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ORIGINAL ARTICLE

CLINICAL AND DEMOGRAPHIC PROFILE OF ADULTS WITH CORONARY ARTERY ANOMALY DETECTED BY COMPUTERIZED TOMOGRAPHY CORONARY ANGIOGRAPHY

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Abstract

Background: *The prevalence of coronary artery anomalies (CAAs) varies from 0.2% to 5.6%. Besides conventional invasive coronary angiography (CAG), Computerised Tomography Coronary Angiography (CT-CAG) provides better anatomy of coronary arteries. Early detection and evaluation of coronary artery anomalies is essential because of their potential association with myocardial ischemia and sudden death. We aimed to find the clinical and demographic profile of patients with CAAs and describe pattern of CAAs as detected by CT-CAG at our centre.* ***Methods:*** *The data were collected by analysing the coronary angiographic reports of the patients that underwent CT-CAG between April 2025 to March 2026. Clinical and demographic profiles of the patients were recorded and CAAs were described using Angelini's classification.* ***Results:*** *CAAs were found in 84 (40 males and 44 females) of 4081 patients giving a frequency of 2.05%. The mean age was 54.02+11.76 (range 25 - 79). The chest pain was the most common indication for undergoing CT-CAG. Among these, anomalies of origin and course were the most common seen in 69(82.14%) cases. RCA arising from left sinus of Valsalva with interarterial course was the most common anomaly present in 47 (55.9%).LCx arising from RSV was found in 8(9.52%) cases. High take-off of RCAfrom ascending aorta, single ostial origin of both coronary arteries and anomalous origin of left main coronary artery (LMCA) each were seen in 4 (4.76%) cases. Coronary artery aneurysm was seen in 9 (10.71%) cases while dual LAD was seen in 2(2.38%) patients. five (5.95%) cases of coronary cameral fistula were seen. one (1.19%) case each of LCx arising from RCA and LAD arising from RSV were found.* ***Conclusion:*** *We found that the frequency of CAAs was 2.05% with slight female predominance and chest pain being commonest indication for CT-CAG. Though generally asymptomatic some CAAs may produce angina symptoms, myocardial infarction and sudden death.*

Keywords: Coronary artery anomalies, coronary angiogram, coronary fistula, prevalence.

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Introduction

The incidence of coronary artery anomalies (CAAs) in the general population is reported to be 0.3–5.6% while in autopsy series, it's around 0.3%.[1-4] Though most CAAs are benign in nature with most patients remaining asymptomatic, few patients present clinically with angina, dyspnoea, syncope, acute coronary syndrome, heart failure, ventricular arrhythmias and sudden cardiac death (SCD) and so have to be treated. Among young individuals,CAAs are the second most common cause of SCD after hypertrophic cardiomyopathy.[5-8] While not associated with increased risk of atherosclerosis and congenital heart disease, CAAs recognition is crucial for those

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patients undergoing coronary angioplasty and cardiac surgery.[9-10] This study was aimed to study theprevalence and pattern of CAAs among patients in our centre who had undergone CT-CAG.

There are two main epicardial coronary arteries supplying blood to the myocardium – the left main coronary artery (LMCA) and the right coronary artery (RCA). The LMCA originates from the left sinus of Valsalva (LSV/LCC), while the RCA originates from the right SV(RSV/RCC). There is typically no artery arising from the posterior SV(PSV/NCC). The LMCA passes between main pulmonary artery and the left auricle and then bifurcates into the left anterior descending (LAD) artery and the left circumflex artery (LCx). In few cases LMCA trifurcates with an additional artery called the ramus intermediate artery (RI). The LAD runs in the anterior interventricular groove towards the apex giving septal and diagonal branches. The LCx runs along the left atrioventricular sulcus and gives out obtuse marginal branches. The RCA passes anteriorly and to the right between the right auricle and the pulmonary artery and then descends vertically in the right atrioventricular sulcus.[11-13]

The classification of CAA as proposed by Angelini is the most widely accepted one and according to this the CAAs are grouped under four subtypes as anomalies of origin and course, intrinsic coronary anomalies, anomalies of termination and anomalous anastomotic vessel.[2,14,15] With substantial technical advances in the last few decades, CCTA has become the gold standard technique for the imaging of CAAs. It offers a high spatial resolution, and advanced post- processing rendering methods have enabled 3-dimensional visualization of the coronary arteries and its relation to surrounding cardiac and non-cardiac structures. This allows detailed characterization of the coronary anatomy and high risk anatomical features, even of the distal vessels and small side branches.[16-19]

Methods

This single centre cross sectional study was carried out in the department of cardiology, Shahid Gangalal National Heart Centre, Kathmandu, Nepal from April 2025 to March 2026 after ethical approval obtained from the institutional ethics committee (IEC). The patients undergoing CT-CAG were included. We excluded the patients with myocardial bridge, separate conal artery, patients less than 18 years of age and post bypass surgery patients. All patients have given their informed consent prior to their inclusion in the study. The CT coronary angiograms reports were reviewed by Cardioimaging radiology consultants and the CAAs found were classified as per the Angelini's classification system.

Statistical analysis was done using statistical package for social survey (SPSS), Version 16.0 for windows. The categorical variables were presented as numbers or percentages and continuous variables were presented as mean ± standard deviation(SD).

Results

A total of 4081 patients underwent CT-CAG and coronary artery anomalies were found in 84 patents giving the prevalence of 2.05%. Among these, there were 40 (47.6%) males and 44 (52.4%) females. The mean age of the patients with CAAs was 54.02 ± 11.76 (range 25-79) years. The highest number i.e. 48 (57.1%) patients with anomalous coronaries were seen in the age group 41- 60 years followed by 26 (31%) in 61-80 years and 10 (11.9%) in 18-40 years age group. The indications for undergoing angiography among these patients were chest pain in 56 (66.67%), pre-operative evaluation in 10(11.9%) and evaluation of left ventricular dysfunction,arrhythmia and syncope in 11(13.09%), 7(8.3%) and 6(7.14%) patients respectively. Demographic characteristics and clinical features of the patients with CAA are presented in **Table 1**.

Table-I

Clinical and demographic profiles of patients with CAAs Values in number (%) or mean ±SD.

Characteristics	Numbers (%)
The total number of CT-CAG	4081
Number of patients with CAAs	84(2.05%)
Mean age (range)in years of patients with CAAs	54.02 ±11.76 (25 – 79)
Age distribution(years)	
18-40	10(11.9%)
41-60	48(57.1%)
>60	26(31%)
Gender distribution of patients with CAAs	
Males	40(47.6%)
Females	44(52.4%)
Clinical profiles	
Hypertension	40(47.6%)
Diabetes mellitus	23(27.38%)
Smoking	38(45.23%)
Dyslipidaemia	17(20.23%)
Indications for CT-CAG	
Chest pain	56(66.67%)
LV Dysfunction	11(13.09%)
Pre-operative evaluation	10(11.9%)
Arrhythmia	7(8.3%)
Syncope	6(7.14%)

Table II
Distribution of Coronary Artery Anomalies

Coronary Anomaly	Number of Patients	Angiographic Incidence (%) (n=84)	Anomaly Incidence (%) (N=4081)
Anomalous origin and course	69	1.69%	82.14%
- RCA arising from LCC /LSV	47	1.15%	55.95%
- LCx from RCC /RSV	8	0.20%	9.52%
- RCA from aorta (High take-off)	4	0.10%	4.76%
- LMCA from RCC /RSV	3	0.07%	3.57%
- LMCA from NCC	1	0.02%	1.19%
- LAD from RCC	1	0.02%	1.19%
- LCx from RCA	1	0.02%	1.19%
- Single coronary artery (single ostium)	4	0.10%	4.76%
- Interarterial (Malignant) course	55	1.35%	65.47%
Anomalies of intrinsic artery	11	0.27%	13.09%
- Aneurysmal (ectatic) artery	9	0.22%	10.71%
- Dual LAD	2	0.05%	2.38%
Anomalies of termination	5	0.12%	5.95%
- Coronary artery fistula (Total)	5	0.12%	5.95%
- LAD draining into MPA	4	0.10%	4.76%
- RCA draining into LA	1	0.02%	1.19%

Among 84 patients,anomaly of origin and course was seen in 69 (82.14%)cases, anomalies of intrinsic coronary artery were seen in 11(13.09%) while only 5(5.95%) were the anomaly of termination. The most common anomalous vessel was the right coronary artery 51(60.71%).TheRCA arising from left sinus of Valsalva (LSV) was present in 47(55.95%), the RCA arising high off from aorta was present in 4(4.76%), and RCA fistula draining into left atrium was seen in 1(1.19%)case. Anomalous origin of left circumflex artery was seen in 9 (10.71%) cases: 8(9.52%) from right sinus of Valsalva and 1(1.19%) from right coronary artery. Four (4.76%) cases of anomalous origin of left main coronary artery were present: 3 (3.57%) from RSV and 1 from non-coronary cusp. Single ostial origin of both coronary artery was present in 4 (4.76%) patients with ostia located in RSV IN 1 CASE AND high up in aorta above LSV IN THE OTHER 3 cases. Among the anomaly of origin LAD arising from RSV was the least common seen in 1 case. Among all anomalies of course 55(65.47%) were interarterial course also called malignant course of coronary artery. Among the anomalies of intrinsic coronary artery, aneurysm of artery was seen in 9(10.71%) while dual LAD was seen in 2(2.38%) cases.Coronary cameral fistula was seen in 5(5.95%) cases among which 4 had LAD fistula draining into main pulmonary artery and 1 had RCA fistula draining into LA. One patient had anomalous origin of RCA from LCC along with aneurysm of LCx. Details about distribution of all coronary artery anomalies is depicted in Table 2.

Discussion

The prevalence of coronary artery anomalies (CAAs) varies significantly across studies depending on the study population and the imaging modality used. Our study found a prevalence of 2.05% among patients undergoing CT coronary angiography (CT-CAG). This finding is consistent with the reported incidence in the general population, which ranges from 0.3% to 5.6%.[4,10,20,21]Also our result of prevalence is similar to a recent study by Murtaza et al. in another tertiary hospital in Nepal, which found a prevalence of 2.1%[22] and another study done in India by Kashyap et al.[5] However the value is higher than that found in another study done by Poudel et al.[23] This discrepancy is likely due to the higher sensitivity of multi-detector row CT (MDCT) in detecting CAAs compared to conventional angiography or autopsy.

Regarding demographics, our study showed a slight female predominance (52.4%), which differs from a study by Gräni et al., where 72.5% of patients were male.[24] This could be due to geographic variation and health care access difference between gender groups. The mean age of our patients (54.02 years) aligns with other adult cohorts where CAAs are often detected incidentally during evaluations for suspected coronary artery disease (CAD).[4,25] In our cohort, chest pain was the most common indication for CT-CAG (66.67%), a finding that mirrors the clinical profile reported in other literatures.[16,24,26]

The distribution of anomalies in our study was dominated by anomalies of origin and course (82.14%), followed by intrinsic anomalies (13.09%) and termination anomalies (5.95%). This pattern is broadly consistent with the landmark study by Yamanaka and Hobbs, which identified origin and distribution anomalies in 87% of their cases.[4] However this is not the case in a report by Sidhu et al that showed higher frequencies of intrinsic coronary artery anomaly than that of origin and course.[27] This could be attributable to different definitions and methodologists adopted by investigators.

In our study, the most frequent anomaly was the RCA arising from the left sinus of Valsalva (LSV), found in 1.15% of the total CAAs which was also the commonest anomaly reported in a study conducted in Korea by Namgung et al[28] and the other study from Nepal by Poudel et al.[23] This finding is also notably higher than the 0.107% reported by Yamanaka series[4] and the 0.51% reported in a South Indian cohort by Sirasapalli et al.[29] In all of our patient with this anomaly the RCA had malignant course i.e. between aorta and pulmonary trunk and the major clinical significance is that this may lead to myocardial ischemia or sometimes sudden cardiac death during exertion. The assumed mechanism of sudden death is ostial closure between the aorta and pulmonary artery and the squeezing of the ostium during exercise, with sudden interference in coronary arterial flow.[28] Such anomalous course has mostly been described in studies using CT scan.[28,30,31]

We observed an anomalous LCx arising from the RSV/ RCA in 0.22% of patients with most of them having subaortic course. This is lower than the incidence reported by Yamanaka series[4] and that reported by Eid et al. in Lebanese population.[32] In contrast a study by Click et al. found this anomaly as one of the most common coronary anomalies.[33] While generally considered benign as it does not causes functional myocardial impairmentbut its recognition is crucial to avoid accidental ligation and injury during surgery.

A coronary anomaly with a high take-off or ectopic origin refers to a left or right coronary ostium, which arises more than 0.5 cm above the sinotubular junction rather than at the aortic sinus.[34] This is a hemodynamically benign coronary anomaly but it may cause difficulties in cannulation during coronary angiography and coronary artery bypass surgerywith risk of being clamped or transacted if surgeon is not aware of this anomaly.[35,36] Anomalous origin of RCA from ascending aorta is present in 0.09% of patients in our study similar to that seen in study by Kashyap et al.[5] and Sidhu et al.[27]

The origin of the LMCA from the right sinus of Valsalva was detected in 0.07% of our patients which is similar to that reported by Graidis et al.[17] and is slightly higher than the 0.017% incidence found in earlier angiographic series.[4] The anomalous vessel often has malignant course so this anomaly is clinically significant as it is strongly associated with sudden cardiac death (SCD) in young individuals during strenuous exertion.

A single coronary artery (where the entire coronary system arises from a single ostium) is extremely rare. It has been classified into 20 categories according to the location of ostium and course of coronary artery.[37] In our study it was found in 0.09% of our patients which is higher than the 0.04% reported by Yamanaka series[4] and 0.02% by Nawale et al.[38] However, it aligns closely with the 0.12% incidence for single RCA reported by Graidis et al.[17] It originated from RCC in 2 cases, from LCC in 1 case and from ascending aorta in 1 case in our study. The clinical risk of SCD depends heavily on whether a major branch takes a malignant interarterial course.

We had one case (0.02%) of LAD arising from RSV that aligns with the value reported by Satish et al[39] and Yamanaka series.[4] One case was present with LMCA arising from NCC which was also reported by Fujimoto et al.in 2 cases(0.03%)[30] and by Yamanaka series in 1 case.[4]

A coronary artery fistula is an abnormal connection between one of the coronary arteries and another structure, most commonly a venous structure or a chamber on the right side of the heart. Small fistulas usually do not cause any hemodynamic compromise. However, larger fistulas can give rise to the coronary artery steal phenomenon, which leads to ischemia of the segment of the myocardium perfused by the coronary artery.[40] We found coronary cameral fistulae in 0.12% of our subjects, which is consistent within the range from 0.06% to 0.18% of cases in previous studies.[17,27,28] Also most common draining site was pulmonary artery as with other studies.[28,41]

Coronary artery aneurysm (CAA) has been classically defined as that segment of the artery in which dilation exceeds over 1.5 times the diameter of an adjacent portion, considered as a reference point. CAA itself is considered as benign entity despite the potential risks of rupture, thromboembolism, and compression of surrounding structures.[42] We also included the patients with coronary artery aneurysms which was seen in 0.12% which is lower than the values reported by various studies.[43-45] Similarly the current study found dual LAD in0.05% patients which contrasts with various other studies.[27,28] This discrepancy could be due the relatively small sample size of our study.

Interestingly one patient had two anomalies in the form of aneurysm of LCx along with RCA originating from opposite sinus with malignant course.

The limitation of our study is that it is a single centre study with a limited time frame of one year and so have relatively small sample size as compared studies with long study time and larger sample size. Thus, the study might not reflect the true prevalence in the general population.

Conclusion

In our study concluded that the prevalence of CAAs was slight female predominance and with chest pain as most common indication for undergoing CT-CAG at our centre. CAAs had been associated with ischemic heart disease and sudden death particularly in athletes and young adults. MDCT could be used for non-invasive diagnosis of CAAs and is expected to become a helpful diagnostic tool for the elucidation of the clinical significance of the condition and management strategy of patients.

Limitations of the study

It was a single-center study. The study population was relative small.Long-term follow-up was not included.

Ethical consideration

The study was approved by the Ethical Review Committee of Shahid Gangalal National Heart Centre, Kathmandu, Nepal. Informed consent was obtained from each participant or the caregiver of the patient.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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