

# Incidence of Anomalous Coronary Arteries in Pakistani Population

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## Abstract

**Objective:** To identify the origin of coronary arteries and detect its abnormalities.

**Methodology:** This was a retrospective analysis comprising 1200 patients during the course of 2 years from May 2021 to a May 2023 who underwent for coronary CT angiogram to determine the coronary artery anomalies at the Islamabad Diagnostic center, with the collaboration of South East Hospital and research center, Islamabad. All the patients who were included in this study had a base line heart rate >65 bpm, and suffered from coronary artery disease and chest pain. They were advised to avoid smoking and coffee 12 hours before the procedure and also avoided eating solid food 4 hours prior to the procedure.

**Results:** The patients' mean age was 49 years, mean heart rate 61.39±5.356 and mean creatinine level was 1.029±1.383. It also showed that 85.7% male and only 2% females were in records. Medical history showed that 64.3% patients were hypertensive, 50% diabetic, 92% patients had presented with shortness of breath, 85% with chest pain, 35.7% were smokers and 42.9% had positive family history of heart diseases. Angina grading score also known as the Canadian cardiovascular society (CCS) showed 50% patients with CCS I, 28.6% CCS II and 21.4% CCS III.

**Conclusion:** Coronary CT angiography is a highly effective diagnostic technique for the diagnosis and origin of coronary arteries as well as its course and termination. We can observe easily all the presentation which cannot be detected through other diagnostic tools.

**Keywords:** Coronary artery disease, Computed Tomography, Angiography, Anomalous Coronaries.

## Introduction

The aortic sinuses of Valsalva are the origin of coronary arteries, which converge closer to the top of the coronaries.<sup>1</sup> There are commonly two primary coronary arteries: the Right Coronary Artery (RCA) and the Left Coronary Artery (LCA). The left circumflex artery, and the left anterior descending artery split out from the left main coronary artery.<sup>2</sup> The RCA normally originates in the ascending aorta's right sinus of Valsalva.<sup>3</sup> The RCA pivots and moves posteriorly via the sulcus onto the diaphragmatic surface and the heart's base at the intense line of the heart.<sup>3</sup> Throughout the RCA, various branches appear: the posterior interventricular branch, the conus branch, the atrial branch, the sinus node, right marginal, and the atrio-ventricular nodal branch.<sup>4</sup> One of the most dangerous coronary artery anomalies is abnormal origin of left coronary artery from the pulmonary artery.<sup>5,6</sup> The LCA, RCA, right coronary sinus and non-coro-

nary sinus are patterns of an anomalous origin of the coronary artery from the opposing non-coronary sinus.<sup>7</sup> A disorder known as a coronary artery fistula occurs when one or more coronary arteries communicate with the superior vena cava, pulmonary artery, cardiac chamber, and coronary sinus.<sup>8,9</sup> As opposed to the Left Marginal Artery (LMA) arising from the LCA, the RCA is more frequently involved.<sup>10</sup> Coronary arcade is an uncommon instance of connection when coronary artery stenosis is not present between the RCA and the LMA that is large enough to be seen angiographically.<sup>11</sup> The extra-cardiac vessels that the coronary arteries are connected to include the bronchial, internal mammary, pericardial, anterior mediastinal, superior and inferior, intercostal, and esophageal branches of the aorta.<sup>12</sup> Only when there is a pressure gradient between two artery systems do these channels become functionally important. Although coronary anomalies are benign, the intra-arterial anomalous right coronary artery and the inter-arterial anomalous left coronary artery are the two most common subtypes that predispose young people to sudden cardiac death. Anomalous origin of coronary arteries occurs when either artery (right or left) arises from different site instead of its actual origin site. Most of the anomalous origin occurs when both coronary arteries arise from the same aortic sinus from the single ostium or two separate ostia. The aim of this study was to examine the origin of coronary arteries retrospectively of 1200 patients over a period of 2 years from May 2021 to May 2023 who underwent coronary CT angiogram to determine the common patterns of coronary arteries anomalies in the local population.

## Methodology

It was a retrospective study of 1200 patients conducted over a two-year period, from May 2021 to May 2023 who had undergone CT coronary angiography to determine the coronary arteries anomalies at the Islamabad Diagnostic center with collaboration of South East Hospital and Research Center. Ethical approval was taken from hospital Institutional Review Board committee (Re: 008-ERC-SEH). From the records, all the



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patients of both genders included in this study had a base line of heart rate >65 bpm, and suffered from coronary artery disease and chest pain. The patients had been advised to avoid smoking and caffeine twelve hours before the procedure, and also avoided eating solid food 4 hours prior to the process. From the instruction list, it was also observed that patients who were allergic from contrast agent and also who received beta-blockers and had renal insufficiency were excluded from this procedure. Using double-syringe injector, weight based iodinated contrast agents followed by using the right cubital vein, 30 milliliters of saline was injected. The injection was applied using the CT devices' corresponding threshold levels; the regions of interest were located in the ascending aorta. The scan parameters were as follows: slice thickness of 0.5 mm and tube voltage of 100 kv with automated tube current modulation. Heart rate acquisition phase for heart rates less than 65 beats per minute. Iterative reconstruction was used for the picture reconstruction. This approach was employed retrospectively to the patients. Data was entered in SPSS (version 23.00, Chicago, IL, USA). Data were expressed as mean ±SD for quantitative parameters, such as age, heart rate, weight and creatinine level. The frequency and percentage of qualitative factors was determined, such as gender, medical history, anomalous coronaries and risk factors.

**Results**

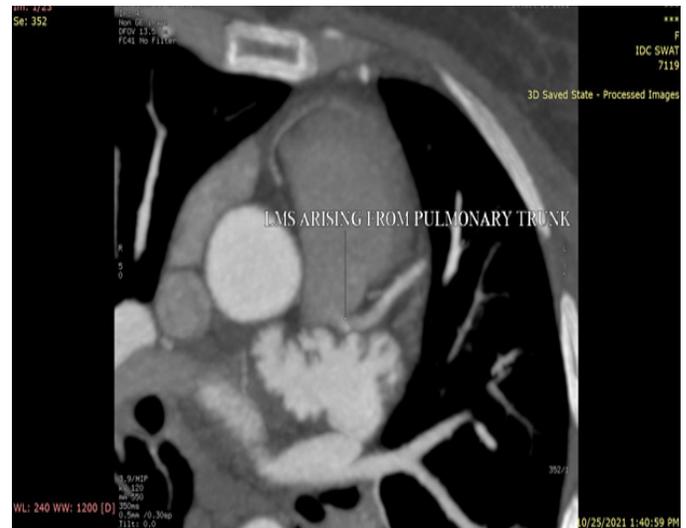
All 1200 patients underwent coronary CT angiography, out of which 14 patients were detected with anomalous coronaries. Aand overall quality of this systematic review on the role of Vitamin B12 in the mental health of children and adolescents.

**Table 1:** Demographic Profile and Medical History of the Patients (n=14)

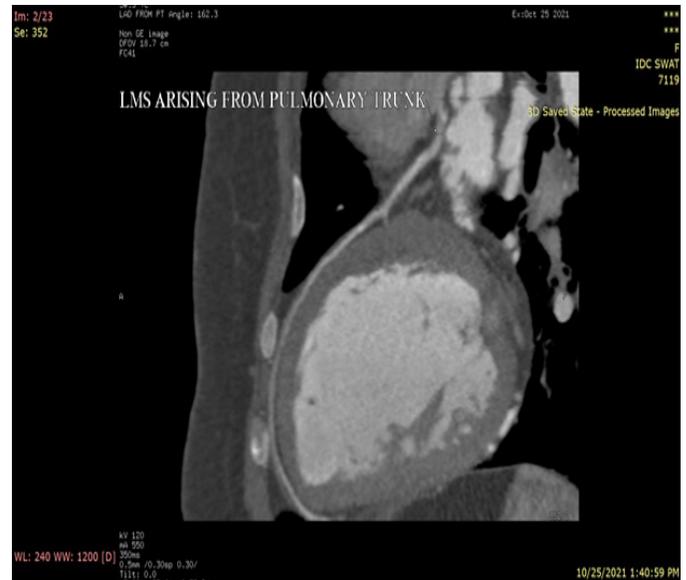
Characteristics	Mean	±SD
Age (years)	49.79	11.074
Heart Rate (minutes)	61.93	5.356
Creatinine (mg/dl)	1.029	.1383
<b>Gender</b>		
Characteristics	Frequency (n)	Percentage (%)
Male	12	85.7
Female	2	14.3
<b>Medical History</b>		
	<b>Frequency</b>	<b>Percentage</b>
Hypertension	9	64.3
Diabetic Mellitus	7	50.0
Chest pain	12	85.7
Shortness of breath	13	92.9
Smoking	5	35.7
Family history	6	42.9
<b>Dyspnea Classifications</b>		
	<b>Frequency</b>	<b>Percentage</b>
Class I	7	50.0
Class II	4	28.6
Class III	3	21.4

Table 1 illustrate the mean age of the patients (49.79±11.074),

mean heart rate (61.39±5.356) and mean creatinine levels (1.029±.1383). It also shows that 85.7% males and only 2% females underwent this procedure. Medical history shows that 64.3% patients were hypertensive, 50% diabetic, 92% patients presented with shortness of breath, 85% with chest pain, 35.7% were smokers and 42.9% had positive family history of heart diseases. Dyspnea classifications shows 50% patients with CCS I, 28.6% CCS II and 21.4% CCS III.



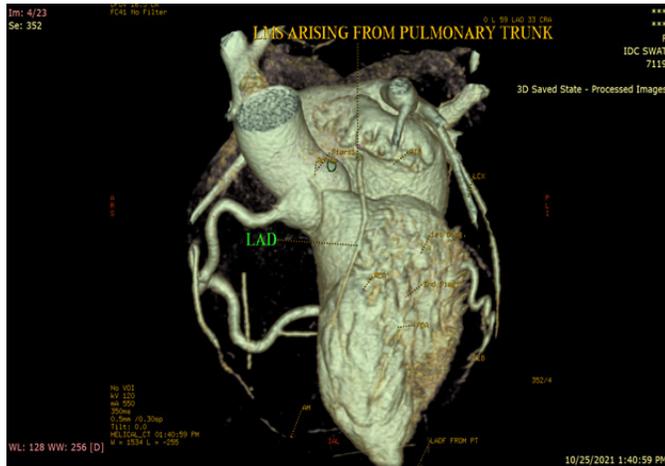
**Figure 1a.** Axial CT coronary angiogram showing left main stem arising from pulmonary trunk, suggestive of pulmonary artery-derived anomalous left coronary artery (ALCAPA)



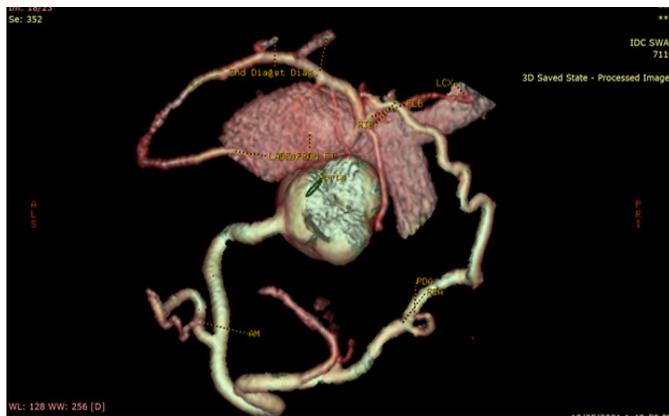
**Figure 1b:** Curved MPR CT coronary angiogram reconstructed image, showing left main stem arising from pulmonary trunk, suggestive of pulmonary artery-derived anomalous left coronary artery (ALCAPA)

During image reconstruction on the AW workstation, four distinct images were generated: (a) Maximum Intensity Projection (MIP), which allows the observation of the stenosis in a single vessel; (b) Curved Planar Reformations (CPR), which provide a detailed view of the vessel; (c) Volume Rendering Technique

(VRT), and (d) Multi-Planar Reformations (MPR), both of which facilitate the examination of the interaction between the myometrium and coronary arteries.



**Figure 1c:** 3 D Volume rendered CT coronary angiogram reconstructed image, showing left main stem arising from pulmonary trunk, suggestive of pulmonary artery-derived anomalous left coronary artery (ALCAPA)



**Figure 1d:** 3 D Volume rendered CT coronary angiogram reconstructed image, showing left main stem arising from pulmonary trunk, suggestive of pulmonary artery anomalous left coronary artery.

## Discussion

In our retrospective observational study, 1200 patients underwent CT angiography in the different branches of Islamabad Diagnostic Center, for a period of two years from May 2021 to May 2023. The findings showed that out of 1200 patients, coronary anomalies were present in 14 (2%) patients. Out of 14 total cases of anomalies of origin, 6 were observed with right coronary artery, 3 with diagonal, 2 with Posterior descending artery, 1 with obtuse marginal, and 1 with Ramus. We only observed the origin of anomalous coronaries and did not observe the anomaly of course and anomaly of termination. In contrast, a study by Fuad Zuki *et al.* in the clinical university of Sarajevo examined 919 patients and observed that 130 (14.1%) of them had coronary anomalous arteries, of which 14 (1.52%) had anomalies of origin, 115 (12.5%) had anomalies of course

and 1 (0.1%) had anomalies of termination.<sup>13</sup> Anomaly of course and origin of both coronary arteries were also found in a study conducted by Smettei *et al* (2017) in the population of Saudi Arabia.<sup>14</sup> Referring to the symptoms and clinical presentation, we observed that 64.3% patients were hypertensive, 50% were diabetic, 92% patients had shortness of breath, 85% had chest pain, 35.7% were smokers and 42.9% had positive family history of anomalous coronary arteries.

Dyspnea classifications showed 50% patients with angina grading score, also known as the Canadian Cardiovascular Society (CCS) CCS I, 28.6% CCS II and 21.4% CCS III. Patient with coronary anomaly with malignant course of RCA often present with palpitation or chest pain resulting in ordering of tests like coronary CT angiography or conventional angiography. These tests help in diagnosing the patients whose coronary arteries have an abnormal origin. Unfortunately, many patients with malignant course of RCA especially when the artery traverses between aorta and pulmonary trunk may present with sudden cardiac death or cardiac arrest. According to another research, out of 115 patients with anomalies, 12.7% involved bridging, 37 involved the LAD, 25 involve D1 and D2, and 49 involved the ramus intermedius. It also showed that 0.43% involved the intra-atrial course of the RCA. The prevalence of bridging the LAD reportedly ranges from 0.5% to 2.5%, which is less than what our analysis found in the literature.<sup>15</sup> Only one incidence (0.1%) with a termination anomaly with a fistula between the coronary sinus was noted.<sup>16</sup> In comparison to other research statistics, 0.33% of individuals had coronary artery fistulas.<sup>17,18</sup>

## Limitations of the study

Although it was a multicentered study and included all those patients who underwent coronary computed tomography, yet the small sample size was not representative of the whole population of Islamabad. Another limitation of our research is that a catheter angiography comparison was not made. Additionally, the population that presented to the hospital owing to a particular ailment was the focus of our study; healthy population was not included.

## Conclusion

Coronary angiography is a highly effective method for identifying coronary artery arteries as well as course and termination. This non-invasive method accurately illustrates coronary abnormalities, giving crucial information for precise diagnosis and patient care planning. We can observe easily all the presentation which cannot be detected through other diagnostic tools.

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**Authors' contributions:** AM conceptualized the study design. RU and HM helped in data. AHK wrote the first draft of manuscript and analysis of the data. The final text draft was read and approved by all authors.

**Conflict of interest:** The authors affirm that there was no conflict of interest.

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