

# Origin of Right Coronary Artery (RCA): A Multidetector Computed Tomography (MDCT) Coronary Angiographic (CA) Study in North India

Sushma Tomar<sup>1</sup>, P K Sharma<sup>2</sup>, Punita Manik<sup>3</sup>, Manoj Kumar<sup>4</sup>

<sup>1</sup>Assistant Professor Department of Anatomy, King George's Medical University UP, Lucknow, <sup>2</sup>Professor & Head Department of Anatomy, Era Lucknow Medical College, Lucknow, <sup>3</sup>Professor, Department of Anatomy, King George's Medical University UP, Lucknow, <sup>4</sup>Professor, Department of Radiodiagnosis, King George's Medical University UP, Lucknow.

## Abstract

**Introduction:** Several clinical and pathological scenarios like hemodynamic procedures, cardiac surgery in heart trauma and arrhythmias from coronary occlusive disease management have importance of variations in the origin of Right Coronary Artery (RCA). The RCA presents a wide spectrum of morphological expressions regarding its sites of origin, course, branches, length, size and termination. RCA usually arises from the Anterior Aortic Sinus (AAS) and traverses through the right atrio-ventricular (AV) groove. **Subjects and Methods:** In the present study, Computed Tomographic (CT) coronary angiograms of 50 routine subjects of different age groups who came to the Department of Radiodiagnosis, King George's Medical University UP, Lucknow in the year 2010- 2011 with known or suspected coronary artery disease, were analyzed. Coronary angiography (CA) was performed on a 64 slice Multidetector Computed Tomographic (MDCT) scanner, using retrospective electrocardiographic (ECG) gating. The incidence of different sites of origin of RCA was assessed. **Results:** In the present study, RCA originated from Anterior Aortic Sinus (AAS) in 47 (94%) subjects. In 3 (6%) subjects, RCA showed anomalous origin from Left Posterior Aortic Sinus (LPAS). These three subjects were males [3(9.38%)]. In all the subjects, the course of RCA was normal except three males having origin of RCA from LPAS. In these three males, the proximal part of RCA coursed between Right Ventricular Outflow Tract (RVOT) and aorta. **Conclusion:** Most common site for origin of RCA was AAS. Anomalous origin of RCA was seen only from LPAS. Anomalous origin of RCA was seen only in male subjects. In all subjects having anomalous origin of RCA from LPAS, RCA coursed between pulmonary trunk and ascending aorta.

**Keywords:** Coronary Angiography, Multidetector Computed Tomography, North India, Origin, Right Coronary Artery

**Corresponding Author:** Dr. Sushma Tomar, Assistant Professor Department of Anatomy, King George's Medical University UP, Lucknow.

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## Introduction

The Right Coronary Artery (RCA) presents a wide spectrum of morphological expressions regarding its sites of origin, course, branches, length, size and termination. The knowledge of these variations is extremely important for their implications in surgical procedures and clinical events. RCA arises from the anterior ('right coronary') Aortic Sinus (AAS). The artery reaches the crux of the heart and ends a little to the left of it, often by anastomosing with the circumflex branch of left coronary artery.<sup>[1]</sup> Anomalous origin of RCA is a rare congenital anomaly that was first described in 1948 by White NK and Edwards JE.<sup>[2]</sup> In an angiographic study, Yamanaka O and Hobbs RE described that anomalous origin of RCA from left sinus of Valsalva, is a congenital abnormality with 0.107% incidence.<sup>[3]</sup> Topaz O, et al found that the RCA is the most common anomalous

vessel.<sup>[4]</sup>

Congenital coronary anomalies are associated with sudden death and exercise-related death. Taylor A J, et al observed that anomalous origin of RCA from left coronary sinus was the second most frequent anomaly and they reported that there is risk of sudden cardiac death with exercise in younger patients (less than or equal to 30 years old) with an isolated coronary artery anomaly. With age, the risk of sudden death decreases. Younger patients (less than or equal to 30 years old) were significantly more likely than older patients (greater than or equal to 30 years old) to die suddenly or during exercise despite their low frequency of significant atherosclerotic coronary artery disease.<sup>[5]</sup> Anomalous aortic origin of a coronary artery (AAOCA) is the second most common cause of sudden cardiac death (SCD) in young athletes. It is postulated that occlusion or compression of the anomalous coronary artery during exercise leads to myocardial ischemia and subsequent lethal

ventricular arrhythmia (ventricular tachycardia and fibrillation). According to available evidences the prevalence of anomalous right coronary artery (ARCA) is approximately six times more than anomalous left coronary artery (ALCA).<sup>[6]</sup>

RCA may arise from different anomalous sites. Cansel M, et al reported origin of RCA from Left Anterior Descending (LAD) artery which is a very rare coronary anomaly.<sup>[7]</sup> Zamani J and Mahmmody Y reported origin of RCA from LCA.<sup>[8]</sup> RCA arising from the main LCA accounts for only 0.65% of coronary artery anomalies.<sup>[9]</sup> Kragel AH and Roberts WC studied the correlation between coronary dominance and anomalous origin of coronary artery and they found that the coronary dominance is useful to distinguish clinically significant anomalies from clinically insignificant anomalies.<sup>[10]</sup> The incidence of coronary anomalies in patients undergoing coronary angiography varies from 0.64% to 1.3%. Many of these anomalies are clinically benign; however, others are associated with serious morbidity.<sup>[11]</sup>

Knowledge of normal anatomy of RCA and its variations or anomalies is of paramount importance in heart surgeries. Inability to detect these anomalies may lead to complications.<sup>[12]</sup> Several clinical and pathological scenarios like hemodynamic procedures, cardiac surgery in heart trauma and arrhythmias from coronary occlusive disease management have importance of variations in the origin of RCA.

The aim of this study was to assess the incidence of different sites of origin of RCA in subjects of North India and to find any anatomic variant.

## Subjects and Methods

### Materials

In this study, digital copies of CT coronary angiograms of 50 subjects of both sex and different age groups [32 males (14-75 years), 18 females (12-70 years); mean age 51.36±14.07 years, age range 12-75 years] were analyzed after taking due permission from Institutional Ethical Committee.

### Method

This was an observational study. Coronary Angiography (CA) was done on patients came to the Department of Radiodiagnosis, King George's Medical University UP, Lucknow in the year 2010- 2011 with known or suspected coronary artery disease.

### Inclusion criteria

Patients presenting with symptoms and signs of cardiovascular diseases e.g. Chest pain and Dyspnoea.

### Exclusion criteria

- (1) Lack of consent.
- (2) Renal insufficiency (High urea / creatinine level).
- (3) Allergy to contrast agent.
- (4) Contraindication to radiation exposure (e.g. pregnancy).
- (5) Uncontrolled Heart rate.
- (6) Atrial fibrillation, frequent atrial or ventricular ectopics

(>1/minute).

- (7) Unable to hold breath for 20 seconds.

CA was performed on 64 Slice Multidetector Computed Tomographic (MDCT) scanner (BRILLIANSTMCT, Version 2.45.22042, manufactured by Philips) which is installed in the department of Radiodiagnosis, King George's Medical University (KGMU), Lucknow, Uttar Pradesh (U.P.), India. Retrospective Electrocardiographically gated imaging was performed (Technical parameters are given in [Table 1]).

**Table 1: Technical Parameters applied in Computed Tomographic Coronary Angiographic (CTCA) images acquisition**

DEVICE - BRILLIANSTMCT, Version 2.45.22042, manufactured by Philips	
Slices/collimation	64/0.625mm
Effective temporal resolution (with 180°algorithm)	165 ms
Tube current	800mAs
Pitch	0.2
Tube voltage	120kV
Tube rotation time	400ms
Section thickness	0.9mm
Reconstruction Increment	0.45mm
Field of view (FOV)	220mm
ECG gating	Retrospective
Isotropic voxel resolution	0.4× 0.4× 0.4 mm.
Scanning time	10-12 seconds

### Pre-procedure precautions

- The subjects were enquired, to rule out the presence of any drug allergy to avoid the occurrence of any untoward anaphylactic reaction during the procedure.
- Two days prior to the procedure the subjects were advised to avoid the intake of fatty food.
- They were advised to drink only water just prior to the procedure.
- Blood urea and creatinine levels were evaluated.

### Procedure

The subjects were laid supine. Their heart rate was stabilized with an oral dose of 50-100 mg Metoprolol one hour before the scan. If heart rate was not stabilized with an oral dose, then intravenous (IV) Metoprolol was given. Electrocardiogram (ECG) and pulse rate were monitored half an hour prior to the procedure. The subjects were counseled to reduce their anxiety.

The subjects were connected to a cardiac monitor. For venous access, an upper extremity vein (antecubital vein) and a 20-gauge intravenous canula was used. 80-85 ml of non-ionic contrast Iohexol (Omnipaque, GE, GE Healthcare Ireland, Cork) containing iodine concentration of 350 mgI/ml, injected with a flow rate of 5.5ml/sec, followed by a 20 ml saline flush at a rate of 4ml/sec with a pressure injector (PSI-325). The scan timing was determined with automated bolus tracking technique by placing the region of interest over mid ascending aorta and setting the trigger threshold to 180 Hounsfield (Hu). The subjects were asked to lie still on the "scanning bed" for a period of 5-10 minutes. The instruction was given to the subjects to maintain an inspiratory breath hold during which CT data and ECG tracings were taken. CTCA was performed 5 seconds after aortic peak density. Scanning coverage was from the level of carina to the bottom of the heart. Raw

spiral CT data of coronary arteries were reconstructed in various phases of cardiac cycle on a work station (Brilliance 64 version 4.5) to obtain images with the highest quality (without motion artefact). Reconstruction performed at 75% of R-R interval was found to be optimal for image analysis in most of the subjects. In some, if heart rate could not be stabilized properly, then reconstructions were performed at 45% of R-R interval. The images generated were reconstructed and viewed utilizing a separate workstation which enabled generation of the coronary arteries in the standard and in various other anatomical planes as and when required and were interpreted with the help of a cardiac radiologist. Subjects with previous bypass surgery and also those with suboptimal study due to breath hold artefacts were excluded.

All images were reviewed first in axial projection and then with post processing tools such as Multiplanar Reconstruction (MPR), Curved Planar Reformation (CPR), thin-slab Maximum Intensity Projection (MIP), and Volume-Rendering Technique (VRT) with transparent background display. MIPs were obtained using various thicknesses (5–30 mm). Volume-rendered (VR) images were also obtained using various orientations.

CTCA images were observed for the origin of RCA. The

statistical analysis was performed by using software SPSS (Statistical Package for Social Sciences) version 15.0. The values were represented in Number (%) and Mean ± Standard Deviation (SD).

**Result**

In the present study, RCA originated from Anterior Aortic Sinus (AAS) in 47 (94%) subjects [29 (90.63%) males and 18 (100%) females] [Table 2, Figure 1a, b & c]. 3 (6%) subjects [3(9.38%) males] showed anomalous origin of RCA from Left Posterior Aortic Sinus (LPAS) [Table 2, Figure 2a, b & c]. In all subjects, the course of RCA was normal except three male subjects who had anomalous origin of RCA from LPAS. In these three male subjects, the proximal part of RCA coursed between Right Ventricular Outflow Tract (RVOT) and aorta. [Figure 3a&b]

**Table 2: Frequency of different sites of origin of RCA**

Site of Origin	Male (Nm=32)	Female (Nf=18)	Total (Nt=50)
AAS	29 (90.63%)	18 (100%)	47 (94%)
LPAS	3(9.38%)	0 (0%)	3(6%)

Nm-Total number of males, Nf-Total number of females, Nt-Total number of study subjects

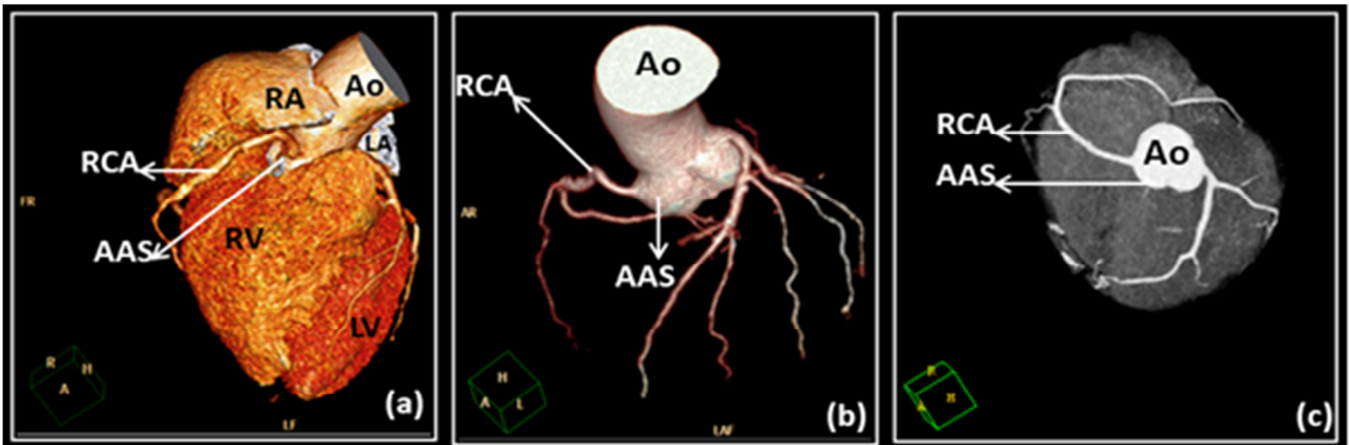


Figure 1: MDCT Images showing Normal Origin of RCA from AAS (a) 3D VR Image, (b) 3D VR Image (Contrast Vessel Tracking Tree), (c) MIP Image RA- Right Atrium, RV- Right Ventricle, LA- Left Atrium, LV- Left Ventricle, Ao- Aorta, AAS- Anterior Aortic Sinus, RCA- Right Coronary Artery

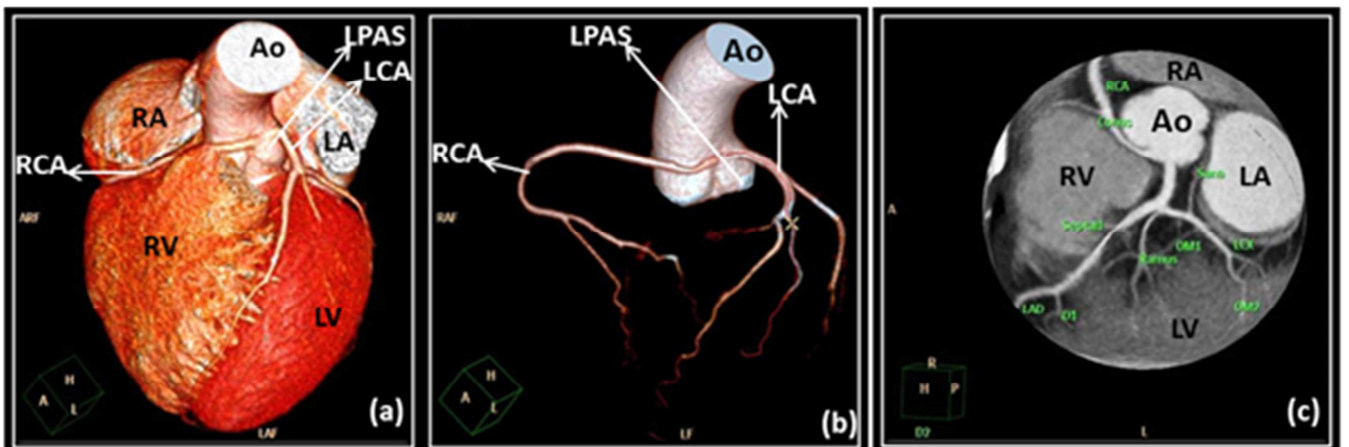


Figure 2: MDCT Images showing Anomalous Origin of RCA from LPAS (a) 3D VR Image, (b) 3D VR Image (Contrast Vessel Tracking Tree), (c) MIP Image RA- Right Atrium, RV- Right Ventricle, LA- Left Atrium, LV- Left Ventricle, Ao- Aorta, LPAS- Left Posterior Aortic Sinus, RCA- Right Coronary Artery, LCA- Left Coronary Artery

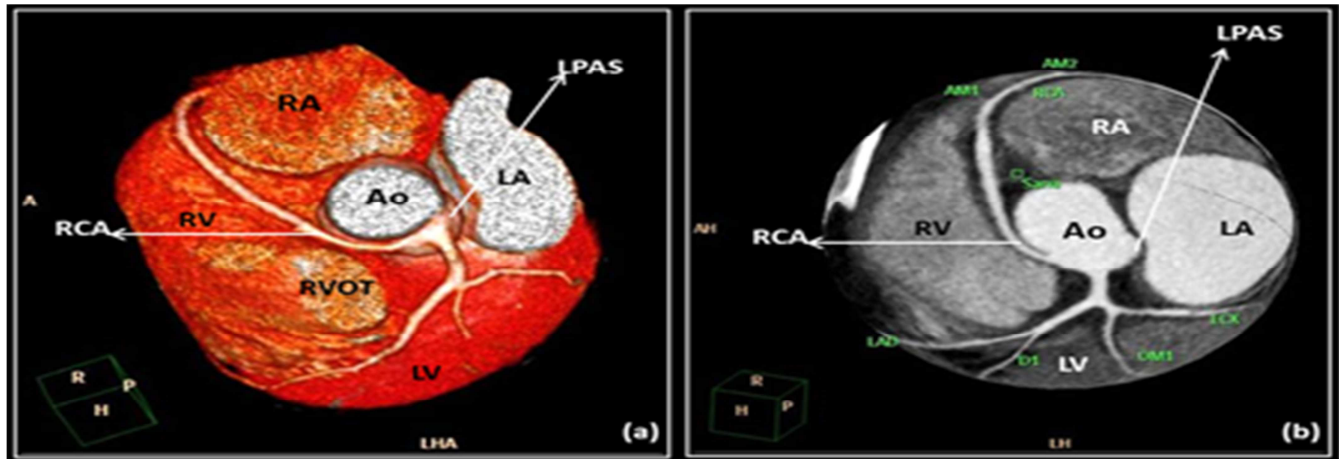


Figure 3: MDCT Images showing Anomalous Course of RCA between RVOT and Aorta (a) 3D VR Image, (b) MIP Image RA- Right Atrium, RV- Right Ventricle, LA- Left Atrium, LV- Left Ventricle, RVOT- Right Ventricular Outflow Tract (RVOT), Ao- Aorta, LPAS- Left Posterior Aortic Sinus, RCA- Right Coronary Artery

**Discussion**

The origin of coronary arteries shows great variability.<sup>[1]</sup> Several studies have been done in the past regarding the origin of RCA [Table 3, 4, 5 & 6]. The most common site of

origin of RCA is AAS. In the present study, RCA arose from AAS in majority of cases (94%). Our findings are similar to the reports of a cadaveric study done by Lufukuja G J (94.7%) [Table 3].<sup>[13]</sup> In some cadaveric studies, RCA arose from AAS in 100% cases<sup>[Table 3].<sup>[14-18]</sup></sup>

**Table 3: Incidence of Normal Origin of RCA from AAS**

Authors & Year of Study	Type of Study	Population & No. of Cases	Origin of RCA from AAS
Kalpana R. 2003	Cadaveric	South Indian, 100	100%
Jim MH, et al. 2004	Catheter Angiography	1532	1519 (99.2%)
Fazliogullari Z, et al. 2010	Cadaveric	Turkish, 50	100%
Kulkarni JP. 2013	Cadaveric	Western Indian, 60	100%
Lufukuja G J. 2016	Cadaveric	Tanzanian, 75	71 (94.7%)
Reddy MV, Pusala B. 2016	Cadaveric	South Indian, 110	100%
Bhele AV, et al. 2017	Cadaveric	Western Indian, 50	100%
Dhobale MR, et al. 2018	Cadaveric	Western Indian, 150	148 (98.67%)
Present study. 2011	64-slice CT Angiography	North Indian, 50	47 (94%)

**Table 4: Incidence of Anomalous Origin of RCA from LPAS and RPAS among Autopsy and Cadaveric Studies**

Authors & Year of Study	Type of Study	Population & No. of Cases	Site of origin of RCA	
			LPAS	RPAS
Alexander RW, Griffith GC. 1956	Autopsy	American, 18950	6	
Frescura C, et al. 1998.	Autopsy	Italian, 1200	7	
Lufukuja GJ. 2016	Cadaveric	Tanzanian, 75	1 (1.3%)	
Dhobale MR, et al. 2018	Cadaveric	Western Indian, 150	2 (1.33%)	

**Table 5: Incidence of Anomalous Origin of RCA from LPAS and RPAS among Catheter Angiographic Studies**

Authors & Year of Study	Population & No. of cases	Site of origin of RCA	
		LPAS	RPAS
Chaitman BR, et al. 1976	Canadian, 3750	6	
Kimbiris D, et al. 1978	American, 7000	12	
Wilkins CE, et al. 1988	American, 10,672	30	
Yamanaka O, Hobbs RE. 1990	American, 126595	136	4
Topaz O, et al. 1992	13010	35	14
Kaku B, et al. 1996	Japanese, 17731	44	
Kardos A, et al. 1997	Central European, 7694		1
Garg N, et al. 2000	North Indian, 4100	15	4
Angelini P et al. 2002	American, 1950	18 (0.92%)	22 (1.13%)
Ayalp R, et al. 2002	Turkish, 5253	2	
Harikrishnan S, et al. 2002	7400	7	
Jim MH, et al. 2004	1532	13 (0.8%)	
Rigatelli G, et al. 2004	Italian, 5450	2	
Eid AH, et al. 2009	Lebanese, 4650	9 (0.19%)	
Ouali S, et al. 2009	Tunisian, 7330	3	1
Solanki P, et al. 2010	American, 2120	8	
Aydar Y, et al. 2011	Turkish, 7810	12	1
Sohrabi B, et al. 2012	Irani, 6065	6(0.1%)	
Tuo G, et al. 2013	Italian, 7960	13	
Lingaraju S, et al. 2016	North Indian (West Rajasthani), 8500	34	4
Turkoğlu S, et al. 2018	Turkish, 5165	16	

Several past studies reported the origin of RCA from anomalous sites such as LPAS, Right Posterior Aortic Sinus (RPAS), descending thoracic aorta, Pulmonary trunk, LCA, Left Circumflex (LCx) artery, LAD artery etc [Table 4, 5 & 6]. After analyzing the findings of these studies, we found that the most common site for anomalous origin of RCA is LPAS. Chaitman BR, et al observed that aberrant ostium of RCA in LPAS is invariably in front of the ostium of LCA.<sup>[19]</sup> But orifice for the ectopic RCA may be present posterior to the left main ostium as found by Yamanaka O and Hobbs RE.<sup>[3]</sup> There are three subtypes of this anomalous RCA based on the anatomic course. Retroaortic, if the anomalous artery traverses posterior to the ascending aorta; Interarterial,

if it runs between the ascending aorta and pulmonary trunk and in third variant it courses anterior to the pulmonary trunk.<sup>[20]</sup> In some studies, it is reported that the RCA coursed anterior to aorta in patients in whom it originated from LPAS.<sup>[19,21-28]</sup> In the present study also, anomalously originated right coronary arteries coursed anterior to aorta. RCA is at high risk when it arises from LPAS and coursed between pulmonary artery and aorta.<sup>[5]</sup> Shu-shui W, et al named this kind of aberrant RCA with interarterial course as 'Coronary Artery Sandwich Anomaly.'<sup>[29]</sup> Ziegler FV, et al reported proximal intramural course of anomalous RCA originated from left sinus of Valsalva.<sup>[30]</sup>

**Table 6: Incidence of Anomalous Origin of RCA from LPAS and RPAS among Computed Tomographic Studies**

Authors & Year of Study	Type of Study	Population & No. of Cases	Site of origin of RCA	
			LPAS	RPAS
Schmitt R, et al. 2005.	4 and 16 row MDCT Angiography	German,1758	11	
Hou KY, et al. 2007	64-slice CT Angiography	Chinese, 540	8 (1.5%)	
El-Sharkawy EM. 2007	64-slice CT Angiography	Egyptian, 1000	5	
ten Kate GJR, et al. 2008	64-sliceCT Angiography	European, 1000	5	
Srinivasan KG, et al. 2008	64-slice CT Angiography	South Indian, 1495	1	
Ziegler FV, et al. 2009	CT Angiography	American, 748	8	
Yildirim D, Oruc F. 2009	EBT Coronary Angiography	Turkish, 454	1	
Shabestari AA, et al. 2012	64-slice CT Angiography	Irani, 2697	12 (0.44%)	1 (0.03%)
Abdulghaffar W, et al. 2012	64-slice CT Angiography	Arabian, 840	4	
Kayan M, et al. 2012	128-slice CT Angiography	Turkish, 83	1	1
Opolski MP, et al. 2013	CT Angiography	8522	20	
Park JH, et al. 2013	MDCT Coronary Angiography	Korean, 1582	7 (0.44%)	
Oliveira CA, et al. 2014	MSCT Coronary Angiography	Portuguese, 663	4	
Krupinski M, et al. 2014	CT Angiography	7115	16	
Namgung J, Kim JA. 2014	64 or 320 slice MDCT Angiography	Korean, 8864	41	
Graidis C, et al. 2015	64 slice MDCT Angiography	Greek, 2572	9 (0.35%)	
Pan C, et al. 2015	MSCT Angiography	Chinese, 7469	51	
Tongut A, et al. 2016	MSCT Angiography	Turkish, 2401	12	
Rao A, et al. 2017	64 slice MDCT Angiography	North Indian, 391	3	
Chaosuwannakit N. 2018	CT Angiography	North-eastern Thailand, 924	12	
Chaiyagool K, et al. 2018	64 slice MDCT Angiography	Southern Thailand 279	3 (1.1%)	
Sirasapalli CN, et al. 2018	64 slice MDCT Angiography	South Indian, 8021	41	
Present study. 2011	64-slice CT Angiography	North Indian, 50	3(6%)	

In the present study, anomalous origin of RCA was seen only from LPAS, and it was observed in 3 (6%) cases [Table 2 & 6]. This incidence was quite high. Anomalously originated RCA is a rare congenital cardiac malformation.<sup>[24]</sup> Houman TM, et al reported that anomalously originated RCA from left sinus of Valsalva is a rare congenital anomaly but frequently causes sudden death in the young. They also suggested that early graft failure had occurred if bypass procedures are used to treat such kind of anomalous origin of RCA.<sup>[31]</sup> This kind of ectopic RCA is difficult to cannulate because of its slit-like orifice and odd angulation.<sup>[3]</sup>

Several authors found that RCA is the most common anomalous vessel among coronary arteries.<sup>[4,23,27,32-34]</sup> While some authors found RCA as the second most common anomalous coronary artery.<sup>[35-37]</sup> Anomalous origin of RCA is often asymptomatic and is found incidentally during evaluation of some cardiac diseases.<sup>[38]</sup> Although origin of RCA from the left sinus of Valsalva and course between the aorta and pulmonary artery is less frequently associated with symptoms, this condition may be associated

with sudden death.<sup>[39]</sup> In a CT angiographic study, Krupinski M, et al observed that high-risk anatomy features are most common in patients with abnormal RCA origin. These patients also have higher prevalence of chest pain and tend to show higher occurrence of cardiac events in the follow-up than individuals with abnormal LCA origin and abnormal LCx artery origin.<sup>[40]</sup>

Anomalous origin of coronary arteries from aorta is uncommon but significant clinically. Clinical manifestations may vary from asymptomatic patients to those who present with heart failure, syncope and arrhythmias.<sup>[41]</sup> Anomalous origin of the coronary arteries may be a risk factor for angina pectoris, acute myocardial infarction and sudden death even if there is no atherosclerosis.<sup>[23]</sup> Roberts WC, et al found fibrosed myocardial patches, small areas of infarcts in patients who suffer sudden death in absence of atherosclerosis.<sup>[42]</sup> Frescura C, et al observed that in 16 patients out of 27 with isolated anomalous origin of coronary arteries, the final outcome was sudden death. Sudden death occurred in 43% of right coronary artery origin from left aortic sinus.<sup>[43]</sup> Clarification of the risk and

mechanisms of sudden death in patients with coronary anomalies may aid in decisions on intervention. Taylor A J, et al proposed the mechanism of myocardial ischemia and sudden death in these patients and proposed causes include: 1) Ostial obstruction due to slit-like coronary orifice. 2) Compression of RCA between aorta and pulmonary artery. 3) Stretching of the RCA with aortic/pulmonary artery distension. Coronary angulation with aortic / pulmonary artery distension.<sup>[5]</sup> Singhi AK, et al stated that anomalously arising RCA from left coronary sinus can have dynamic narrowing and kinking causing myocardial ischemia and sudden cardiac death. Anomalous artery should be surgically repaired in the symptomatic patients because of risk of ischemia or ventricular arrhythmia and a close follow up is required in asymptomatic patients with exercise restriction as per present guideline.<sup>[44]</sup> Targeted patients for treatment are those whose anomalous artery is dominant, whose anomalous artery is having proximal intramural course and those who become symptomatic before 35 years of age.<sup>[41]</sup>

Cheatham JP, et al reported origin of RCA from descending thoracic aorta and found atypical and elastotic changes and wall thickening in this RCA.<sup>[45]</sup> According to Yamanaka O and Hobbs RE, origin of the RCA from pulmonary artery is extremely rare. They found origin of RCA from pulmonary trunk in 2 cases, which is a potentially serious anomaly.<sup>[3]</sup> Rigatelli G, et al and Hakim K, et al reported anomalous origin of RCA from pulmonary artery.<sup>[46,47]</sup> In a cadaveric study, Vasuki AKM, et al found origin of RCA from pulmonary trunk in three specimens out of fifty.<sup>[48]</sup> Some authors have reported origin of RCA from LCA.<sup>[4,8,9]</sup> While some have observed origin of RCA from LAD artery.<sup>[7,49-53]</sup> Duran C, et al also reported absence of RCA in one case.<sup>[51]</sup> Chaitman BR, et al; Tanrıverdi H, et al and Aydar Y, et al, reported origin of RCA from LCx artery in one case each.<sup>[19,54,55]</sup> Harikrishnan S, et al and Chung J, et al found double RCA in one case each.<sup>[36,56]</sup>

If RCA takes origin from above the Sino-tubular (ST) junction, then it is known as high take-off of RCA. In the present study, no case of high take-off of RCA was found whereas several authors reported high take off of RCA.<sup>[3,14,24,27,28,43,57-61]</sup> Sahni D and Jit I reported an incidence of 3.4% in males and 1.7% in females.<sup>[57]</sup> High takeoff of the coronary arteries usually presents no major clinical problems, but may cause difficulty in cannulating the vessels during coronary arteriography. Selective intubation of the coronary artery may be extremely difficult, especially when the RCA is anomalously located high over the left coronary sinus.<sup>[62]</sup> Angelini P, et al reported low origination of RCA.<sup>[63]</sup>

Anomalous coronary arteries may be found as an isolated defect or may occur as a part of congenital malformations of the heart. A high incidence of congenital heart diseases was reported by Topaz O, et al in cases of anomalous coronary arteries. Recognition of these anomalous arteries is important in patients undergoing coronary angioplasty or cardiac surgery.<sup>[43]</sup> In some catheter angiographic studies, the incidence of primary congenital anomalies of coronary arteries is more in males than females.<sup>[21,32,35,64]</sup> But in a study done by Aydar Y, et al, the incidence found more for females.<sup>[55]</sup>

Cardiac surgeons should take care of anomalous coronary arteries in order to avoid transection, ligation, or iatrogenic occlusion of anomalous arteries during surgery.<sup>[65]</sup> Anomalously originated coronary arteries are the second most common cause of athletic-field deaths in the United States.<sup>[66]</sup> Why an athlete can exercise intensely for several years without symptoms until the sentinel event occurs remains unknown.<sup>[6]</sup> Jim MH, et al stated that the RCA anomalously arising from left coronary sinus is associated with early development of Coronary Artery Disease (CAD) while Suryanarayana P, et al found that there is no difference in the occurrence of atherosclerosis between anomalous and nonanomalous coronary arteries.<sup>[34,67]</sup> Coronary artery anomalies should be recognized during life time of a patient by the use of noninvasive procedures to prevent the risk of sudden death and to plan surgical correction if clinically indicated.<sup>[43]</sup>

## Conclusion

In the present study, most common site for origin of RCA was AAS. Anomalous origin of RCA was seen only from LPAS. Anomalous origin of RCA was seen only in male subjects. In all subjects having anomalous origin of RCA from LPAS, RCA coursed between pulmonary trunk and ascending aorta.

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