Journal of Chitwan Medical College 2022;12(42):30-33
Available online at: www.jcmc.com.np

ORIGINAL RESEARCH ARTICLE

CORONARY ARTERY ANOMALIES IN PATIENTS UNDERWENT CORONARY ANGIOGRAPHY IN A TERTIARY HOSPITAL OF CENTRAL NEPAL

Shahid Murtuza[1,*], Bishnu Mani Dhital[1], Shyam Raj Regmi[1], Shovit Thapa[1], Puran Gurung[1], Amir Khan[1], Sagar Thapa[1], Asraf Hussain[1]

[1]Department of Cardiology, Chitwan Medical College and Teaching Hospital, Bharatpur, Nepal

Received: 15 Oct, 2022

Accepted: 25 Dec, 2022

Published: 31 Dec, 2022

Key words: Anomalies; Coronary angiography; Coronary artery.

***Correspondence to:** Shahid Murtuza, Department of Cardiology, Chitwan Medical College, Bharatpur, Nepal.*
Email: shahidmurtuza35@gmail.com
*DOI:*https://doi.org/10.54530/jcmc.1187

Citation

Murtuza S, Dhital BM, Regmi SR, Thapa S, Gurung P, Khan A, Thapa S, Hussain A. Coronary artery anomalies in patients underwent coronary angiography in a tertiary hospital of central Nepal. Journal of Chitwan Medical College.2022;12(42):30-33.

ABSTRACT

Background: Coronary artery anomalies are infrequent findings during coronary angiography and may result in longer radiation time and increase the risk of complications. Insufficient knowledge of coronary anomaly may lead to accidental damage of vessels during cardiac surgery. This study aimed to estimate the prevalence of coronary artery anomalies among the patients underwent coronary angiography at our center.

Methods: A retrospective study was conducted at Chitwan Medical College. Coronary angiography records of all patients from 1st April 2020 to 30th April 2022 were analyzed by two interventional cardiologists. Statistical analysis was done using Statistical package for social survey, Version 20.0 for windows. The categorical variables were presented as numbers or percentages (%) and continuous variables were presented as mean ± standard deviation.

Results: A total of 1015 patients who underwent coronary angiography for various indication were included. Coronary artery anomalies were observed in 21 (2.1%) patients. Among anomalies most common was anomalies of origin 16 (76.2%) followed by anomalies of intrinsic coronary artery 5 (23.8%). Separate origin of the conus branch was the most common coronary artery variation 103 (10.1%).

Conclusions: The prevalence of coronary artery anomalies in present study was similar to many large sample size previous studies from different geographical area. However present study reflects scenario of our population, which may be helpful for interventional cardiologist and cardiac surgeon during coronary angioplasty and cardiac surgery.

INTRODUCTION

Coronary artery anomalies (CAAs) are not unusual findings during coronary angiography (CAG). The incidence of CAAs in the general population is ranging from 0.2% to 5.6%, this variation is due to difference in method (autopsy vs angiography), classification criteria and study population between studies.[1-3] However, retrospective study with large number of coronary angiographic analysis reported that the incidence of CAAs were 0.9%.[4] Majority of CAAs (80%) were benign, while 20% of associated with life threatening conditions, such as sudden death, arrythmias, syncope or angina symptoms.[1,5] Coronary artery disease (CAD) is leading cause of morbidity and mortality worldwide. Hence, for the diagnosis of CAD the number of CAG procedures were also increasing by time.[6] CAAs cause difficulty in engaging coronary ostia and may require special catheters and maneuvers to perform angiography or angioplasty which result in longer radiation time and increase the risk of complications during procedures. Furthermore, sometimes during cardiac surgery insufficient knowledge of coronary anomaly may lead to accidental damage of vessels.[7] Therefore, accurate recognition and documentation of coronary artery anomaly is mandatory to avoid complication during coronary interventions and bypass surgery.

In this study, we aimed to estimate the prevalence of CAAs among the patients who underwent coronary angiography at our center.

METHODS

A retrospective study was conducted at Chitwan Medical College and Teaching Hospital, Bharatpur from 1st April 2020 to 30th April 2022 and catheterization laboratory records of 1015 were analysed after ethical approval obtained by Institutional Review committee (Ref. no: CMC-IRC/078/079-295). Coronary angiogram (CAG) of all patients were assessed by two interventional cardiologists independently before final documentation regarding any CAAs were taken into account. In case of any difference in opinion, a consensus was reached after discussion with senior interventional cardiologist. The patients with CAAs that occurred as a part of congenital heart disease and patients with post bypass surgery were excluded from study.

Normal coronary anatomy was defined as any morphological characteristics seen in > 1% of unselected general population, i.e., normally coronary arteries arise from the aortic sinuses as two main branches; left main stem (LMS) originates from the left sinus of Valsalva (LSV) and bifurcates into the left anterior descending artery (LAD) and the left circumflex artery (LCX), while right coronary artery (RCA) originated from right sinus of Valsalva (RSV). These three epicardial arteries give adequate branches for the dependent myocardium and finally terminated into capillary bed.

Normal anatomical variations were alternative and relatively unusual morphological feature observed in > 1% of the population among normal coronary anatomy and not associated with major adverse events, like coronary dominance and supply of atrioventricular nodes, ramus intermedius branch, wraparound LAD, Shepherd's crook RCA, Acute take-off LCX. The coronary dominance determines by the artery that supplies posterior descending artery, posterolateral branch and small branch from distal segment of dominance artery supplies atrioventricular node. There are three situations: supply by RCA called Right dominance, supply by LCX called Left dominance and supplied by both the RCA and LCX called Co-dominance. The conus artery is first branch of RCA, which supply infundibulum of right ventricle. However, in some patients the separate conus branch arises from the aorta. Ramus intermedius is another frequent normal variation that arises from trifurcation of left main coronary artery and supplies the lateral and inferior walls of heart. The LAD may be a very long vessel that may wrap around the cardiac apex and supply the apical inferior wall of heart, known as a "wraparound LAD". A "shepherd's crook" RCA is variant in which RCA has normal origin but takes a tortuous and high course immediately after it originates from aorta. Other normal variants include an acute takeoff of the LCX, when the angle between LMS and LCX is less than 45 degree. High take-off a coronary artery is defined when the ostium of coronary artery arises ≥5mm above the sinotubular junction of aorta.[8-10]

Coronary artery anomalies are defined as congenital abnormalities in normal morphological features of the coronary anatomy that are observed in less than 1% of the general population. The classification of CAAs were done according to current updated angelini classification: a) anomalies of origin; b) anomalies of course; c) anomalies of coronary termination and d) anomalous anastomotic vessels.[8.11.12]

Myocardial bridge (MB) was defined as an atypical course of a portion epicardial coronary artery intramyocardially, which may result in compression of the vessel during systole. In angiography and autopsy the prevalence of myocardial bridging varies between 0.15%25% and 5%-86% respectively, and therefore its frequency in the general population suggests that it should be considered a normal variant.[10] We excluded MB from CAAs and considered it separately.

Statistical analysis was done using statistical package for social survey (SPSS), Version 20.0 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 1015 patients who underwent coronary angiography for various indication were included. The mean age of study population was 62.3±12.2 years (Range 19-92 years). More than half were 571(56.3%) males. ST-elevated myocardial infraction was the frequent-most indication for CAG (37.3%), followed by positive treadmill exercise stress test 151(14.9%) (Table 1).

Table 1: Sociodemographic variables and indication for undergoing coronary angiography in the study population (n = 1015)

Variables	Summary statistic
Age (years), mean ± SD	
Overall	62.3 ± 12.2
Male	61.4 ± 12.7
Female	63.4 ± 11.4
Gender, n (%)	
Male	571 (56.3)
Female	444 (43.7)
Indication for CAG, n (%)	
ST elevated Myocardial infarction	379 (37.3)
Non-ST-elevated myocardial infarction	108 (10.6)
Unstable angina	138 (13.6)
Chronic stable angina	114 (11.2)
Cardiomyopathy	39 (3.8)
Positive Tread mill test	151 (14.9)
Pre-operative evaluation	63 (6.2)
Rechecking of stent	17 (1.7)
Arrhythmia	2 (0.2)
Syncope	4 (0.4)

Coronary artery anomalies were observed in 21 (2.1%) patients. Among them, most of CAAs was anomalies of origin 16 (76.2%), with about 5 (23.8%) had anomalies of intrinsic coronary artery and one patient had anomalies of coronary termination noted as coronary artery fistula (LCX to RV), who also had another anomaly in the form of conus branch from early acute marginal artery. A high majority of the patients 811(79.9%) had right dominance coronary circulation. Ramus intermedius was present in 99 (9.8%) patients. Separate origin of the conus branch was the most common coronary artery variation 103 (10.1%). Myocardial bridge was noted in 72 (7.09%). Single segment MB were noted in most of patients, except for one patient who had two segments of MB, one was in mid LAD and another in distal LCX (Table 2).

Table 2: Distribution of the coronary artery anomalies and coronary artery variations in the patients that underwent coronary angiography (n = 1015)

Variables	Numbers (%)
Coronary Artery Anomalies (CAAs)	
Number of patients with CAAs	21 (2.1)

Anomalies of origin*	
Separate origin of LAD and LCX from LSV	9 (42.9)
RCA originated from LSV	3 (14.3)
LCX originated from RCA	2 (9.5)
Conus branch from early acute marginal artery	2 (9.5)
Anomalies of intrinsic coronary artery*	
Dual LAD	3 (14.3)
Dual RCA	2 (9.5)
Anomalies of coronary artery termination*	
Coronary artery fistulae (LCX to RV)	1 (4.8)
Coronary Artery Variation	
Coronary dominance	
Dominant right coronary artery	811 (79.9)
Dominant circumflex artery	133 (13.1)
Co-dominant artery	71 (7.0)
Ramus intermedius artery	99 (9.8)
Wrap-around LAD	228 (22.5)
Acute take-off LCX	22 (2.2)
High take-off RCA	3 (0.3)
Shepherd's crook RCA	17 (1.7)
Separate origin of conus branch	103 (10.1)
Distribution of myocardial bridges	
LAD and branches	60 (5.9)
LCX and branches	11 (1.1)
RCA and branches	2 (0.2)

*Out of 21 patients that had coronary anomaly

LAD, Left anterior descending artery; LCX, Left circumflex artery; LSV, Left sinus of Valsalva; RV, Right ventricle.

DISCUSSION

In this study, we found that overall CAAs were observed in 21 (2.1%), Which is consistent with studies conducted by Kashyap et al and Altin C et al.[7,13] However, the incidence of CAAs from large population size retrospective studies were 1.3% and 0.7%.[4,14] This may be due to differences in geographic location and sample size between studies. In our study we found most common CAAs were anomalies of origin (76.2%) in which the commonest anomaly was separate origin of LAD and LCX (42.9%) in the absence of left main coronary artery from LSV. Similarly, Kashyap et al (35.7%),[7] Yildiz A et al. (64.29%) [4] and Yamanaka O (30.4%)[1] reported this anomaly as most common one but Sidhu NS et al. and Jiang X et al. had different opinion.[14,15]

In present study the second common anomaly was origin of RCA from LSV (14.3%), these findings were supported by previous large studies Yildiz A et al (13.36%) and Aydinlar A et al (8%) as they also reported as second common anomaly.[4,16] Although this anomaly considered as potentially serious coronary anomaly and may result in life-threatening clinical manifestations like myocardial infarction, ventricular tachycardia, syncope and sudden death in the absence of significant atherosclerosis, this might be due to compression of proximal RCA by great arteries as its course between aorta and pulmonary trunk during exercise time which result in myocardial ischemia.[1] However, in present study we did not encounter such clinical manifestations in patients with this anomaly.

The origin of LCX from RCA or RSV is suspected when the contrast injection into left coronary artery reveals an unusually long, nonbranching proximal segment. Although this anomaly is considered benign but has clinical significance due to risk of accidental ligation during valve surgery and hence cardiac surgeon should be informed regarding this anomaly.[1] In our study origin of LCX from RCA (9.5%) was third common anomaly, which was nearly similar to Kashyap et al (10.9%), Yildiz A et al (8.9%) and Sidhu NS et al (13.13%) but lower when compared with result of large study conducted by Yamanaka O et al (27.7%).[1,4,7,15] This anomaly was published as most common anomaly by Yuksel S et al. (58.3%) and Sivri N et al. (48.42%).[17,18]

Regarding anomalies of intrinsic coronary artery, we found dual LAD seen in 14.3 % and dual RCA in 9.5% among total coronary anomalies and considered as benign. However, Kashyap et al. and Sidhu NS et al. reported dual LAD in 27.1% and 22.22% respectively.[7,15] In our study the anomalies of termination were least common and we found one patient (4.8%) had coronary arterial fistulae, which was nonsignificant fistula without causing any volume overload to cardiac chambers and Kashyap et al. also reported least common incidence (1.5%) of this anomaly.[7]

Among coronary artery anatomical variation, the distribution of coronary dominance in present study was 79.9% right, 13.1% left and 7.0% co-dominant. which was equivocal with previous studies.[13,19] However, Jiang X et al. disagree with our result and reported 60.58% right dominance, co-dominance (27.51 %) and only 11.91% patients were left dominance.[14] Ramus intermedius artery (RIA) was noted in 9.8% patients which is very much similar with Altin C et al. (11.0%), but Cademartiri F et al. reported higher frequency (21.9%) of RIA.[13,19] Wrap-around LAD was noted in 22.5 % patients, which is supported by previous literature. [20] Acute take-off LCX was reported in 2.2% patients, consistent with studies reported by Angelini P et al.[21] Separate origin of conus branch was seen in 10.1% of patients, similar finding was noted by Cademartiri F et al (11.6%).[19] Finally among coronary anatomical variations, we noticed High take-off RCA and Shepherd's crook RCA were 0.3% and 1.7% respectively in present study.

The incidence of myocardial bridge (MB) was reported from 0.83% to 26.0% in previous studies.[19,22-24] MB is not expected to cause impairment in myocardial perfusion, ischemia or angina as more than two-thirds of blood flow in the coronary system occurs in diastole and considered as benign. However, clinical symptoms depend on extent of the compression during systole. If the blockage is less 50%, patient remain asymptomatic but the compression more than 70% blockage result in anginal symptoms. Ischemia in MB is considered to be associated with the severity of systolic compression, diastolic filling time and heart rate. Tachycardia may provoke an ischemic effect by shortening the diastolic phase and increasing the importance of systolic blood flow. Clinically important MB can cause complications such as vasospasm, angina pectoris

and arrhythmias, and required similar treatment as coronary artery disease. [25,26] In this study MB was found in 7.2 % patients, However the clinical manifestation was not encountered in any patients. We noticed that most of MBs were located in LAD and its branches followed by LCX and its branches, and less common in RCA and its branches, which was similar with Jiang X et al finding.[14]

This study has some limitation. First, study was conducted at single-center and have relatively small sample size as compared with studies from different geographical area. Hence does not reflect the overall true prevalence in the general population of this region. Second, computed tomographic coronary angiography provides more detailed 3-dimensional anatomic information that may be difficult to obtain with invasive coronary angiography. Which is not available at our center.

CONCLUSION

The prevalence of coronary artery anomalies in present study was similar to many large sample size previous studies from different geographical areas. However present study reflects scenario of our population, which may be helpful for interventional cardiologist and cardiac surgeon during coronary angioplasty and cardiac surgery. Further large sample size, multi-center prospective studies are required for actual prevalence of CAAs in our population.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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