



Frequency of Coronary Artery Anomalies Undergoing Coronary Interventions Patients at Tertiary Hospital

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Authors' contributions

This work was carried out in collaboration among all authors. In this study, all of the contributors to this article/paper were directly involved in the design, implementation, and analysis of the research project. All of the authors of this manuscript have reviewed and given their approval to the final version that has been submitted. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aims to identify the frequency of Coronary Artery Anomalies (CAA) in coronary intervention receiving patients at tertiary care hospital.

Sample: To obtain the sample size of the study i.e., 228 were selected at a Confidence level of 95%.

Study Design: Cross-sectional study.

Place and Duration of Study: This Descriptive cross-sectional study was conducted at Tertiary care hospital - National Institute of Cardiovascular Disease, Sindh-Karachi. Six months after the approval from IRB-NICVD (April 2018 – October 2018).

Methodology: Nonprobability consecutive sampling was used to collect the study data. All Patients of either gender from age 18 to 60 years of age undergoing Primary Coronary Intervention (PCI)/coronary artery angiography because of substernal chest pain were included.

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Results: Total 228 sample population was enrolled in the study, among which 88 (38.6%) were females and 140 (61.4%) were males. CAA was found in the coronary arteries of patients with abnormal aortic valves with a frequency of 1.3 percent. The most often occurring anomaly in our analysis is the separation of the origins of Left Anterior Descending Artery (LAD) and Left Circumflex Artery (LCx) from the Left Coronary Artery (LCA). The Circumflex Artery resulting from Right Coronary Sinus (RCS)/ Right Coronary Artery (RCA) was the second most often seen anomaly in our analysis, accounting for 22.78 percent of all anomalies. The RCA caused by LCS was the next abnormality, with a 7.59 percent frequency. In three cases, the left major coronary artery was derived from RCS, accounting for 3.8 percent of abnormalities.

Conclusion: Among patients receiving diagnostic coronary angiography, we discovered a 0.9 percent incidence of coronary artery abnormalities. In our research, the prevalence of coronary artery abnormalities was 7% among patients who had coronary procedures. The drawback of our research is that we only included individuals who had had coronary angiograms rather than a random sample of the different cardiac tertiary care hospitals.

Keywords: *Coronary Artery Anomaly (CAA); Single Coronary Artery Disease (SAD); Anomalous Left Coronary Artery Pulmonary Artery (ALCAPA); Left Circumflex Artery (LCX); Left Coronary Main Artery (LCMS).*

1. INTRODUCTION

The rare congenital disorder “Coronary Artery Anomalies (CAA)” varies differently in clinical presentation and on average 1% of the adult population represents in autopsy [1]. Out of 80% of the coronary artery anomalies are benign in nature and on angiographic profile, 0.1%- 1.3% of patients are reported of anomalous coronary arteries [2]. The rate of CAA is extending from 0.17% to 1.2% in post-mortem examination [3]. A few kinds of aortic root abnormalities (such as a bicuspid aortic valve) are present in around 26% of CAA, as is mild asymmetry of the aortic sinuses [4]. For example, Temel et al. reported that the most common vessel anomaly involved was left main coronary artery and right coronary artery originating from left aortic sinus 38.1%, followed by anomalous ostium near sinotubular junction, the second leading anomaly with an incidence of 16.6% [5]. Furthermore, an Indian research included 838 individuals with coronary artery abnormalities who underwent multidetector computed tomography angiography (MD-CTA) with a prevalence incidence of 10.09 percent. The greatest percentage was 9.22 percent for intrinsic anatomical abnormalities, 1.18 percent for origin and course anomalies, and 0.03 percent for termination anomalies. [6]. Amongst which 0.51% incidence was shown in the anomalous area right coronary artery (RCA) from a left coronary sinus (LCS), thus making it the leading type of anomaly. Similarly, Jeet R et al. reported an incidence of 2.06% of coronary artery anomaly after reviewing, 6,258 coronary angiograms in the age ranging from 51-60 years [1].

With 1.29 percent, the most prevalent abnormality was anomalous origin and course of arteries, followed by intrinsic abnormalities of coronary arterial system anomalies of coronary termination and anomalous anastomotic vessels, at 0.7 percent and 0.03 percent, respectively. Pakistan has revealed increasing trends of CAA from 998 patients to 1505 patients in the span of the past three years [2]. Pakistani study reported 36 patients of CAA, underwent coronary CT angiography in one year span. The most common anomaly reported in 9 patients was an anomalous origin of a coronary artery from the opposite coronary sinus with an anomalous course (1.4 percent), addition to that an anomalous origin of RCA from the left coronary sinus with an inter-arterial course, which was similar to the global assessed data. [4]. CAA are scarcely experienced in the generalized populace out of which 20% are benign by nature identified in the angiographic detections as termination of the arteries, its number, and its origin [7]. However, although coronary artery abnormalities are less common than congenital artery anomalies, they are still important since they are the leading cause of infarction, ischemia, and sudden death. Also included in the planning of cardiac surgery for coronary interventions, heart defect treatment, or valve replacements [8].

Multiple reviews of CAA have been published in the literature. For example, a study conducted by Noor H et al revealed that 38.4 percent of anomalies arise from the anomalous origin of a right coronary artery from the posterior sinus of Valsalva, followed by the separate origin of a left

anterior descending artery and left circumflex artery, which has a prevalence of 30.7 percent. With a frequency of 15.3 percent, the anomalous origin of the left circumflex from the right sinus of Valsalva was the third most prevalent aberration [8]. Serkan Yuksel's investigation on 48 individuals revealed an occurrence of different sorts of abnormalities. The most common defect documented in 28 (58.3) individuals was the origin of the circumflex artery (Cx) from the right coronary artery (RCA). Considering that, the origin of anomalous RCA from the LAD was discovered in 6 (12.5) patients. In addition, the most prevalent abnormality connected to the Cx artery [9].

CAA was found to be asymptomatic incidental findings that can deteriorate coronary circulation and lead to sudden cardiac death, especially in young athletes. Because interventional techniques for the treatment of coronary artery disease (CAD) are becoming more common in the present day, a thorough knowledge of CAA is becoming an increasingly important component in dealing with CAD. The purpose of this study is to determine the frequency of CAA in National Institute of Cardiovascular Disease (NICVD) patients who arrive at a tertiary hospital for coronary interventions. Targeting the same approach this study fills the gap regarding the current burden of disease in our population because of the different body habitus, environment, and dietary habits, as NICVD is Pakistan's leading public sector hospital with thousands of patients admitted to our institute. Moreover, after a careful search, we did not find any local study in the previous five years. This will help to obtain evidence for the local population which was reliable and illustrate the true picture in the local population.

2. MATERIALS AND METHODS

This descriptive cross sectional study was carried out in a single-centre hospital i.e. National Institute of Cardiovascular Disease, Karachi from April 2018 to October 2018 after the approval from the IRB NICVD. This study is derived from the thesis submitted to College of Physicians and Surgeons Pakistan (CPSP) for the degree certification and it was under the supervision of a senior researcher and consultant cardiologist. Nonprobability consecutive sampling was used to collect the study data. To obtain the sample size of the study i.e., 228, Open epi sample size calculator was used on a Prevalence up to 5.64% on Precision of 3% at a Confidence level of 95 All Patients of either gender from age

18 to 60 years of age undergoing PCI / coronary artery angiography because of substernal chest pain as defined in operational definition were included. All patients with the previous administration of fibrinolytic therapy were assessed with history and through previous reports, history of percutaneous coronary intervention, history of cardiac surgery, Deranged RFT (creatinine>1.2mg/dl) or not willing for hospital admission treatment and coronary angiography were excluded from the data collection.

Verbal and written informed content were taken prior to enrolling them in the study. After approval of the study from the CPSP and an ethical permission certificate from a supervisor, all the patients underwent PCI as per inclusion criteria in NICVD for using their data in research. Demographic detail (including name, age, and gender) was obtained. All those who fulfil the inclusion criteria were included in the study otherwise were excluded. History was taken regarding coronary artery disease and for factors such as hypertension, diabetes mellitus, and smoking status were noted by the researcher on predesigned proforma as per operational definition. The patient underwent PCI within 48 hours of hospital admission and findings regarding the CAA as per operational definition were collected by the researcher on predesigned proforma. All PCI was done by the experienced cardiologist having at least 02 years of experience after fellowship. Confidentiality of the data was maintained by restricting it to the principal investigator or the authors only. All data is restricted to primary investigator, ethical integrity was maintained by keeping all subjects anonymous and coded for data recording.

Statistical Package of Social Sciences (SPSS) version 20 was used to input and evaluate all of the gathered data. For quantitative data such as age, weight, height, and BMI, the mean and standard deviation were determined. For qualitative variables such as gender, diabetes Mellitus, obesity, hypertension, smoking status, and coronary artery abnormalities, frequency and percentages were determined. Effect modifiers like age, gender, diabetes mellitus, smoking status, obesity, hypertension, and CAA were controlled by stratification. Post stratification by Chi-square test was used to determine the impact of these variables on the results. P-value of .01 was considered to be highly significant. The calibration of the data was established using a bar chart and a ring circle.

3. RESULTS

In this study, a total of 228 patients have enrolled the study, among which 88 (38.6%) were females and 140 (61.4%) were males. The mean age of the patients was 52.6 ± 10.9 (18-60: Min-Max) years and the mean BMI of the patients is 27.23 ± 4.36 (23.8-30.4: Min-Max) kg/m^2 . Descriptive statistics of all quantitative variables were calculated, among 228 patients, there was an equal number of diabetic and nondiabetic patients, hypertensive, and non-hypertensive patients. Obese patients was found 68.4% in the study sample. With respect to the tobacco intake, out of 228 patients, 60 have a current smoking history, 96 got rid of the smoking while 72 patients never smoked in their life. The overall distribution of CAA was observed in 16 patients which is 7% of the total population [Table 1].

Diabetes mellitus showed a significant difference where 12 (11.5%) diabetic patients have CAA and 4 (3.2%) found in non-diabetic patients ($P\text{-Value}=.01$). Hypertension showed a significant difference where 14 (11.1%) hypertensive patients have CAA and only 2 (2%) normotensive patients have found CAA ($P\text{-Value}=.01$). Obesity showed a non-significant difference where 12 (7.7%) patients were obese have CAA and only 4 (5.6%) were patients non-obese ($P\text{-Value}=.55$). Smoking status showed a non-significant difference where 6 (7.3%) patients who were current smokers had CAA and 7 (7.3%) Ex-smokers were found CAA, 3 (4.2%) non-smokers found to have CAA ($P\text{-Value}=.42$). Age showed a non-significant difference where 6 (10%) patients have age ≤ 45 years have CAA and 10 (6%) patients have age >45 years have coronary

artery anomalies. ($P\text{-Value}=.29$) Among 228 patients, CAA in the patient received coronary interventions were found 16 (7%). Gender showed significant difference with respect to CAA, 12 (13.6%) females have CAA and only 4 (2.9%) in male patients ($P\text{-Value}=.00$). Congenital anomalies of coronary artery prevalence in anomalous aortic origin were 1.3%. The commonest anomaly of this study differentiates from the LCS to the origin of LAD and LCx. This study observed the commonest anomalies were the Cx arising from RCA/RCS, which constituted 22.78 percent from all anomalies. The RCA resulting by LCS was followed by an abnormality with a 7.59% incidence. In three cases, the left major coronary artery was formed by RCS, accounting for 3.8% of the abnormalities. Furthermore, single coronary artery (SCA) was discovered in 3 individuals with a 3.8% incidence, while one patient with three CA developing independently from RCS was observed in the research. Furthermore, in our study, one patient, a 49-year-old woman, was diagnosed with ALCAPA. [Table 2] [Fig. 1].

4. DISCUSSION

D. Ilic reported 45 (2.88%) out of 1562 patients who were exposed to CAA with a frequency of 0.41-0.67%. A most occurring anomaly was the absence of left circumflex artery originating from LCS and separate origin of LAD with a prevalence of 0.77%- 26.7% of all coronary anomalies. In addition to that 5 patients were reported 2 patients with LCA arising from non-coronary sinus and RCA originating from the left anterior sinus [10]. Among 2235 patients, 241

Table 1. Presentation of demographic and study variables among 228 study sample size

Variables		Frequency (Percentage)
Gender	Female	88 (38.60%)
	male	140 (61.40%)
Diabetes Mellites	Present	104 (45.60%)
	Absent	124 (54.40%)
Hypertension	Present	126 (55.26%)
	Absent	102 (44.70%)
Obesity	Present	156 (68.40%)
	Absent	72 (31.60%)
Smoking Status	Current Smoker	60 (26.30%)
	Ex-Smoker	96 (42.10%)
	Never Smoked	72 (31.60%)
Coronary Artery Anomalies	Present	16 (7%)
	Absent	212 (93%)

Table 2. In the stratification of CAA with study variables following is the analysis with the p-values when applied chi-square on it

Variables		CAA		P-Value
		CAA Present	CAA Absent	
Gender	Female	12 (13.60%)	76 (86.40%)	.00
	male	4 (2.90%)	136 (97.10%)	
Diabetes Meletus	DM Present	12 (11.50%)	92 (88.50%)	.01
	DM Absent	4 (3.20%)	120 (96.80%)	
Hypertension	HTN Present	14 (11.10%)	112 (88.90%)	.01
	HTN Absent	2 (2%)	100 (98%)	
Obesity	Obesity Present	12 (7.70%)	144 (92.30%)	.55
	Obesity Absent	4 (5.60%)	68 (94.40%)	
Tobacco Intake	Current Smoker	6 (10%)	54 (90%)	.42
	Ex-Smoker	7 (7.30%)	89 (92.70%)	
	Never Smoked	3 (4.20%)	69 (95.80%)	
Age	Age ≤ 45 Years	6 (10%)	54 (90%)	.29
	Age ≥ 45 Years	10 (6%)	158 (94%)	

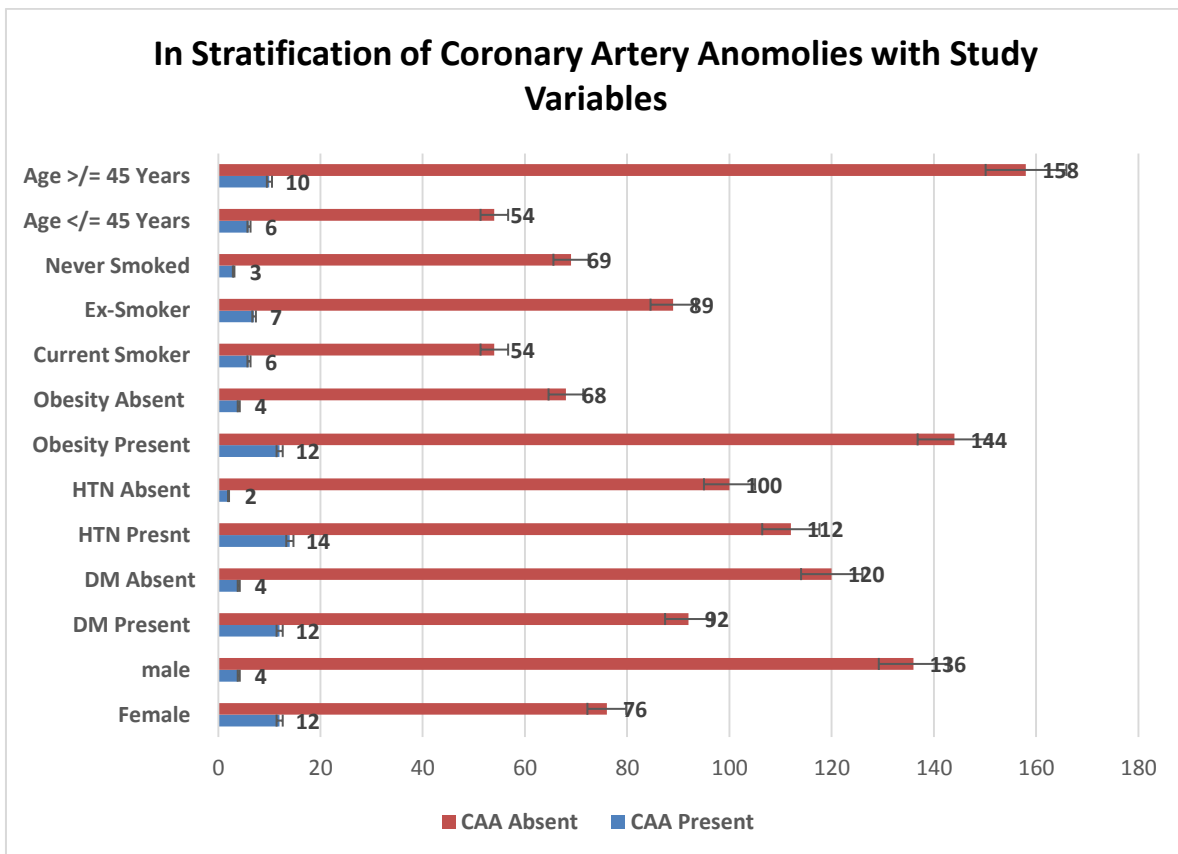


Fig. 1. Graphical representation of CAA stratified with study variables following are the analysis with the p-values when applied chi-square on it

reported coronary artery anomalies. The prevalence of CAA was reported at 1.029% in Saudi Arabia. An in-depth examination of this revealed that 34 individuals had a varied position of coronary Ostia, and 22 patients had different origins of the left circumflex coronary arteries and

left anterior descending (0.98%) [11]. Fuad Zukic and fellows observed CAA in 130 patients out of which originating anomalies were reported in 14 patients (1.52%) among those, anomalies from where the right coronary artery and left coronary artery is arising were found in 11 patients (1.2%)

and 3 patients (0.3%) respectively [12]. Incidence of single coronary artery (SCA) is the scarcest reported anomaly in works of literature. The study described 0.27% incidence of SCA out of which SCA arising from the left coronary sinus was found in 1 patient and the rest had SCA origination from the right sinus [13].

CAA is infrequent overall, however, the most frequently occurring kind of congenital heart disease [14]. Numerous classification plans have been proposed, regularly taking into consideration, anomalies of ventricular myocardium supply, vessel origin, number, and course [15]. In our investigation, the most prevalent anomaly was the separation of the LCx and LAD from the LCS. This anomaly was considered benign and has no hemodynamic. The presence of an avascular region near the LMCA distribution might address doubts about the origin of the LAD and LCX. A similar anomaly has been assessed in a Chinese study, CAA was detected with an incidence of 0.61%- 1.3%, and separate origin of LAD and LCX was reported with a prevalence of 5.99% [16]. The CX resulting from RCS/RCA was the second most often seen anomaly in our dataset, accounting for 22.78 percent of all anomalies. A case- study identical to this anomaly has been studied with respect to a 63-year-old male. In spite of the fact that the depicted anomaly is frequent and mild in nature, it can cause the compression of the coronary supply route and myocardial ischemia in the settings of mitral or aortic valve implantation [17].

The proximal LMCA appears increase in length and non-branching, as well as when the lateral wall was inadequately perfused, this anomaly should be reported to a cardiac surgeon in order to minimize unintentional vascular compression during valve replacement. This anomaly is thought to be harmless. The RCA caused by LCS was the third most prevalent anomaly, accounting for 7.59 percent of all cases which is also noted in the Turkish study carrying a prevalence of 0.31% in 16 patients thus proving it to be the most common anomaly among all the anomalies. In this case, the RCA emerges from an orifice in the LCS anterior to the left major ostium. When the RCA ostium is not positioned in the RCS and collaterals are lacking, this anomaly is suspected. Because of its slit-like orifice and unusual angulation, this ectopic RCA is difficult to cannulate [18]. In three cases, the left major coronary artery was formed by RCS, accounting for 3.8 percent of the abnormalities.

This is quite a rare anomaly. Brian and Hong found out that the prevalence of LMCA from RCS is 0.1%, according to angiographic studies. Accepting a predominance within the common populace of as it were 1/10th of this, there would be almost 300,000 subjects with this irregularity in the United States alone. Furthermore, this anomaly is quite unknown and rare [19].

LMCA arising from the RCS may be an especially uncommon and unsafe anatomical variety, with the detailed worldwide frequency of 0.15% but as it were 0.008% in adult patients since 59% mortalities happen before 20 years of age [20]. It should be noted that in the study of Rajesh Vijayvergiya a total of 12 patients with SCA were included in the study among which PCI of significant CAD was found in 09 patients. In 6 patients SCA was arising from the Right sinus of Valsalva (RSV) and 3 cases were reported for the left sinus of Valsalva. 11 PCI methods were performed in the study including coronary bifurcations injury, chronic total obstruction, PCI of left main, and multi-vessel disease. Rot ablation was performed in 3 patients with calcified lesions whereas intravascular imaging was performed in 4 patients [21].

Although, an Anomalous Left Coronary Artery from the Pulmonary Artery (ALCAPA) is an uncommon anomaly however it has the potential to cause fatal congenital coronary anomalies correlated to early infant death and unexpected adult mortality [22]. As per literature, the incidence of ALCAPA has been noted with a prevalence of 0.01% in 15,741 births. To the best of our knowledge, only two rare anomalies had previously been documented. The first abnormal Cx from RCS patient, who diagnosed with a second major OM artery coming from the LCA on the opposite side of its normal side. LCX took a retro-aortic path. There was no disease in any of the arteries [23].

5. CONCLUSION

Finally, CAA are an uncommon set of disorders having broad variety of clinical manifestations connected to their progression. Better management of this entity will result from increased understanding of its presence, clinical importance, and therapeutic approaches. Because of the clinical relevance and value in patients having coronary angioplasty or cardiac surgery, angiographic detection of these arteries is critical. In general, the frequency and pattern

of CAA in this research were consistent with previous data from throughout the globe.

CONSENT

Before enrolling patients in the study, informed permission was obtained from them in both written and verbal form.

ETHICAL APPROVAL

This study was extracted from the dissertation submitted at the College of Physicians and Surgeons Pakistan (CPSP). Ethical approval was obtained prior to the data collection from the Institutional Review Board-National Institute of Cardiovascular Disease (IRB-NICVD). This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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