Research Article

A study of incidence and pattern of coronary artery anomalies in Western Rajasthan, India

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ABSTRACT

Background: Coronary artery anomalies (CAAs) are a diverse group of congenital disorders whose manifestations and pathophysiological mechanisms are highly variable. Among patients undergoing coronary angiography, the incidence depends on the population studied and the criteria used to define an anomaly. This is the first ever study conducted in western Rajasthan to detect the incidence and pattern of coronary anomalies.
Methods: We retrospectively studied 8500 coronary angiographies (CAG) done in the institution over a period of 12 years from 2004 to 2015 for detection of incidence and pattern of coronary anomalies. Patients with ischemic heart disease and valvular heart disease who underwent CAG were included in the study.
Results: Out of the 8500 angiograms screened a total of 108 coronary anomalies were detected (incidence of 1.27%). Anomalies of origin and course was the most common anomaly (106 out of 108 patients) followed by anomalies of coronary termination (fistulas) which was seen in just two patients. Most common anomaly was absent left main artery with separate origin of the left anterior descending (LAD) artery and left circumflex artery (LCx) (n=36, 33.3%), followed closely by anomalous origin of right coronary artery (RCA) from left sinus (n=34, 31.48%). Anomalous origin of LCx from right sinus/ RCA was the third most common anomaly (n=22, 20.37%). Other rare anomalies include anomalous origin of left coronary artery from right coronary sinus (n=6, 5.55%), RCA from posterior sinus (n=4, 3.7%). Single coronary artery, LAD from RCA and coronary artery fistula were seen in two patients each (n=2, 1.85%).
Conclusions: In present study though the total incidence of coronary anomalies was similar to that in other studies, the pattern of coronary anomalies was slightly different from that reported from different parts of the world.

Keywords: Coronary artery anomalies, Anomalous origin, Coronary artery fistula, Aortic sinus

INTRODUCTION

Coronary artery anomalies (CAAs) are a diverse group of congenital disorders whose manifestations and pathophysiological mechanisms are highly variable. By definition, coronary anomalies are rare.

Among patients undergoing coronary angiography, the incidence depends on the population studied and the criteria used to define an anomaly. One large study reported an incidence rate of coronary anomalies of 1.3% for adults undergoing catheterization primarily for the detection of coronary artery disease.[1] Anomalous coronary arteries can be defined based on the relative frequency of anatomic variations in the general population.[2]

Normal anatomy describes any morphologic feature observed in more than 1% of an unselected population, whereas the term normal variant describes an alternative, relatively unusual morphologic feature but still seen in more than 1% of the same population.

An anomaly, therefore, would be defined as a morphologic feature identified in less than 1% of the population. Coronary anomalies can be classified into 3

main types: (a) anomalies of coronary artery origin and course which include anomalous location in the root in the proper sinus, anomalous origin from a different coronary sinus or anomalous origin from a location other than coronary sinus (b) anomalies of the intrinsic coronary anatomy like coronary ectasia, aneurysm, myocardial bridging, and (c) anomalies of coronary termination like coronary fistulae.

Though anomalous coronaries are incidentally discovered during routine coronary angiography, not all anomalies are clinically significant.

However, some specific anomalies have the potential for serious sequelae and some may cause cardiac symptoms or events including chest pain, syncope, heart failure, dyspnea, ventricular arrhythmia, myocardial infarction, and sudden death.

Geographical variations in incidence and pattern of coronary anomalies are well known.[3-5] This is the first ever study conducted in western Rajasthan to detect the incidence and pattern of coronary anomalies.

METHODS

We retrospectively studied 8500 coronary angiographies (CAG) done in our institution over a period of 12 years from 2004 to 2015 for detection of incidence and pattern of coronary anomalies. Patients were selected based on the following criteria.

Inclusion criteria

Patients who were >18 years of age with ischemic heart disease and valvular heart disease who underwent CAG were included in the study.

Exclusion criteria

Patients with congenital heart diseases were excluded from the study.

Patients with other coronary anomalies like ectasia, myocardial bridging, abnormal high and low origin of coronary arteries from normal sinus and separate origin of the conus artery from the right coronary sinus (RCS) were also excluded from the study.

RESULTS

Out of the 8500 angiograms screened a total of 108 coronary anomalies were detected with incidence of 1.27%. This included 72 male patients and 36 female patients. Anomalies of origin and course was the most common anomaly (106 out of 108 patients) followed by anomalies of coronary termination (fistulas) which was seen in just two patients (Table 1). All the patients with coronary anomalies were the one who underwent CAG for ischemic heart disease or suspected chest pain. No anomalies were found in patients with valvular heart disease who underwent CAG before valve replacement surgeries.

Table 1: Incidence of different coronary anomalies.

Coronary anomaly	Number of patients (n=108)	Angiographic incidence %	Anomaly incidence %
Separate origin of LAD &LCX	36	0.42	33.3
RCA arising from LCS	34	0.40	31.48
LCX arising from RCS/RCA	22	0.25	20.37
LCA arising from RCS	6	0.07	5.55
RCA arising from posterior sinus	4	0.04	3.70
Single coronary artery	2	0.02	1.85
LAD from RCA	2	0.02	1.85
Coronary artery fistula	2	0.02	1.85

Separate origins of left anterior descending artery and left circumflex artery from the left coronary sinus

Most common anomaly was absent left main coronary artery (LMCA) with separate origin of the left anterior descending (LAD) artery and left circumflex artery (LCx). This was seen in 36 patients with angiographic incidence of 0.42% and anomaly incidence of 33.3% (Figure1).

Anomalous origin of right coronary artery (RCA) from left sinus

Anomalous origin of right coronary artery (RCA) from left sinus (n=34, 31.48%) was the second most common anomaly with angiographic incidence of 0.40% (Figure 2). Majority of these patients (n=30) had RCA origin from orifice located just anterior to LMCA and remaining of the patients had the origin posterior to LMCA.

Figure 1: Coronary angiogram showing separate origins of left anterior descending artery and left circumflex artery from the left coronary sinus.

Figure 2: Coronary angiogram showing anomalous origin of right coronary artery (RCA) from left sinus.

Anomalous circumflex artery from the right coronary sinus/ right coronary artery

Anomalous origin of LCx from right coronary sinus/ RCA was the third most common anomaly (n=22, 20.37%) with angiographic incidence of 0.25% (Figure 3). In all these patients LCx had a retroaortic course.
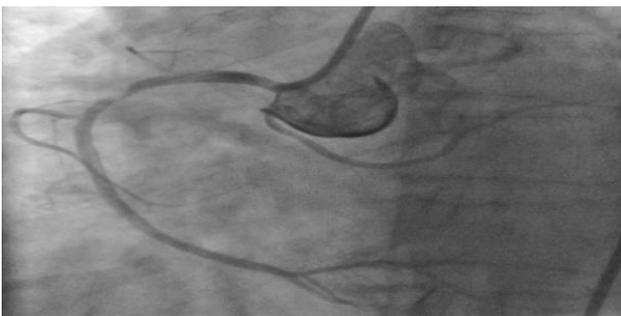

Figure 3: Coronary angiogram showing anomalous circumflex artery from the right coronary sinus.

Left coronary artery arising from right coronary sinus

Anomalous origin of left coronary artery from right coronary sinus was seen in 6 patients with angiographic incidence of 0.07% and anomaly incidence of 5.55% (Figure 4). The course was interarterial in 2 patients, septal in 3 patients and anterior course in one.

Figure 4: Coronary angiogram showing left coronary artery arising from right coronary sinus.

Right coronary artery arising from posterior sinus

RCA arising from posterior sinus was seen in 4 patients with angiographic incidence of 0.04%.

Single coronary artery

Single coronary artery was seen in 2 patients with angiographic incidence of 0.02% and anomaly incidence of 1.85% (Figure 5). Both the patients had normal Left main and LAD with absence of RCA .The LCX was hyperdominant with course to the right AV groove (Figure 5, 6). The posterior descending artery was arising from the LCX.
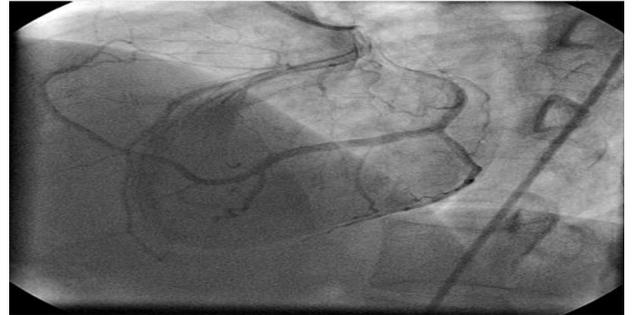

Figure 5: Coronary angiogram showing single coronary artery with LCX continuing into the right AV groove as anomalous RCA in LAO cranial view.
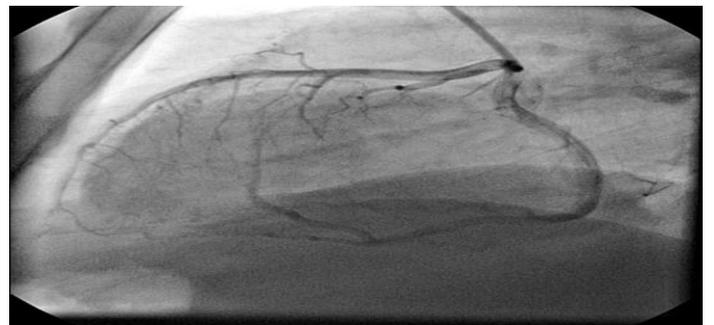

Figure 6: Coronary angiogram showing single coronary artery with LCX continuing into the right AV groove as anomalous RCA in lateral view.

Left anterior descending artery arising from right coronary artery

This was a rare anomaly seen in just 2 patients with angiographic incidence of 0.02%.

Coronary artery fistulae

Coronary artery fistulae were seen in two patients with angiographic incidence of 0.02% and anomaly incidence of 1.85% (Figure 7). In both the patients the fistula was seen arising from LAD and opening into pulmonary artery.
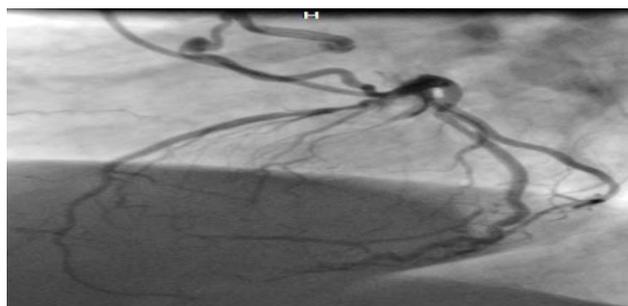

Figure 7: Coronary angiogram showing coronary artery fistula.

DISCUSSION

The prevalence of coronary artery anomalies (CAA) depends on the definition that is used to define each anomalies which, unfortunately, is usually not mentioned in most reports of CAA studies. Because of this defective methodology, the prevalence of CAA has been variably reported in the literature. Most of the prevalence data come from studies of patients seen in the catheterization laboratory, so this type of study has a referral bias. Though many studies of CAA have been published this is the first ever large study conducted in Rajasthan. In our study we found an overall incidence of CAA of 1.27%. This is similar to the incidence range of 0.16-1.3% which is described in various similar studies.[6-12]

Most common anomaly in our study was absent left main coronary artery (LMCA) with separate origin of the left anterior descending (LAD) artery and left circumflex artery (LCx). This was seen in 36 patients with angiographic incidence of 0.42% and anomaly incidence of 33.3% which is similar to the incidence of 35.3% described by Yamanaka in his series.[1] This anomaly is a clinically benign variant. This is suspected when a true LCx is not seen after cannulation of the LMCA. There could be two possibilities in this setting; one is separate origin of LCx and LAD or anomalous origin of LCx from right coronary sinus.

Second most common anomaly in our study was anomalous origin of right coronary artery (RCA) from

left sinus. This was seen in 34 patients with anomaly incidence of 31.48%. This was the most common anomaly (38.5%) in the study by Garg et al.[9] Because this anomaly involves a course between the aorta and pulmonary artery, it has been implicated in sudden cardiac death. Majority of patients (n=30) in p[resent study had RCA origin from orifice located just anterior to LMCA and remaining of the patients had the origin posterior to LMCA.

Most of the time this anomaly is seen while injecting LMCA; when there is refluxes of the dye which opacify the anomalous RCA. This anomaly is also suspected when RCA cannot be cannulated from right sinus during normal CAG (after excluding anterior or posterior origin of RCA from right coronary sinus). Sometimes we may have to perform an aortogram in LAO projection to find the exact origin.

Third most common anomaly in present study was anomalous origin of LCx from right coronary sinus (RCS)/ RCA which was seen in 22 patients with anomaly incidence of 20.37% and angiographic incidence of 0.25%. In all these patients LCx had a retroaortic course. Yamanaka reported this anomaly in 27.7% of patients in his study.[1]

When the LCx arises from the RCS; it can usually be cannulated with the Judkins right catheter or right Amplatz. A multipurpose catheter is useful when the coronary artery origin is low and has a sharp inferior course; after engaging the ostium of the RCA, a clockwise rotation will engage the anomalous LCx.

Anomalous origin of left coronary artery from right coronary sinus was seen in 6 patients in our study with angiographic incidence of 0.07% and anomaly incidence of 5.55%. This anomaly is quite rare, and has an estimated incidence of 0.03- 0.15% in various studies. This anomaly is clinically significant, as it is associated with sudden cardiac death, especially during vigorous exercise.[13] When LMCA arises from the RCS, it may take four possible courses (a) Interarterial course: Between the aortic root and the pulmonary artery.[14]

The LMCA initially courses up toward and then behind the right ventricular outflow tract before travelling anteriorly to its normal point of bifurcation. (b) Septal course: The LMCA may course intramyocardially or subendocardially, along the floor of the right ventricular outflow tract. It will then surface in the midseptum, at which point it branches into the LAD and LCx. (c) Anterior (to the right ventricular outflow tract) course: The LMCA passes anteriorly over the right ventricular outflow tract, making a cranial anterior loop in which the artery passes initially rightward then up and over the right ventricular infundibular free wall in the RAO view before reaching the interventricular groove and then dividing normally. (d) Retroaortic (posterior to the aortic root) course: The LMCA may arise to the right of the RCA and

pass posterior to the aortic root. In our study the course was interarterial in 2 patients, septal in 3 patients and anterior course in one.

Single coronary artery was seen in 2 patients in our study. One of these patients was a 48yrs old male who came with atypical chest pain. He had non-specific ST-T changes in baseline ECG. Hence exercise TMT (Bruce's protocol) was performed which showed episode of VT at the 6:54 minutes of the test after which the test was stopped and the VT settled spontaneously at 2:30 minutes post recovery. The patient was taken up for coronary angiography.

In CAG left coronary injection showed normal Left main and LAD. The LCX was hyper dominant with course to the right AV groove. The posterior descending artery was arising from the LCX. Several attempts for catheterization of RCA failed. Although aortic root injection was done with suspicion of arterial cut off from the origin, RCA was not apparent. Aortic root angiography showed single LCA and absence of right coronary ostium. In this patient attributing the symptoms and arrhythmia to this coronary anomaly is reasonable. Moreover, it is well established that an anomalous origin of the RCA can lead to angina pectoris, myocardial infarction, malignant arrhythmias and/or sudden death, in the absence of atherosclerosis.[15]

Coronary artery fistulae were seen in just two patients in our study with angiographic incidence of 0.02% and anomaly incidence of 1.85%. Though these fistulae commonly arises from RCA and opens into right ventricle in majority of patients, in both of our patients the fistula was seen arising from LAD and opening into pulmonary artery. Both these patients were young and were symptomatic. They underwent successful percutaneous closure of fistulae with Gianturco coils. RCA arising from posterior sinus and Left anterior descending artery arising from right coronary artery were other rare anomalies in our study with angiographic incidence of 0.04% and 0.02% respectively.

CONCLUSION

In present study though the total incidence of coronary anomalies was similar to that in other studies, the pattern of coronary anomalies was slightly different from that reported from different parts of the world. Although majority of patients with coronary anomalies in our study were not associated with symptoms attributable to the anomaly per se they were detected incidentally during coronary angiography, but awareness of these variants is clinically important for the appropriate management of cardiac patients.

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