diameter and the point of termination of coronary arteries are not available in people living in and around Puducherry, the present study was undertaken to study these parameters in cadaveric hearts.

## MATERIALS AND METHODS

This descriptive study was done in 50 adult cadaveric hearts. The adult cadaveric hearts of both genders without any obvious pathology were included. The hearts with any gross pathology, traumatic damage or congenital anomalies were excluded from the study.

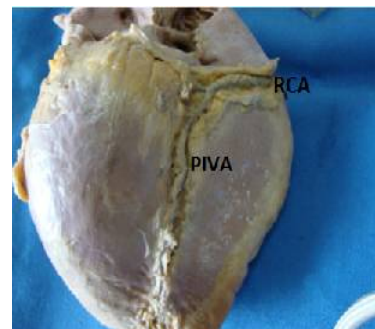
The heart was taken out by incising the fibrous pericardium and great vessels like aorta, pulmonary trunk, superior vena cava, inferior vena cava and pulmonary veins. The specimens were collected, numbered and preserved in 10% formalin solution. The visceral pericardium and sub epicardial fat were removed [4]. The coronary arteries [RCA and LCA] and their branches were carefully dissected out and followed till their termination. The origin, course and termination of various branches, variations if any were noted. The external diameter at the starting points of

these branches was measured using digital caliper. To determine the dominant circulation, the origin of PIVA and its termination was noted in each specimen. Photograph of each specimen was taken using digital camera, numbered and labelled. The findings were tabulated.

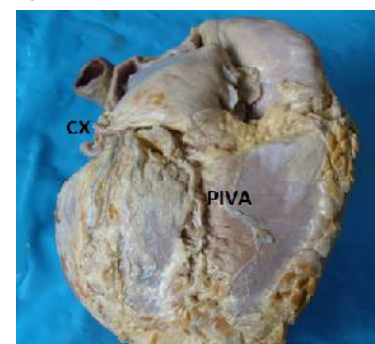
## RESULTS AND TABLES

In the present study the right dominance, left dominance and co dominance were found to be 84%, 8%, and 8% respectively [Table1] and [Fig 1,2,3]. The external diameter of LCA ranged from 2.1 to 5 mm at its origin. In 70% of hearts it measured 3.1 to 4mm. In other major arteries the external diameter ranged from 1 to 4 mm. It was 2.1mm to 3 mm in RCA (74%), anterior inter ventricular artery [AIVA] (92%) and CX (88%) [Table 2]. The level of termination of RCA was at the crux of heart in 48%, extended beyond the crux in 36% and at the right margin of heart in 16% [Table3]. The level of termination of AIVA was at the posterior inter ventricular groove in 70% and at the apex of the heart in 30% [Table4]. Presence of myocardial bridge over the AIVA was noticed in one heart (2%) [Fig 4]. In another heart the RCA and CX united at the crux of the heart and gave rise to PIVA [Fig 5].

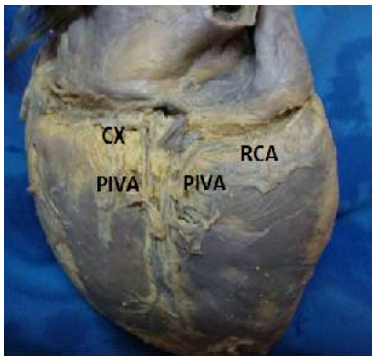
**Fig. 1:** Heart with right dominance pattern. Posterior inter ventricular artery (PIVA) is seen arising from the Right coronary artery (RCA).



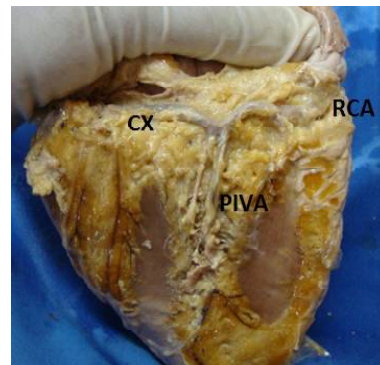
**Fig. 2:** Heart with left dominance pattern. Posterior inter ventricular artery (PIVA) is seen arising from the Circumflex artery (CX).



**Fig. 3:** Heart with co dominance pattern. Posterior inter ventricular arteries (PIVA) are arising from both Right coronary artery (RCA) and Circumflex artery (CX).



**Fig. 5:** Right coronary artery (RCA) and Circumflex artery (CX) unite at the crux of the heart and give rise to Posterior inter ventricular artery (PIVA).



**Fig. 4:** A myocardial bridge is seen over the Anterior inter ventricular artery (AIVA).



**Table 4:** The level of termination of anterior inter ventricular artery in cadaveric hearts.

Level of termination	Number of Hearts (50)	Percentage
At the Apex of heart	15	30%
At the Posterior inter ventricular groove	35	70%

**Table 1:** Coronary arterial dominance pattern in cadaveric hearts.

Type of Coronary Arterial Dominance	Number of Hearts N= 50	Percentage
Right Dominance	42	84%
Left Dominance	4	8%
Co Dominance	4	8%

## DISCUSSION

The branching pattern and distribution of coronary arteries have been studied by various authors. A comparison of coronary arterial dominance found by different investigators in different populations with present study is shown in Table 5. In all the studies the majority of hearts were right dominant [Fig 1]. Even though the right dominance is predominant, the LCA is almost always considered more important than the RCA as it is the major source of blood flow to the left ventricle in almost in all humans even in those with anatomical right dominance. The left dominance [Fig 2] and co dominance [Fig 3] are variously reported by different authors. In the present study each of them was found in 8% of hearts [Table 1]. This finding is similar to studies by Fazlul Aziz Main et al [3], Ortale JR et al [5], Kaimkhani et al [6], Abdellah et al [7], Kosar et al [8] and Fazliogullari et al [9]. These variations mainly affect the diaphragmatic surface of the ventricles because the criterion used for the definition of 'dominance' is the origin of PIVA.

**Table 2:** Comparison of external diameter of coronary arteries at their level of origin in 50 cadaveric hearts.

Name of the Artery	1-2 mm	2.1-3 mm	3.1-4 mm	4.1-5 mm
Right coronary artery	1 (2%)	37 (74%)	12 (24%)	-
Left coronary artery	-	9 (18%)	35 (70%)	6 (12%)
Anterior inter ventricular artery	1 (2%)	46 (92%)	3 (6%)	-
Circumflex artery	3 (6%)	44 (88%)	3 (6%)	-

**Table 3:** The level of termination of right coronary artery in cadaveric hearts.

Level of termination	Number of Hearts -50	Percentage
At the Right Margin of Heart	8	16%
At the Crux of	24	48%
Extending Beyond the Crux of heart	18	36%

According to Standring S in Gray's Anatomy [1] the calibre of coronary arteries range from 1.5 to 5.5 mm at their origin. The left being larger in 60%, the right is larger in 17% and both vessels are approximately equal in 23%. The external diameter of LCA was significantly greater than



that of RCA [4,5]. In this study the mean external diameter of RCA was from 1 to 4 mm and that of LCA was from 2.1 to 5mm [Table 2]. The external diameter of RCA was from 2.1 to 3 mm in 74% whereas that of LCA was from 3.1 to 4 mm in 70%. Though this is in agreement with previous studies the mean diameter was less when compared to them [Table 6].

**Table 5:** Comparative frequency of the types of coronary arterial dominance by different investigators.

Author's name	Right dominance	Left dominance	Co-dominance
Moore, Dalley & Agur (2010) [2]	67%	15%	18%
Fazlul Aziz Main et al, (2011) [3]	60.50%	19.50%	23.30%
Bhimalli et al (2011) [4]	60%	23.30%	16.66%
Ortale JR et al (2004) [5]	62.50%	12.50%	25%
Kaimkhani et al (2005) [6]	60.40%	15%	24.50%
Abdellah et al (2009) [7]	77%	8%	15%
Kosar et al (2009) [8]	76%	9.10%	14.80%
Fazliogullari et al (2010) [9]	42%	14%	44%
Kalpana (2003) [10]	89%	11%	Nil
Nerantzis et al (1980) [12]	88%	12%	
Present study	84%	8%	8%

**Table 6:** Comparison of average external diameter of RCA and LCA in different studies.

Author's name	Diameter of RCA	Diameter of LCA
Ortale et al (2004) [5]	3.6±0.8 mm	4.6 ± 0.9 mm
Fazliogullari et al (2010) [9]	3.32±0.79 mm	4.44 ± 1.79 mm
Bhimalli et al (2011) [4]	5.38±0.81 mm	5.73±0.74 mm
Present study	2.8±0.47 mm	3.7±0.45mm

In subjects with right dominance the mean diameter of CX was smaller and in those with left dominant pattern the mean diameter of RCA was small.

The RCA usually extends beyond the crux of the heart and ends by anastomosing with CX. But in 10% it terminates at the right border of heart and in 10% terminates between the right border and crux and in 20% it reaches the left border replacing the CX [1].

In this study the termination of RCA was at the right margin of heart in 8 (16%), at the crux cordis in 24 (48%) and beyond the crux cordis in 18 (36%) [Table 3]. In none of the specimen it reached the left margin replacing the CX. The AIVA terminated at the apex of heart in 15 (30%) and extended beyond the apex in 35 (70%) [Table 4]. In a study by Kalpana such terminations of AIVA were reported as 20% and 80% respectively [10].

Presence of myocardial bridge over the AIVA was noticed in one heart (2%) [Fig 4] whereas in the study by Mavi et al, the location of the myocardial bridge in AIVA was found in 28 cases (96.5%) and over the CX in 1 case (3.4) [11].

## CONCLUSION

A detailed study of coronary arteries would be of use to cardiologists and interventional radiologists to predefine the abnormalities by invasive and non invasive studies. The present study showed that coronary arterial dominance was not significantly different from that given in the literature. Further studies on coronary arteries in more number of cadaveric hearts may add more information.

**Conflicts of Interests: None**

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**How to cite this article:**

Priyadharshini. S, Sivakumar. M. A STUDY OF CORONARY ARTERIAL DOMINANCE PATTERN. *Int J Anat Res* 2016;4(3):2817-2821.

**DOI:** 10.16965/ijar.2016.343