

AN ANGIOGRAPHIC STUDY OF RIGHT CORONARY ARTERY :A CROSS SECTIONAL STUDY

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Received : 20/07/2026
 Received in revised form : 13/08/2026
 Accepted : 29/08/2026

Keywords:
 Angiography, Anomaly, Dominance,
 Right coronary artery.

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DOI: 10.47009/jamp.2026.8.5.159

Source of Support: Nil,
 Conflict of Interest: None declared

Int J Acad Med Pharm
 2026; 8 (5); 1009-1012



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ABSTRACT

Background: Anomalies of the right coronary artery (RCA) is more commonly seen in this subcontinent than that of the left coronary artery. The knowledge of the calibre, territorial extent, branching pattern and anomalies are important for cath lab operators in hardware selection and for surgeons for interpreting angiogram, percutaneous coronary interventions (e.g., stenting, coronary artery bypass graft and in correction of coronary anomalies associated with congenital heart diseases) and also for coronary revascularization procedures. The study was undertaken for angiographic evaluation of the right coronary artery and its branches. **Materials and Methods:** It was a cross sectional observational, tertiary care institution based study, conducted in the Department of Cardiology in two renowned hospital, from December 2016 to May 2017. **Result:** In our study Shepherd's crook variety of take off (of the RCA) was found in 3.5% of cases. multiple Conus arteries were found in only 0.2% of cases. In 81.3% of cases there were right dominance, 9.3% showed left dominance and 9.4% of cases showed co- dominant coronary circulation. **Conclusion:** Knowledge of coronary artery and its branches are important for coronary interventions.

INTRODUCTION

The human heart is supplied by the coronary arteries (vasa vasorum). Coronary arteries arise as minute buds from the aorta at 7th week just after the formation of the aorta by the division of the truncus arteriosus.^[1]

In the adult, the right coronary artery (RCA) that supplies free wall of the right ventricle arises from the upper or middle third of the right or anterior aortic sinus of Valsalva. The left main stem or the left coronary artery in about 90% of cases originates from the left posterior aortic sinus.

The coronary ostia normally lead to an orthogonally oriented proximal stem, off the aortic wall that faces each other around right ventricular outflow tract.^[2] The conus artery, which is usually the first branch of RCA may sometimes arise separately as the third coronary artery from the anterior aortic sinus. A useful definition of "normal" coronary arteries is needed based on the knowledge of the variations of each of the features used to describe the coronary anatomy (e.g. the number and location of ostia, its course, diameter or cross - sectional area of coronary arteries, extent or its termination, branching pattern and intrinsic coronary arterial anomalies).^[2] Statistically it is known that each descriptive feature

is considered anatomically normal when it is found within two standard deviations of the mean value for Gaussian distribution continuous parameters.^[3]

Pathophysiological consequences of any given morphological variation, and its obvious association with coronary artery disease (CAD) is important. Its understanding will greatly help medical diagnosis and interventions that begins with pre-procedural evaluation of the coronary arteries. And the gold standard for the diagnosis of CAD is catheter based angiography.^[4] According to Andre F.Cournand, cardiac catheterization was first performed by Claude Bernard in 1844.^[5] Muller and Sanborn described and cited references for experiments by Stephen Hales (1733) and others.^[6] Selective coronary angiography was reported by Doctor Mason Sones and others in 1959 and was perfected to a remarkable excellence over the ensuing years.^[7] It is critical too, to an angiography operator to be aware of the anomalies, failing which leads to a catastrophic complication. Iatrogenic ostial injury can complicate coronary angiography, intraoperative coronary perfusion. Aortic valve replacement and tricuspid annuloplasty or replacement can also be complicated by injury to the right coronary artery.^[8]

MATERIALS AND METHODS

The study was conducted in the Department of Cardiology, Calcutta National Medical College and Hospital, (196 cases) and in SSKM Hospital, (IPGME&R) Calcutta (312 cases) after obtaining Ethics Committee approval, from December 2016 to May 2017. Informed consent were taken from selected patients for angiography. Pre operative ECGs and Echo cardiographs were done and patient received loading dose of dual antiplatelet drugs (aspirin, clopidogrel).

Angiographic procedure was done with femoral access or radial access. Introducer sheath wire was introduced through puncturing needle placed in the artery. J tip teflon guide wire and JL 3.5/JR 3.5 catheter advanced under fluoroscopic guidance with the patient on C-arm. Cannulation of coronary ostia done with manipulation, more manipulation was needed for right ostia with Judkin's technique. Images were taken by the fluoroscope following standardized angiographic views, e.g.-

1. LAO (left anterior oblique)- cranial projection for the origin of RCA and the entire mid RCA, PDA (posterior descending artery), PLV (posterior left ventricular artery) bifurcation at the crux. Patients were instructed to take deep inspiration to clear the diaphragmatic shadow overlap.
2. The RAO (right anterior oblique) 45° view for mid RCA.
3. The AP-cranial for PDA & PLV of a dominant RCA.

Interpretation was done by cardiologists accepting angiographers' standardized observational criteria describing certain parameters of Right coronary artery including length, calibre, extent, overlapping or foreshortening. Anatomically, the artery is divided into the first and 2nd segment but angiographically it is described most commonly as having three segments. There is case to case variations arising due to the size and position of branches.^[9]

Statistical analysis: Data were entered in MS Office Excel and analyzed with the help of SPSS (Statistical Package for Social Scientist) version 16.0, IBM, Chicago, USA. Chi-square test was applied at 5% significance level.

RESULTS

The study was carried on 508 patients of which most were male (81%) and 60% of patients belonged to 40-59 year- age group. Vascular accesses were done through Femoral (52.8%) and Radial approaches (46.9%)

In our study take off of RCA was normal in 64.2% of cases, superior take off in 13.8% and Shepherd's crook variety [Figure 1] was found in 3.5% of cases. From the first segment: (i. the conus branch, ii. the branch to SA node), separate origin of Conus artery from the right aortic sinus was seen in 13% of cases. Annulus of Vieussens [Figure 2] were found in 0.6%

cases where as frequency of multiple Conus arteries were found in only 0.2% of cases.

From 2nd segment: {i. Right anterior ventricular rami (RV). ii. The right (acute) marginal branch (AM) }

1. Good calibre RV and AM were the branches from the 2nd segment in 73.4%, RV and AM very small and thin in 6.3% of cases.
2. Very large RV in association with thin AM or absent AM or large RV entering PDA territory in 2.6%, 0.8% and 7.3% respectively.

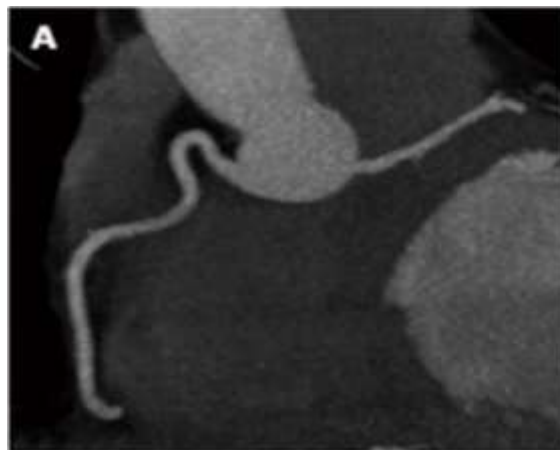


Figure 1: Angiogram A shows the hooked or Shepherd's Crook Variety of take-off of RCA

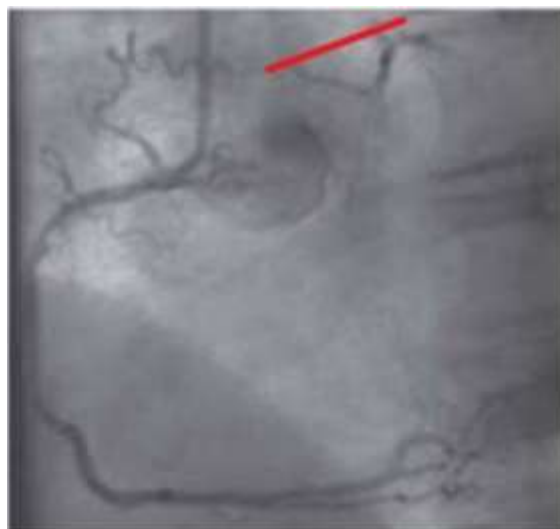


Figure 2: A Vieussens Collateral extend from the proximal artery to the LAD (arrow). (Angiogram)

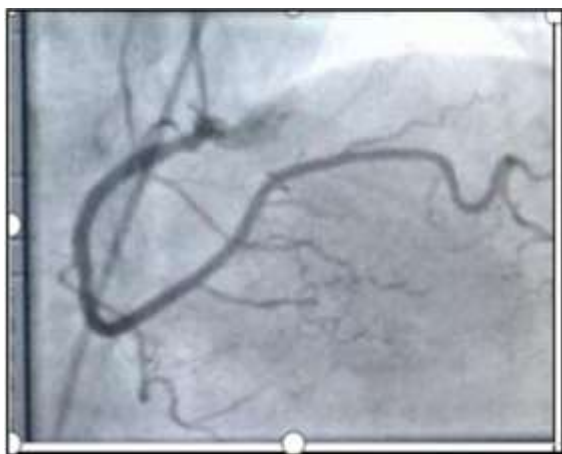


Figure 3: Super dominant right coronary artery (angiogram).

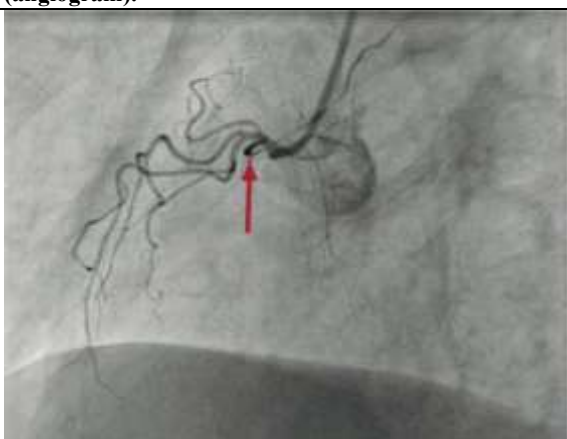


Figure 4: Coronary Angiogram in the left anterior oblique (LAO) cranial view showing non-dominant diminutive right coronary artery.

From 3rd segment: {1. right posterior inter ventricular artery commonly known as the posterior descending artery (PDA) and the 2. Posterior left ventricular artery -(PLV).} It was seen that-

1. Normal bifurcation at the 3rd segment with good caliber PDA and PLV, found in 64.4%, where as PLV was supplied by LCX (left circumflex) in 13% cases and PDA and PLV both supplied by LCX was in 5.9% cases.

No PDA or PLV was found from the 3rd segment in 1.6% cases.

Regarding the pattern of dominance, in 81.3% of cases there were right dominance including super dominant right coronary artery [Figure 3],## and non dominant diminutive RCA [Figure 4]- 9.3% of cases showed left dominance and 9.4% of cases showed co-dominance.

Table 1: Distribution of the source of SA nodal branch among study population (n=508)

Code no.	Frequency	Percent
1	237	46.7
2	22	4.3
3	249	49
total	508	100

Descriptive code-1.SA nodal from RCA1, 2.SA nodal from LCX; 3.SA nodal from both RCA1 and LCX.

DISCUSSION

In our study 508 cases were analyzed, of which male was 81.35% & female was 18.7%. The study sample has the lowest age of 20 years and a highest age of 80 years with a mean of 54.21 ± 9.90 (Standard deviation). A study by Ramanathan L, Shetty P consisted of 114 females and 186 males with similar mean age of 55 years.^[10]

In our study the right coronary artery showed normal origin from the middle third of right anterior aortic sinus in 94.1% of cases (n= 508) and high up origin in 2% of cases.

Take off of RCA was normal in 64.2% of cases. Superior -13.8%, Inferior -13.8% and Shepherd's crook variety of take off was seen in 3.5% of cases.

In our study it has been observed:

a) Branches from 1st segment with separate origin of conus artery from the right anterior aortic sinus in 13% of cases and Annulus of Vieussens were found in 0.6% of cases. Frequency of multiple conus was seen only in 0.2% of cases.

b) Branches from 2nd segment- Good caliber RV and AM were the branches from the second segment in 73.4% of cases. RV & AM very small & thin were found in 6.3% of cases. Very large RV with a) thin AM, b) absent AM or large RV entering PDA territory was 2.6%, 0.8% and 7.3% respectively.

c) Branches from 3rd segment- Normal bifurcation at the 3rd segment of RCA with good caliber PDA & PLV were found in 64.4%. PLV was provided by the LCX in 13% of cases. PDA & PLV both supplied by the LCX in 5.9% of cases. No PDA or PLV was found from the 3rd segment of RCA in 1.6% of cases.

Our study showed 81.3% cases of right dominance i.e. PDA is supplied by the RCA, 9.3% showed left dominance and 9.4% of cases showed co-dominance. In a study by Rajesh Nepal and Anil Oam showed Right Dominance 83%, Left dominance 10%, Co-dominance in 18.57% of cases.^[11]

Study by N Fatima showed Right Dominance 83%, Left dominance 14.5%, Co-dominance in 2.5% of cases.^[12]

A study titled "Prevalence of anatomical variants and coronary anomalies in 543 consecutive patients studied with 64- slice CT Coronary angiography" found Right dominance-86.6% Left dominance =9.2% and co dominance in 4.2% of cases.^[13]

We found that in 46.7% of cases the source of SA nodal branch was from the 1st segment of RCA (RCA1), SA node was supplied only by the proximal LCX in 4.3% of cases. Supply came from both of the above two sources were found in 49% of cases.

In a study by Filippo Cademartiri and Ludovico La Grutta et al Showed:

Sinus node artery from RCA - 65.4% from LCX - 16.6% from both-9.4% from pulmonary artery -0.2% of cases.^[13]

A study by Abdur Rafe, Abdul Waheed et al showed SA nodal artery from RCA 71.26%, from LCA 28.74%.^[14]

In our study AV nodal branch was arising from: PLV from RCA3 in 79.9% of cases, where as arising from PLV from LCX in 20.1% of cases.

In a study by Ramanathan L, Shetty P, et al found the SA (sinoatrial) node was supplied by the right coronary artery (RCA) in 53% of the cases by the circumflex (Cx) branch of left coronary artery (LCA) in 42.66% and by both coronary arteries in 4.33% of cases.^[10] The AV (atrioventricular) node was also more often supplied by the RCA (72.33% of cases) than by the Cx branch of the LCA (27.66%), and in none of these cases was this node supplied by both coronary arteries.

CONCLUSION

Coronary artery disease is an emerging problem worldwide. After excluding MB (Myocardial Bridges), prevalence of coronary artery anomalies was 1.36%, as some authors consider MB as a normal variant rather than anomaly.^[15] Angiographic evaluation is an essential requirement and gold standard both for diagnosis and intervention (e.g., bypass- angioplasty). Variations that include super dominant RCA, diminutive non dominant RCA, separately originating conus, multiple conus should be kept in mind to avoid injury to coronary ostium. However MR angiography is diagnostic for coronary anomalies.

Limitations: As the coronary artery anomalies incidence were 1.3% in a study undergoing coronary arteriography at the Cleveland Clinic Foundation from 1960 to 1988, the study sample should have been much larger than what was taken in the present study.^[16]

The Study could not comment on the comparison of radial access and femoral access due to differences in operator's preference in two tertiary care hospitals.

There are slightly different interpretations of angiographic data among the operators which could not be over ruled.

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