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Prevalence of different types of coronary arteries in human cadavers from Telangana region

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Abstract
Normally heart is supplied by two coronary arteries: the right coronary artery (RCA) and left coronary artery (LCA). Variations with regard to origin, course, branching pattern, and termination of coronary arteries have been observed in many studies. Variability in the origin of the posterior inter-ventricular artery (PIVA) determines the predominance of heart. The coronary artery which gives the PIVA determines the coronary predominance. If PIVA is a branch of RCA it is called right predominance and if the PIVA is a branch of left circumflex artery then it is called as left predominance and if the same arises from both RCA and left circumflex artery then such heart is said to be balanced type of heart. The same parameters are used in the present study to determine the cardiac predominance. Hence the present study was planned to evaluate the prevalence of the coronary arteries in the cadaveric population from Telangana region.
The present study was planned in Department of Anatomy, Prathima Institute of Medical Sciences, Nagunoor, Telangana from March 2007 to Jan 2008. The study was planned in 20 Cadaveric hearts obtained to institute. Cadaveric Heart specimen was immersed in 10% formaldehyde to preserve it. The heart was dissected and the coronary arterial dominance was noted. Schlesinger's criteria was used to determine coronary dominance. Approval of the institutional ethical committee was taken prior to conduct of this study.
The data generated from the present study suggest that majority of the people showed right predominance. So these people are less likely to be affected by the cardiac problems. 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 might help cardiologists and radiologists for the better understanding and management of cardiac diseases.

Keywords: coronary arteries, Left coronary artery, right coronary artery, cadavers, etc

Introduction
Coronary circulation is the circulation of blood in the blood vessels that supply the heart muscle (myocardium). Coronary arteries supply oxygenated blood to the heart muscle, and cardiac veins drain away the blood once it has been deoxygenated. Because the rest of the body, and most especially the brain, needs a steady supply of oxygenated blood that is free of all but the slightest interruptions, the heart works constantly and sometimes works quite hard. Therefore its circulation is of major importance not only to its own tissues but to the entire body and even the level of consciousness of the brain from moment to moment. Interruptions of coronary circulation quickly cause heart attacks (myocardial infarctions), in which the heart muscle is damaged by oxygen starvation. Such interruptions are usually caused by ischemic heart disease (coronary artery disease) and sometimes by embolism from other causes like obstruction in blood flow through vessels.
Coronary arteries supply blood to the myocardium and other components of the heart. Two coronary arteries originate from the left side of the heart at the beginning (root) of the aorta, just after the aorta exits the left ventricle. There are three aortic sinuses (dilations) in the wall of the aorta just superior to the aortic semilunar valve. Two of these, the left posterior aortic sinus and anterior aortic sinus, give rise to the left and right coronary arteries, respectively. The third sinus, the right posterior aortic sinus, typically does not give rise to a vessel. Coronary vessel branches that remain on the surface of the artery and follow the sulci of the heart are called epicardial coronary arteries [1].
The left coronary artery distributes blood to the left side of the heart, the left atrium and ventricle, and the interventricular septum. The circumflex artery arises from the left coronary artery and follows the coronary sulcus to the left. Eventually, it will fuse with the small branches of the right coronary artery. The larger anterior interventricular artery, also known as the left anterior descending artery (LAD), is the second major branch arising from the left coronary artery. It follows the anterior interventricular sulcus around the pulmonary trunk. Along the way it gives rise to numerous smaller branches that interconnect with the branches of the posterior interventricular artery, forming anastomoses. An anastomosis is an area where vessels unite to form interconnections that normally allow blood to circulate to a region even if there may be partial blockage in another branch. The anastomoses in the heart are very small. Therefore, this ability is somewhat restricted in the heart so a coronary artery blockage often results in myocardial infarction causing death of the cells supplied by the particular vessel [1].
The right coronary artery proceeds along the coronary sulcus and distributes blood to the right atrium, portions of both ventricles, and the heart conduction system. Normally, one or more marginal arteries arise from the right coronary artery inferior to the right atrium. The marginal arteries supply blood to the superficial portions of the right

ventricle. On the posterior surface of the heart, the right coronary artery gives rise to the posterior interventricular artery, also known as the posterior descending artery. It runs along the posterior portion of the interventricular sulcus toward the apex of the heart, giving rise to branches that supply the interventricular septum and portions of both ventricles [1].

There are some anastomoses between branches of the two coronary arteries. However the coronary arteries are functionally end arteries and so these meetings are referred to as potential anastomoses, which lack function, as opposed to true anastomoses like that in the palm of the hand. This is because blockage of one coronary artery generally results in death of the heart tissue due to lack of sufficient blood supply from the other branch. When two arteries or their branches join, the area of the myocardium receives dual blood supply. These junctions are called anastomoses. If one coronary artery is obstructed by an atheroma, the second artery is still able to supply oxygenated blood to the myocardium. However, this can only occur if the atheroma progresses slowly, giving the anastomoses a chance to proliferate [2].

Under the most common configuration of coronary arteries, there are three areas of anastomoses. Small branches of the LAD (left anterior descending/anterior interventricular) branch of the left coronary join with branches of the posterior interventricular branch of the right coronary in the interventricular sulcus (groove). More superiorly, there is an anastomosis between the circumflex artery (a branch of the left coronary artery) and the right coronary artery in the atrioventricular groove. There is also an anastomosis between the septal branches of the two coronary arteries in the interventricular septum. The photograph shows area of heart supplied by the right and the left coronary arteries [3].

The left and right coronary arteries occasionally arise by a common trunk, or their number may be increased to three; the additional branch being the posterior coronary artery (which is smaller in size). In rare cases, a person will have the third coronary artery run around the root of the aorta. Occasionally, a coronary artery will exist as a double structure (i.e. there are two arteries, parallel to each other, where ordinarily there would be one) [4].

The vessels that remove the deoxygenated blood from the heart muscle are known as cardiac veins. These include the great cardiac vein, the middle cardiac vein, the small cardiac vein, the smallest cardiac veins, and the anterior cardiac veins. Cardiac veins carry blood with a poor level of oxygen, from the myocardium to the right atrium. Most of the blood of the coronary veins returns through the coronary sinus. The anatomy of the veins of the heart is very variable, but generally it is formed by the following veins: heart veins that go into the coronary sinus: the great cardiac vein, the middle cardiac vein, the small cardiac vein, the posterior vein of the left ventricle, and the vein of Marshall. Heart veins that go directly to the right atrium: the anterior cardiac veins, the smallest cardiac veins (Thebesian veins) [5].

The heart regulates the amount of vasodilation or vasoconstriction of the coronary arteries based upon the oxygen requirements of the heart. This contributes to the filling difficulties of the coronary arteries. Compression remains the same. Failure of oxygen delivery caused by a decrease in blood flow in front of increased oxygen demand of the heart results in tissue ischemia, a condition of oxygen deficiency. Brief ischemia is associated with intense chest pain, known as angina. Severe ischemia can cause the heart muscle to die from hypoxia, such as during a myocardial infarction. Chronic moderate ischemia causes contraction of the heart to weaken, known as myocardial hibernation. In addition to metabolism, the coronary circulation possesses unique pharmacologic characteristics. Prominent among these is its reactivity to adrenergic stimulation.

The vessels that deliver oxygen-rich blood to the myocardium are the coronary arteries. When the arteries are healthy, they are capable of autoregulating themselves to maintain the coronary blood flow at levels appropriate to the needs of the heart muscle. These relatively narrow vessels are commonly affected by atherosclerosis and can become blocked, causing angina or a heart attack. The coronary arteries that run deep within the myocardium are referred to as subendocardial. The coronary arteries are classified as "end circulation", since they represent the only source of blood supply to the myocardium; there is very little redundant blood supply, that is why blockage of these vessels can be so critical.

Normally heart is supplied by two coronary arteries: the right coronary artery (RCA) and left coronary artery (LCA). Variations with regard to origin, course, branching pattern, and termination of coronary arteries have been observed in many studies. Variability in the origin of the posterior inter-ventricular artery (PIVA) determines the predominance of heart. The coronary artery which gives the PIVA determines the coronary predominance. If PIVA is a branch of RCA it is called right predominance and if the PIVA is a branch of left circumflex artery then it is called as left predominance and if the same arises from both RCA and left circumflex artery then such heart is said to be balanced type of heart. The same parameters are used in the present study to determine the cardiac predominance. Hence the present study was planned to evaluate the prevalence of the coronary arteries in the cadaveric population from Telangana region.

Methodology

The present study was planned in Department of Anatomy, Prathima Institute of Medical Sciences, Nagunoor, Telangana from March 2007 to Jan 2008. The study was planned in 20 Cadaveric hearts obtained to institute. Cadaveric Heart specimen was immersed in 10% formaldehyde to preserve it. The heart was dissected and the coronary arterial dominance was noted. Schlesinger's criteria was used to determine coronary dominance. [6] Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion Criteria: Normal hearts with age groups 20-70 years of both sexes

Exclusion Criteria: Hearts weighing more than 370 gms. in males and 280 gms. in females, heart specimens in cadavers of age more than 70 yrs. and less than 20 years, grossly abnormal hearts were excluded.

Results & Discussion

Sound knowledge on basic anatomy of LCA has recently been emphasized due to increasing use of diagnostic and therapeutic interventional procedures. The location and level of the ostia are very important for the successful performance of a coronary angiogram during manipulation

of the catheter tips. Difficulties may arise more considerable in patients in whom the ostium is above the level of sinotubular ridge (Taylor and Thorne) [7].

Majority of population has right coronary predominance where posterior interventricular artery is derived from the right coronary. Minority of population, where posterior interventricular artery is a branch of LCA, are more affected by the coronary artery disease because the entire left ventricle and the ventricular septum are supplied by the LCA. In some cases where posterior interventricular artery is derived from both the coronary arteries; such individuals have balanced coronary circulation and are least affected by coronary diseases.

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 [8]. 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 [9]. In patients with acute coronary syndrome, left dominance is a significant and independent predictor of increased long-term mortality according to Goldberg *et al* [10]. It was also reported that atherosclerotic involvement of the RCA and the Left circumflex artery is more common in right dominant heart [11]. 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.

Table 1: Myocardial bridges occurrence

Myocardial Bridges	Total
Right Coronary Artery	12
Left Coronary Artery	8
Both	0
Total	20

Table 2: Number of single myocardial bridge over right coronary artery branches

	Total
Right Marginal Branch	3
Proximal segment of RCA	5
Posterior interventricular Branch	6

Table 3: Number of single myocardial bridges over left coronary artery branches

	Total
Left anterior descending Branch	3
Diagonal Branch	3
Left Marginal Branch	1
Circumflex Branch	0
Posterior interventricular branch	6

Table 4: Previous reported literature

Authors	Sdtudy Area	Right coronary artery (%)	Left coronary artery	Both right & left coronary artery
Hussein Ali Fakhir *et al.* [12]	Iraq	76	13	11
Fazliogullari Z *et al.* [13]	Turkey	42	14	44
Fazlul Aziz Mian *et al.* [14]	Pakistan	60.5	19.5	20
Jose Roberto Ortale *et al.* [15]	Brazil	88	8	4
MA El Sayed [16]	Egypt	80	10	10
Hirak Das *et al.* [17]	Assam	70	18.5	11.5
Vasudeva Reddy J *et al.* [18]	South India	86.5	11.25	2.5
Current Study	South India	60	40	nil

Gazetopoulos N *et al.*, [19] studied the relation between the length of the maineft coronary artery and the degree of atherosclerosis in It's branches by post-mortem examination and suggested that in case with a short main left coronary artery, the atherosclerotic lesions in the anterior descending and circumflex branches appeared earlier, progressed faster at higher levels of severity and led more frequently to myocardial infarction than in cases with a long left coronary artery. During aortic valve surgeries, myocardial perfusion depends on the positioning of one or more cannulas in the coronary arteries. In this regards, the length of LMCA is important, because when catheter is inserted into one of the terminal branches, the opacification of the other branch will not occur and thus, an incomplete image of coronary artery tree will be found.

Conclusion

The data generated from the present study suggest that majority of the people showed right predominance. So these people are less likely to be affected by the cardiac problems. 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 might help cardiologists and radiologists for the better understanding and management of cardiac diseases.

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