



## CORONARY DOMINANCE

Om Shankar

Department of Cardiology, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005

Gunjan Rai

Department of Anatomy, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005

Rubi Bhola

Department of Anatomy, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005

Royana Singh

Department of Anatomy, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005

**ABSTRACT**

Arterial supply to heart is achieved by two arteries which are the only branches from ascending aorta. These arteries branch in such a manner that they occupy atrioventricular and interventricular groove in the shape of a crown. Hence they are called the coronary arteries. Coronary arteries, as first branches of aorta, supply blood to myocardium.

Coronary arteries, normally found impairs may vary in origin, distribution, number and size. These arteries emit several branches responsible for irrigation the whole surface and interior heart tissue.

Coronary artery disease is one of the major causes of death in developed countries. The incidence of coronary artery disease is increasing today in developing countries as well, because of changing life style, urbanization, sedentary life style, hypertension, diabetes mellitus and increased type A personality. The increasing use of diagnostic and therapeutic interventional procedures necessitates that a sound, basic knowledge of the coronary artery pattern is essential. More progress has been made in the last few decades than in all foregoing medical history in management of cardiovascular disease.

According to the World Health Organization (WHO), coronary heart diseases constitute the main cause of death in the industrial world. The main risk factors are lipid disorders, hypertension, diabetes, obesity, lack of physical activities and other disorders which cause functional impairment and damage to vascular cells. This study was performed for codominance of coronary arteries.

**KEYWORDS :** Left coronary artery, Right coronary artery, atrioventricular groove, interventricular groove, co- dominance

**Introduction:****CORONARY ARTERIAL SUPPLY**

The right and left coronary arteries arise from the ascending aorta in its anterior and left posterior sinuses. The levels of the coronary ostia are variable: they are usually at or above cuspal margins. The two arteries, LCA and RCA indicated by their name, form an oblique inverted crown, in which anastomotic circle in the atrioventricular groove is connected by marginal and interventricular (descending) loops intersecting at the cardiac apex. The degree of anastomosis varies and is usually insignificant. The Right coronary artery, Left coronary artery and its major branches are usually subepicardial, but when it travel in the atrioventricular and interventricular grooves are often deeply sited, and occasionally hidden by overlapping myocardium or embedded in it.

The term '**dominant**' is used to the coronary artery that gives the posterior interventricular (descending) branch (which supplies the posterior part of the ventricular septum and often part of the posterior-lateral wall of the left ventricle). Left coronary artery (70%), which is also invariably the larger in two vessels, where it is not, the posterior interventricular (descending) branch is either bilateral, issuing from both the right coronary artery and the left circumflex artery, or absent and replaced by a network of smaller vessels given off from both right and left coronary arteries. Anastomoses between right and left coronary arteries are abundant during foetal life, but are much reduced by the end of the first year of life. Anastomoses providing collateral circulation may become prominent in conditions of hypoxia and in coronary artery disease. An additional collateral circulation is provided by small branches from mediastinal, pericardial and bronchial vessels. The calibre of coronary arteries, both main stems and larger branches, ranges between 1.5 and 5.5 mm for coronary arteries at their origins. The left exceed the right in 60% of individual hearts, the right being larger in 17%, and the vessels approximately equal in 23%. The diameters of the coronary arteries may increase up to the 30<sup>th</sup> year.

**CORONARY DISTRIBUTION**

Details of coronary distribution require integration into a concept of total cardiac supply. Most commonly, the right coronary artery supplies all the right ventricle (except a small region right of the anterior interventricular groove), a variable part of the left ventricular diaphragmatic aspect, the posteroinferior one-third of the interventricular septum, the right atrium and part of the left, and the conducting system as far as the proximal parts of the right and left crura. Left coronary distribution is reciprocal, and includes most of the left ventricle, a narrow strip of right ventricle, the anterior two-thirds of the interventricular septum and most of the left atrium. As noted variations in the coronary arterial system mainly affect the diaphragmatic aspect of the ventricles; they consist of the relative 'dominance' of supply by the left or the right coronary artery. The term is misleading, as the left artery almost always supplies a greater volume of tissue. In 'right dominance', the posterior interventricular (descending) artery is derived from the right coronary; in 'left dominance' it derives from the left. In the so-called 'balanced' pattern, branches of both arteries run in or near the groove. Less is known of variation in atrial supply because the small vessels involved are not easily preserved in the corrosion casts that are used for analysis. In more than 50% of individuals, the right atrium is supplied only by the right coronary; in the remainder the supply is dual. More than 62% of left atria are largely supplied by the left and 27% by the right coronary; in each group a small accessory supply from the other coronary artery exists, and 11% are supplied almost equally by both arteries. Sinoatrial and atrioventricular supplies also vary. Various studies have reported that the right and left coronary arteries supply the sino-atrial node in 51-65% and 35-45% respectively (fewer than 10% of nodes receive a bilateral supply). The atrioventricular node is supplied by the right coronary (80-90%) and left coronary arteries (10-20%).

**MATERIALS AND METHODS:**

**Study Area and population:** The population selected for the proposed work is from eastern part of U.P. and surrounding states including western Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh Nepal. Most of the heart specimen collection from the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, which came within Jurisdiction of Varanasi District. Other half of specimen was collected from the preserved Cadavers in the Department of Anatomy, Institute of Medical Sciences, and Banaras Hindu University.

CT scan, heart angiography was taken from the Department of Radiology, Institute of Medical Sciences, and Banaras Hindu University. For all the Specimen Collected as well as Angiography, Inform consent form the patient/minor next to kin were taken.

Conventional Angiography of patients from the Department of Cardiology was taken along with their personal history.

**Study Period:** The study was done between the time periods July 2012 to May 2014 i.e. 2 years.

**Sample Size:** Data for present study consisted of 35 hearts collected from cadavers from anatomy department unclaimed dead body from the forensic department and 70 CT angiogram and 26 conventional angiogram from the Department of radiology and department of cardiology respectively were taken.

**Table 1: Classification of coronary arterial abnormalities**

Anomalies of origin	1. Number of ostia Multiple (>2), single 2. Anomalous location of ostium in the appropriate coronary sinus 3. Origin from opposite coronary sinus 4. Origin from noncoronary sinus 5. Origin from pulmonary artery 6. Abnormalities of angle of origin
Anomalies of course (normal origin)	1. Myocardial bridging 2. Duplication
Anomalies of termination	1. Coronary artery fistula 2. Coronary arcade 3. Extra cardiac termination
Intrinsic coronary arterial abnormality	1. Coronary stenosis 2. Atresia 3. Ectasia/aneurysm

We evaluated the coronary artery of heart by anatomical dissection and angiographic record by observing the following parameters:

- Termination of right coronary artery.
- Termination of left circumflex artery.
- Termination of Left anterior interventricular artery.
- Termination of posterior interventricular artery.
- Origin of posterior interventricular artery (dominance).
- Origin of SAN and AVN nodal artery.
- Branching pattern of right coronary artery.
- Branching pattern of left coronary artery.
- Diameter of Left coronary artery (LCA) Right coronary artery (RCA). Left circumflex artery (LCx) and Left interventricular artery (LIVA) at its origin.
- Myocardial bridging in the course of anterior interventricular artery

**CT Angiography:**

**Patient's preparation:** The patients were asked to fast for a minimum of 4 hours prior to the CT examination. The renal function tests of the patients are checked before the doing the CT. 18G IV cannula for adult 20G -22G IV cannula for children was placed preferably in the leg veins or the antecubital vein injection for the contrast.

**Machine:** CT angiography was carried out with GE (General Electric) Light Speed VCT 64 slice MDCT machine and adv 4.4 version advantage workstation.

**Subject selection:** Short term prospecting study having groups of patients of age range 25-76 year (mean 65 ± 9 years).

**Inclusion criteria:**

- Patients with atypical chest pain.
  - Non pathologic stress ECG finding.
  - Exclusion criteria:
  - History of contrast allergy.
  - Reactive airway disease.
  - Atrial fibrillation.
  - Very low cardiac output states.
- Impaired renal function.

**Protocol and Technical Parameters:**

- Detector collimation : 64 × 0.6 mm
- Pitch : 0.984 mm
- Gantry rotation time : 0.4 sec
- Tube voltage : 120 Kv
- Tube current : 400 mA (Adult)
- 220 mA (Paediatrics)
- Table feed : 55 mm per tube rotation
- Slice thickness : 0.625 mm
- Interslice interval : 0.625 mm

Coronary angiography may be done if you have:

- Angina for the first time
- Angina that is becoming worse, not going away as fast, occurring more often, or happening at rest (called [unstable angina](#))
- [Aortic stenosis](#)
- Atypical chest pain, when other tests are normal
- Had an abnormal heart stress test
- To have surgery on your heart and you are at high risk for coronary artery disease.
- [Heart failure](#)
- Recent heart attack

**Result**

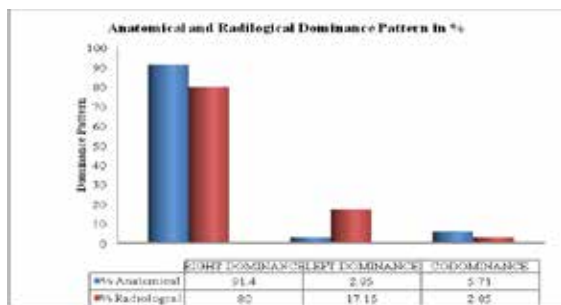
**Dominance Pattern**

Out of 35 human hearts, 32 were of right dominance (male 26, female 6) and 1 specimens of left dominance (male), and 2 specimens (male 1, female 1) of co-dominance type of coronary circulation was observed. The percentage of incidence 91.4% in right dominance, 2.85% left dominance & 5.71% were of co-dominance. On radiological evaluation of 70 angiogram of coronary artery, 57 (male 42, female 15) of right dominance, and 11 angiogram (male 7, female 4) of left dominance and 2 angiogram (female 2) of co-dominance type of coronary

circulation was observed. The percentage of incidence 80% in right dominance, 17.15% left dominance & 2.85% were co-dominance.

**Table 1: Pattern of Dominance (both gross (A) and radiological (R))**

Dominance pattern	ANATOMICAL		RADIOLOGICAL		TOTAL (A+R)
	Male	Female	Male	Female	
Right dominance	26	6	42	15	89
Left dominance	1	0	7	4	12
Codominance	1	1	0	2	4
Total	28	7	49	21	105



**Figure 1: Bar Diagram representing comparison of coronary artery dominance pattern by anatomical and radiological study**



**Fig. 2:** Right dominance with right coronary artery terminating at left border of heart and posterior interventricular branch reaching till Apex.



**Fig. 3:** Right dominance with right coronary artery terminating at right border of heart.



**Fig. 4:** Diaphragmatic surface of the heart in a situation of coronary co dominance in which the right coronary and the circumflex arteries irrigate the diaphragmatic surface of its corresponding ventricle. The anterior interventricular artery goes around the apex cordis and ascends a few millimetres via the posterior interventricular groove.

**Discussion:**

In the present study, we evaluated both anatomically (by dissection) and radiologically (by coronary angiography) the coronary arterial circulation. We took 35 human hearts (28 male & 7 female) for dissection from department of anatomy and department of forensic of our institution. For radiological evaluation we took 70 angiogram (56 male & 24 female) from department of radiology, Institute of medical sciences, Banaras Hindu University.

The RCA after arising from the anterior aortic sinus usually gives the following branches: Branch to SA node, conus, acute marginal, posterior interventricular artery & branch to AV node. Posterior interventricular artery branch gives septal branches to the posterior 1/3rd of interventricular septum. The posterior interventricular artery and branch to the AV node decides the dominance of coronary arteries. If it is a branch of right coronary artery, it is called as right dominant circulation. In 35 hearts on anatomical evaluation AV nodal artery was found to be a branch of RCA in 91.4% and of left circumflex artery in 8.57% (3 cases). If it is a branch of left circumflex artery called left dominance. In our present study, on anatomical evaluation by dissection we found 91.4% right dominance, 2.85% of left dominance and 5.71% of co-dominance. On analysis on 70 angiograms we got 80% of right dominance, 17.15% of left dominance & 2.85% of co-dominance. On dissection we got only one specimen of left dominance (Male). Two hearts having co-dominance pattern one each belong to male and female. On analyzing angiogram we got two specimen of co-dominance pattern all were female. In angiogram out of 11 left dominance (7 Male, 4 Female) there is gross difference in the incidence of left dominance between radiological and anatomical evaluation. The difference (17.15% vs. 2.85%) in left dominance may be due to the fact that angiography were done exclusively on the patients attending the cardiology clinic of our hospital and cardiac complains are more commonly described in left dominants by various studies (Goldberg et al., 2007).

Other similar studies that compares anatomically the dominance pattern had shown wide variation like Schlesinger MJ (1940)-Right dominance-48%, Left dominance-18%, Co-dominance-34%, James TN (1961) Right dominance-90%,left dominance-10%), Cavalcanti et al., (1995)-Right dominance-69.09%,left dominance-11.82%,codominance-19.09%) Bezbaruah NK, 2003 (right dominance-76%,left dominance-20%,codominance-4%), Kalpana R, 2003(right dominance-89%,left dominance-11%), Hirak Das, 2010 (right dominance-70%, left dominance-18.57%, co-dominance-11.43%). Jain et al; 1958 (right dominance-57%, left dominance-10%, co-dominance-33%). In our study (Right dominance-91.4%, left dominance-2.85%, co-dominance-5.71%)

On radiological evaluation by Kosar et al, 2009 (right dominance-76%, left dominance-9.1%, co-dominance-14.8%) In our present study the ratio was right dominance-80%, left dominance-17.15%, codominance-2.85%.

The prevalence of coronary heart disease had increased rapidly from 1% in 1960 to 9.7% in 1995 in urban population (Mandal S, 2009). Even in rural population the prevalence has doubled in the last decade. The hearts having Left dominance are more susceptible for coronary artery disease than the right dominance (Kumar K, 2007). Hence it can be concluded that anatomical factors are less responsible for development of coronary artery disease in our population.

**References:**

1. Bezbaruah NK, Vani M. An anatomical study of human coronary arteries in North eastern Indian Population. Research & Reviews: A Journal of Surgery. 2012;1(3)1-6
2. Goldberg A, Southern D, Galbraith PD, Traboulsi M, Knutson M.L, GhaliWA. Coronary dominance and prognosis of Patients with acute coronary syndrome. Am. Heart J. 2007;154(6)1116-1122.
3. Hutchison MCE. A study on the atrial arteries in man. J Anat. 1978; 25: 39-54.
4. Hutchins GM, Kessler HA, Moore GW. Development of the coronary arteries in the embryonic human heart. Circulation. 1988; 77: 1250.
5. Hutchison MCE. A study on the atrial arteries in man. J Anat. 1978; 25: 39-54.
6. Hutchins GM, Kessler HA, Moore GW. Development of the coronary arteries in the embryonic human heart. Circulation. 1988; 77: 1250.