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Original Research Article

Coronary anomalies and anatomical variants detected by coronary computed tomographic angiography in Kashmir, India

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ABSTRACT

Background: Coronary Artery Anomalies (CAAs) presenting in adulthood are rare and associated with adverse cardiac events, including sudden cardiac death. Coronary artery anomaly is the second most common cause of Sudden Cardiac Death (SCD) in young athletes. Cardiac Computed Tomographic Angiography (CTA) is a readily available non-invasive imaging modality that provides high-resolution anatomical information of the coronary arteries. Multi-detector row CT is superior to conventional angiography in defining the ostial origin and proximal path of anomalous coronary branches.
Methods: This was a prospective study included 186 patients who underwent coronary CTA from December 2018 to November 2019 in Government medical College, Srinagar on a 256 slice CT. The indications for coronary CTA were an equivocal, or non-diagnostic stress test, atypical chest pain, suspected anomalous coronary, as well as the evaluation of cardiac cause of syncope.
Results: Ramus intermedius was the most common anatomical variant seen in 25 patients (13.4%). The prevalence of coronary anomalies in this study was 5.66% including myocarding bridging. The most common anomaly was high take off of coronary artery from sinotubular junction accounting for 1.6%.
Conclusions: Coronary Computed Tomographic angiography is much superior in detecting coronary artery anomalies than invasive coronary angiography because of the absence of soft tissue information like as is needed in myocardial bridging. Proper knowledge of the anomalies and their clinical significance is highly important in planning treatment and easing hardships of cardiologists in dealing with them.

Keywords: Coronary artery anomalies, Coronary computed tomographic angiography, Invasive coronary angiography, Ramus intermedius

INTRODUCTION

Coronary Artery Anomalies (CAAs) presenting in adulthood are rare and associated with adverse cardiac events, including sudden cardiac death.[1] Coronary artery anomaly is the second most common cause of Sudden Cardiac Death (SCD) in young athletes.[2] Invasive Coronary Angiography (ICA) is an invasive, slightly expensive, and may not provide the required information about the abnormal coronary anatomy. Cardiac Computed Tomographic Angiography (CTA) is a readily available noninvasive imaging modality that provides high-resolution anatomical information of the coronary arteries. High-quality cardiac imaging without β-blocker premedication, even in patients with high heart rates, particularly after the introduction of modern protocols that allowed coronary CTA with a radiation dose substantially lower than that of invasive coronary angiography.[3-5] Multi–detector row CT, with its faster volume coverage and higher spatial and temporal resolution, allows imaging of the coronary arteries and detection of related diseases.[6] Multi-detector row CT is superior to conventional angiography in defining the ostial origin and proximal path of anomalous coronary branches.[7] The spatial resolution of MRI is substantially inferior to that of the newest generation CT scanners.[8,9] Given higher spatial resolution than CMR, CTA is useful in diagnosing abnormal coronary anatomy and allows simultaneous 3-D visualization of the coronary arteries, the coronary veins, the pulmonary veins, the aorta, the atria, and the ventricles.

METHODS

This was a prospective study included 186 patients who underwent coronary CTA from December 2018 to November 2019 in Government medical College, Srinagar on a 256 slice CT. The indications for coronary CTA were an equivocal, or non-diagnostic stress test, atypical chest pain, suspected anomalous coronary, as well as the evaluation of cardiac cause of syncope. Peak of contrast enhancement time was calculated using test bolus injection. Retrospective ECG gating was used, and patient was asked to hold breath.

A bolus of iodinated contrast material (350 mg/ml, Omnipaque) at a dose of 1.5 ml/kg with dual-head power injector followed by 10-20 ml of saline flush at a same rate was given and coronary CT angiogram was done. Axial images were reconstructed with 0.75 mm slice thickness and 0.5 mm increment. Coronary CTA images were transferred to a dedicated 3D-postprocessing workstation. Maximum Intensity Projections (MIPs), curved Multiplanar Reformats (cMPRs), and Volume Rendering Technique (VRT) were performed. Coronary artery anomalies were divided into 3 groups: anomalies of origin, anomalies of course and anomalies of termination.

Inclusion criteria

- Patients with an equivocal, or non-diagnostic stress test, atypical chest pain, suspected anomalous coronary, suspected cardiac cause of syncope.

Exclusion criteria

- Refusal to participate in study.
- Patients with atrial fibrillation.
- Patients with high serum creatine level >2.0mg/dl.
- Patients with history of contrast allergy and pregnant women.

Statistical analysis

Categorical values were presented with absolute and relative frequencies (%) and continuous values with mean.

RESULTS

Out of 186 patients, 102 were males and 84 were females. The mean age of patients was 46.7 years. Ramus intermedius was the most common anatomical variant seen in 25 patients (13.4%) (Figure 1). Ramus intermedius is the third branch of left coronary artery along with left anterior descending and left circumflex. Authors also had 2 cases of origin of sinoatrial branch from left coronary artery which was included as normal variant (Figure 2). The prevalence of coronary anomalies in this study was 5.66% including myocarding bridging. Coronary anomalies were divided into anomalies of origin, anomalies of course and anomalies of termination.

Table 1: Prevalence of coronary artery anomalies of origin in this study.

Anomalies of origin	N (%)
High take off	3(1.6%)
Multiple ostia	2(1.0%)
Origin of coronary artery from non-coronary or opposite cusp	2(1.0%)

Table 2: Prevalence of coronary artery anomalies of course in this study.

Anomalies of course	N (%)
Myocardial bridging	2(1.0%)

Table 3: Prevalence of coronary artery anomalies of termination in this study.

Anomalies of termination	N (%)
Coronary artery fistula	1(0.53%)
Coronary arcade	1(0.53%)

The most common anomaly was high take off (Figure 3) of coronary artery from sinotubular junction accounting for 1.6% (Table 1). There was no case of single coronary artery or anomalous origin of coronary artery from pulmonary artery. Authors had one case of separate origin of conal artery from right coronary cusp (Figure 4) and one case of separate origin of acute marginal artery from right coronary cusp (Figure 5) i.e. 2 cases of multiple ostia (Table 1). Authors had one case of origin of right coronary artery from left coronary cusp with intraarterial course between aorta and pulmonary artery (Figure 6) and one case of origin of left coronary artery from right coronary cusp (Table 1).

Table 4: Prevalence of coronary dominance type in this study.

Dominance type	N (%)
Right dominant	141(75.8%)
Left dominant	37(19.8%)
Co dominant	8(4.8%)

Figure 1: Axial coronary computerized tomographic angiography revealing most common anatomical variant in form of ramus intermedius.

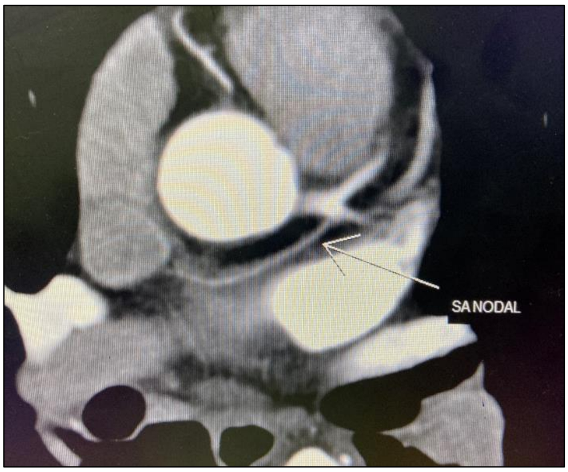

Figure 2: Axial coronary computerized tomographic angiography revealing origin of sino atrial artery from left main coronary artery as denoted by arrow.

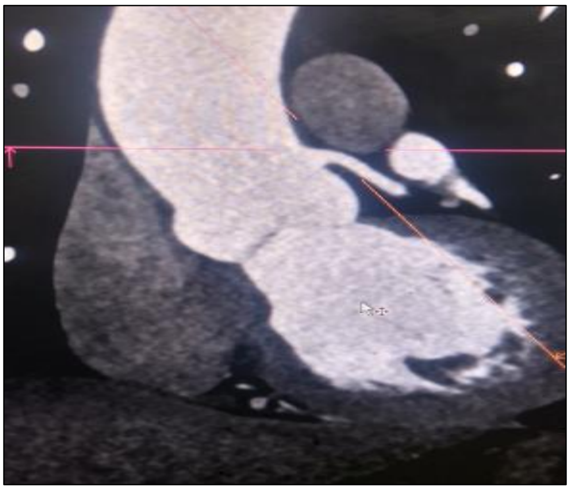

Figure 3: Coronal CECT Image revealing high take off of left coronary artery.

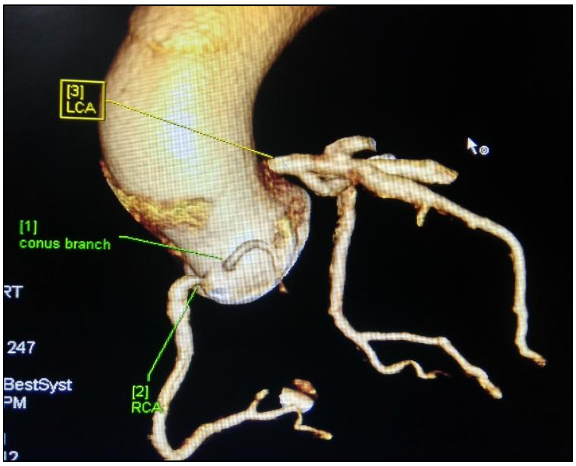

Figure 4: Volume Rendered technique revealing separate origin of conal artery from right coronary cusp suggestive of multiple ostia.

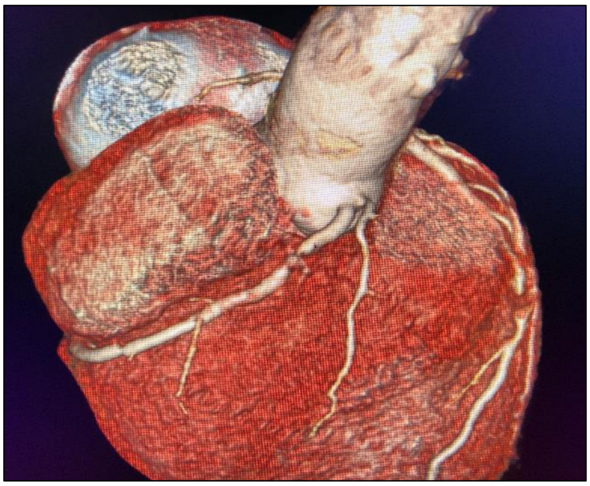

Figure 5: Volume rendered image revealing separate origin of acute marginal artery and right marginal from right coronary cusp.

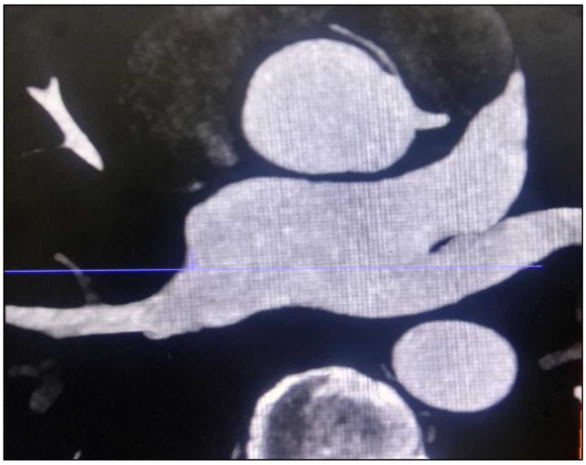

Figure 6: Axial CECT image revealing anomalous origin of attenuated right coronary artery from left coronary cusp with interarterial course.

Figure 7: Coronal coronary computerized tomographic angiography revealing myocardial bridging as denoted by arrow.

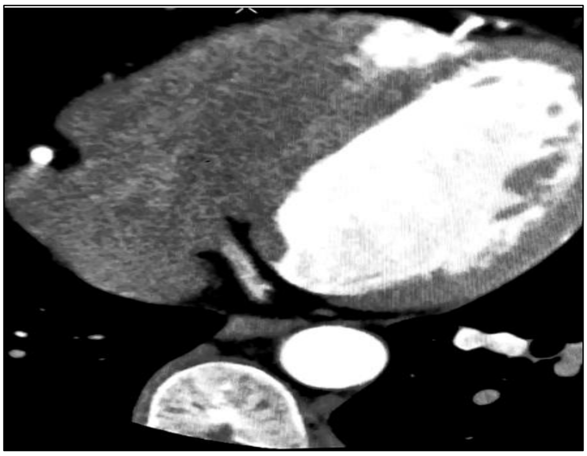

Figure 8: Axial coronary computerized tomographic angiography image revealing coronary artery fistula between left anterior descending and right ventricle.

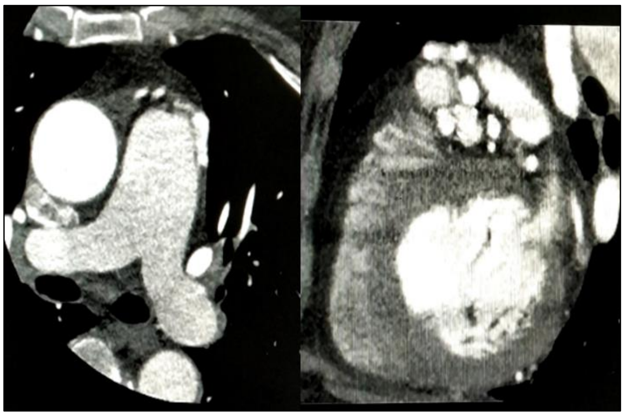

Figure 9: Axial and sagittal coronary computerized tomographic angiography images revealing communication between the right coronary artery and the left anterior descending artery anterior to pulmonary artery suggestive of coronary arcade.

Authors had 2 cases of myocardial bridging one involving diagonal branch (Figure 7) and other involving left anterior descending (Table 2). Authors had one case of coronary artery fistula between left anterior descending and right ventricle (Figure 8) demonstrated by intravenous injection of contrast followed by saline flush and one case of coronary arcade between right coronary artery and left anterior descending (Figure 9) (Table 3). 75.8% patients had right dominant circulation, 19.8% has left dominant circulation and 4.8% had codominant circulation (Table 4). Type of dominance is decided by the origin of posterior descending artery.

DISCUSSION

Conventional Invasive Coronary Angiography (ICA) has been the technique of choice for visualisation of the coronary artery system for several decades. Besides being invasive, ICA has limitations in detecting coronary artery anomalies because of the limited number of 2D projection images obtained and because of the absence of soft tissue information. The prevalence of coronary anomalies in this study was 5.66% including myocarding bridging. This is much higher than earlier studies due to possibly two factors first is inclusion of myocardial bridging in prevalence of coronary anomalies in this study and performing Computerized tomography coronary angiography on 256 slice CT which allows faster volume coverage and higher spatial and temporal resolution, allows imaging of the coronary arteries and their anomalies with very high precision. Although these results are similar to those of von Ziegler et al, who reported a prevalence of 3.2%, they are still high compared to other studies.[10-12] Narumol Chaosuwannakit in his study reported that overall prevalence of CAs was 3.7%.[13] Several classification systems of the CAs have been used.[14-16] According to these systems, anomalies of the CAs are divided into anomalies of origin and course, anomalies of intrinsic coronary arterial anatomy. Authors used anomalies of origin, course, and termination in this study. Some authors consider the multiple ostia or absent LM as normal variants, while others include it under the category of anomalous origin.[17-19] In this study, most common anomaly found was high take off of coronary arteries above the junctional zone between its sinotubular part of the ascending aorta. Vlodaver et al, reported that both coronary ostia were situated above the sinotubular junction in 6% of randomly selected adult hearts.[20] High takeoff of the coronary arteries usually doesn't cause major clinical problems, but it may cause difficulty in cannulating the vessels during coronary arteriography.

This study was prone to bias and confounding factors due to its retrospective nature due to highly selective sample of population and small number of patients in this study. It may not represent the true prevalence of coronary anomalies in whole population. Furthermore, only those patients underwent CT Coronary Angiography who had some clinical presentation related to coronary system or were suspicious of having coronary anomaly.

CONCLUSION

Coronary computed tomography angiography is a highly useful in diagnosing abnormal coronary anatomy and allows simultaneous 3-D visualization of the coronary arteries. It is much superior in detecting coronary artery anomalies than invasive coronary angiography because of lack of soft tissue information. Proper knowledge of the anomalies and their clinical significance is highly important in planning treatment and easing hardships of cardiologists in dealing with them.

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