FREQUENCY, ASSOCIATED RISK FACTORS AND ANGIOGRAPHICAL CLASSIFICATION OF CORONARY ARTERY ECTASIA (CAE) AND CORONARY ARTERY ANEURYSM (CAA) IN ST ELEVATION MYOCARDIAL INFARCTION(STEMI) PATIENTS UNDERGOING PRIMARY PERCUTANEOUS CORONARY INTERVENTION (PPCI)

Waseem Raja, Naseer Ahmed Samore, Javeria Kamran, Mohsin Saif, Syed Khawar Abbas Jaffri, Qamar Zaman Bhatti, Amer Rauf

Armed Forces Institute of Cardiology/National Institute of Heart Disease (AFIC/NIHD)/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To study the frequency, associated risk factors and morphological distribution of Coronary Artery Ectasia (CAE) and Coronary Artery Aneurysm (CAA).

Study Design: Descriptive cross sectional study.

Place and Duration of Study: Department of Cardiology, Armed Forces Institute of Cardiology & National Institute of Heart disease (AFIC/NIHD) Rawalpindi from Jul 2018 to Jul 2019.

Methodology: All patients who underwent Primary Percutaneous Coronary Intervention (PCI) for ST elevation Myocardial Infarction (STEMI) at our institute were considered for this descriptive cross sectional study. A consecutive sampling method was used and inclusion/exclusion criteria was applied. Number of patients having ectatic coronary arteries, ectasia distribution and morphological classification was done by trainee researcher after studying the coronary angiograms. Demographic information, symptoms and risk factors were also documented. Data recording, storage, assessment and analysis was done by using SPSS software version 21.

Results: A total 1354 patients diagnosed with STEMI underwent PPCI during the study period and Coronary Artery Ectasia (CAE) was diagnosed in 31 patients (2.2%), out of that 5 (16.13%) patients had Coronary Artery Aneurysm (CAA). Mean age of patients was 58.32 (± 11.22). Hypertension was the commonest preexisting risk factor 9 (29%) followed by Diabetes Mellitus (DM) 4 (12.9%). Left Anterior Descending (LAD) artery was ectatic vessel in majority of our study group. Ectatic coronaries were classified as fusiform 20 (64.52%) and saccular 11 (35.48%) on the basis of shape and in type 1-4 (type 1=16.13%, type 2=35.48%, type 3=32.26%, type 4=16.13%). Statistically significant association (*p*-value=0.003) was found between infarct related artery and the ectatic artery.

Conclusion: CAE has low prevalence in STEMI patients but it has statistically significant association with infarct related artery. Hypertension is a common risk factor. Ectasia has a predilection for both LAD and RCA in our study group.

Keywords: Aneurysm, Ectasia, Myocardial infarction, Percutaneous coronary intervention.

INTRODUCTION

The terms coronary artery ectasia and coronary artery aneurysm have historically been used interchangeably to describe aneurysmal dilation of coronary arteries. However, the term coronary artery aneurysm is usually used to describe focal dilation of a coronary segment (≥1.5 times the adjacent normal segment), and the term coronary artery ectasia is a dilatation exceeding more than one-third of the coronary artery length with the diameter of the dilated segment measuring more than 1.5 times the diameter of a normal adjacent segment[1]. The prevalence of CAE is 1.7% in patients who undergo Primary PCI for acute MI[2]. Obesity, smoking, male sex and hypertension are some of the risk factors for CAE. The vast majority of coronary artery aneurysm and coronary artery ectasia is detected incidentally during coronary angiography or computed tomography but CAE has been associated with Coronary Artery Disease (CAD) in various

Correspondence: Dr Waseem Raja, Department of Cardiology, AFIC/NIHD, Rawalpindi Pakistan
Email: vazim9@hotmail.com

studies. Local thrombosis in proximal large coronary artery aneurysms can lead to distal embolization and acute myocardial infarction. Progressive enlargement of coronary artery aneurysm may result in symptomatic local compression of adjacent structure (pulmonary artery, tricuspid valve, etc.) and can also eventually rupture, producing life-threatening cardiac tamponade or fistulous communications. Stress-induced ischemia due to microvascular dysfunction in dilated coronary arteries (dilated coronopathy) has also been documented in patients who have coronary artery ectasia or coronary artery aneurysm without associated obstructive coronary lesions[3]. The present study was performed to determine the prevalence and risk factors associated with CAE in patients presenting with acute Myocardial Infarction (MI). We also analyzed the association between ectatic vessel and the culprit vessel causing acute MI.

METHODOLOGY

All patients who underwent Primary Percutaneous Coronary Intervention (PCI) for ST elevation Myocardial Infarction (STEMI) for a period of twelve months at our institute were considered for this descriptive cross sectional study. A consecutive sampling method was used. Patients older than 18 years and coronary angiographically proven ectasia were included in the study. Patients with a history og Coronary Artery Bypass Graft (CABG) surgery, those undergoing elective PCI (Percutaneous Coronary Intervention) and unwilling patients were excluded from our study.

Clinical data was obtained by both interviewing the patients and reviewing the hospital records. Angiograms were studied by two researcher cardiologists for ectasia distribution and morphological classification. Research protocol was approved Ethical Review Board committee. Written informed consent was obtained from all the patients. Coronary angiograms were performed by either radial or femoral approach in STEMI patients. Orthogonal views were taken for both the right and left coronary systems.

Coronary artery (CA) ectasia and stenosis were evaluated by visual analysis and counter checked, if needed, by quantitative analysis. Significant coronary artery disease was defined as >50% stenosis for left main stem and >70% stenosis for other coronaries. A narrowing of coronary lumen of >50%, but less than 70% was defined as subcritical coronary artery disease; while stenosis of less than 50% was taken as minor CAD. Coronary Artery Ectasia was defined as a dilatation with a diameter of 1.5 times the adjacent normal coronary artery. Coronary Artery Aneurysm was defined as focal (less than one third of the length of the coronary artery) dilatation with a diameter of 1.5 times the normal adjacent vessel. (Same as Type 4 CAE). Ectasia was divided into four types depending on the length of the involved artery as per Markis classification[4]. Type 1 was defined as diffuse ectasia with aneurysmal lesions in two vessels, type 2 as diffuse ectasia in one vessel and focal in another, type 3 as diffuse ectasia in one vessel only and type 4 as focal ectasia in one vessel only. Morphological classification was either saccular (transverse diameter is greater than the longitudinal dimension) or fusiform (transverse diameter less than the longitudinal dimension).

Demographic information, symptoms and risk factors were also documented. Data recording, storage, assessment and analysis was done by using SPSS software version 21. Continuous variable data was presented in mean and standard deviation. Categorical variable data is presented in frequencies and percentages. Chi-square test was used to find association between ectatic vessel and the diseased vessel on coronary angiogram. A p-value<0.05 was taken as significant.

RESULTS

A total 1354 patients diagnosed with ST-segment elevation myocardial infarction (STEMI) underwent primary percutaneous coronary intervention during the study period from July 2018 to July 2019. Out of 1354 patients, 300 (22.2%) had single vessel coronary artery disease, 262 (19.4%) had double vessel coronary artery

disease and 379 (28.0%) had triple vessel coronary artery disease. In 104 (7.7%) cases coronary angiogram was found to be normal. The prevalence of ectatic cases in our institute during study period was 2.2% as Coronary Artery Ectasia (CAE) was diagnosed in 31 patients, out of which 29 (93.50%) were males and 2 (6.50%) were females. Access site was radial artery in all 31 cases (100%). Twenty one (67.7%) cases were diagnosed as the anterior wall Myacardial infarction whereas 10 (32.3%) as cases of inferior wall Myacardial infarction. Mean age of patients was 58.32 (± 11.22). Door to balloon time (DTBT) for 1354 cases was 47.81 ± 49.02 where as in 31 ectatic cases it was found to be 52.23 ± 32.12. Risk factors, types of diseased vessels and the ectatic vessels (table-I).

Table-I: Baseline characteristics and risk factors of the study population (n=31).

Characteristic	N (%)
Age (mean ± SD)	58.32 ± 11.22
Gender	
Male	29 (93.50)
Female	2 (6.50)
DM	4 (12.9)
HTN	9 (29)
Family History	1 (3.7)
Severity	
NYHA I/ II	12 (38.7)
NYHA III/IV	19 (61.2)
Vessels involved	
LAD	11 (35.6)
LCX	1 (3.2)
LMS	1 (3.2)
RCA	9 (29.4)
Trifurcation branch	2 (6.5)
Others	7 (22.6)
Ectatic Vessel	
LAD	15 (48.8)
RCA	14 (45.2)
Trifurcation branch	2 (6.5)

Left Anterior Descending (LAD) artery was ectatic vessel in majority of our study group i.e., 15 (48.8%) followed by Right Coronary Artery (RCA) i.e., 14 (45.2%).

Chi-square was used to develop the association between Ectatic vessels and vessels labeled as diseased on coronary angiogram. Statistically significant association was found between these two variables whereas the association between ecstatic vessel and gender, classification on basis of shape and types versus type of STEMI was not found as significant. Out of total 9 (25.4%) RCA vessel reported diseased vessel only 2 (14.3%) were found to be ectatic, whereas 11 (35.5%) of LAD vessel reported diseased, only 3 (20.0%) and 2 (100%) of Trifurcation branch were found to be ecstatic.

DISCUSSION

CAE was first described by Bougon in 1812 as a post-mortem finding in a patient who died of symptoms similar to acute coronary syndrome[5]. The prevalence of CAE varies in different studies and populations. In our study group, which consisted of only STEMI patients, 2.2% patients had ectatic coronary arteries. A study carried out by Campanile *et al*[2] showed its prevalence to be 1.7% in acute MI patients. Various other studies have shown a prevalence ranging from 1.4%[6] to 7.4%[7]. CAE can be acquired or congenital and more than 50% of cases are reportedly related to atherosclerosis. Other causes of CAE include vasculitides (Kawasaki disease, Takayasu disease), connective tissue disorders (rheumatoid arthritis), collagenopathies (Marfan's syndrome),

Table-II: Association between ectatic and infarct related artery.

Diseased vessel on coronary angiogram	Ectaticvessels (n=31)				*p*-value
	LAD	RCA	Trifurcation branch	Total	
LAD	3	8	-	11	0.003
RCA	7	2	-	9	
Trifurcation branch	-	-	2	2	
Others	5	4	-	9	
Total	15	14	2	31 (100%)	

iatrogenic cause (coronary interventions), trauma, congenital malformations, infections (syphilis), etc[8]. It is postulated that other factors like high C-Reactive Protein (CRP)[8], reduced vitamin D levels[9], higher uric acid levels[10] elevated insulin-like growth factor I (IGF-I) level, IL-1b, tumor necrosis factor alpha (TNF-α), and interleukin 10 are associated with CAE. Although in literature

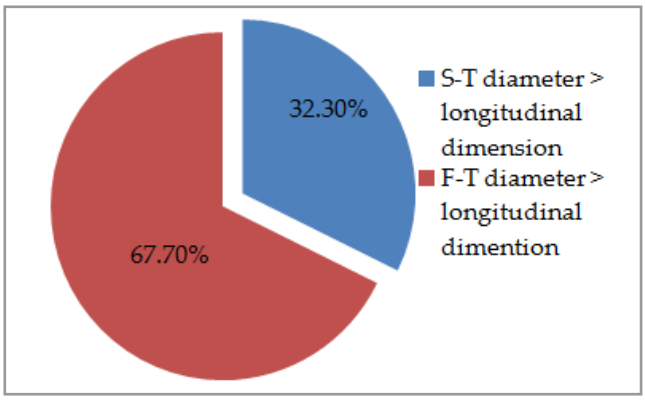

Figure-1: Classification based on shape of the CAE (Coronary A Rtery Ectasia).

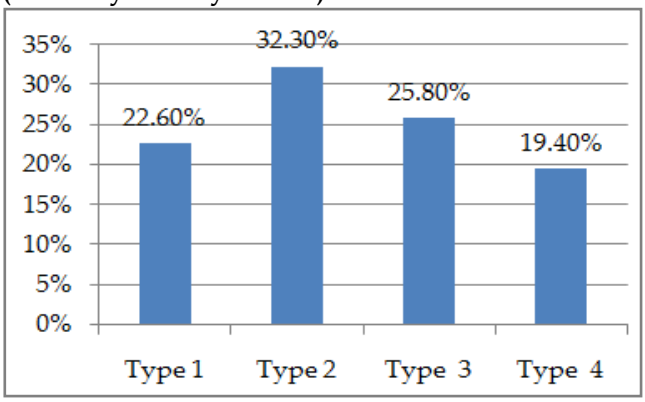

Figure-2: Classification on the basis of vessel involvement.

CAE is commoner in younger adults[11] but in our study group the mean age was 58.32 (± 11.22) probably because our study population consisted ot STEMI patients, which was more common in older adults. It is also more prevalent in men as compared to womevn as shown by our study as well as many international studies. Hypertension was the most common associtaed risk factor in our study population. Other risk factors are smoking and obesity while DM is negatively associated with CAE as shown in literature[1]. CAE often presents as exercise induced angina but its not uncommon to present as Acute Coronary Syndrome (ACS). A study carried out by Endoh *et al* showed 65% had myocardial infarction, 91% had coronary artery disease, and 48% had single-vessel disease[12]. The gold standard for diagnosis is coronary angiography where it is recognized by delayed anterograde contrast filling, local contrast deposition in artery segment (stasis), or segmental back-flow phenomenon.

CAE is associated with significant Coronary Artery Disease (CAD)[1,13]. In our study group all patients with ectasia has CAD and the presentation was acute Myocardial Infarction. Natural history and management of the disease have not been fully understood given the scarcity of the disease. Patients with isolated CAE without significant coronary stenosis can still present with exertional angina, which may be explained by reduced coronary flow reserve and microcirculatory dysfunction in the dilated segment of a coronary artery[14]. Zografos *et al* observed that the topographical extent of ectasia is associated with clinical presentation independent of co-existing CAD. The study also concluded that 'isolated CAE should be considered as suffering conventional CAD[15]. Shahid, Shi-Min and Giannoglou showed that RCA was the commonest ectatic-veseel[1,11] but some studies have also shown LAD to be the commonest artery involved as it was shown in our study group. Diffuse and fusiform morphology was prevalent. Markis *et al* proposed classification of CAE based on the extent of anatomic involvement; type I – diffuse ectasia of two or three vessels, type II – diffuse ectasia in ine vessel and localized in another, type III – diffuse ectasia of one vessel only and type IV – localized or segmental ectasia. Maximum patients had type II CAE in our patients.

The natural history of CAE is yet not very clear and its relationship with atherosclerosis is only modestly established. But it has been showed in many studies that ectasia does not always have a benign course. In the setting of ACS, patients with ectatic vessels have poorer outcome. A study done by Campanile *et al* showed that Primary PCI perforfmed on ectatic

Infarct Related Artery (IRA) was successful in 70.3% of cases and unsuccessful or complicated in 29.7%. Nine patients had a stent thrombosis: 3 acute and 6 sub-acute[16]. Yip *et al* earlier reported the clinical features and outcome of CAE in patients with acute myocardial infarction (AMI) undergoing a primary PCI. In their study, all of the infarct-related arteries (IRAs) were filled with heavy thrombi. The no-reflow phenomenon and distal embolization after primary PCI were found in 62.5% and 70.8% of IRAs, respectively[17]. When co-existing with CAD, the prognosis and treatment of CAE are the same as for CAD alone but the procedural success is low in ectatic vessels.

Controversies remain regarding the definitive treatment plan and prognosis for CAE. Some authors suggest anticoagulant therapy to prevent thrombus formation, but this recommendation has not been supported by clinical trials. Nitrates tend to exacerbate myocardial ischemia due to 'coronary steal phenomenon' and are not recommended. CAE related MI is generally managed as a primary PCI (PPCI), regardless the thrombus burden and reflow outcome. Stenotic lesions adjacent to ectatic arteries can be a challenge for selection of an optimal stent size and adequate apposition. Intracoronary ultrasound may be used to help determine the stent size. Surgical treatment is reserved for those with multi-vessel diffuse ectasia or refractory symptoms despite optimal conservative medical therapy and those with serious adverse events (coronary artery rupture or dissection). Surgical options include aneurysm ligation, aneurysmectomy and coronary artery bypass grafting (CABG).

This study has limitations like a single center study, small sample size and study population was only STEMI patients (which may not be true representation of prevalence of CAE as asymptomatic/angina/NSTEMI patients were not studied. But at the same time we were able to establish the statistically significant association between ectatic artery and culprit artery causing STEMI. Furhter prospective studies with larger sample size are required to elucidate symptomatology and prognosis of CAE which will help us pen down treatment strategies for this rare yet not a benign condition.

CONCLUSION

CAE is a relatively rare but clinically significant condition as shown by this study and literature review. It has even lower prevalence in STEMI patients but it has statistically significant association with culprit artery causing the infarction. Hypertension is a common risk factor. Ectasia has a predilection for both LAD and RCA in our study group.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

REFERENCES

1. Rashid S, Gul U, Ali M, Sadiq T, Mehmood Kiyani A. Coronary Artery Ectasia: Clinical and Angiographic Features. J Coll Physicians Surg Pakistan 2018; 28(11): 824–28.
2. Campanile A, Sozzi FB, Consonni D, Piscione F, Sganzerla P, Indolfi C, et al. Primary PCI for the treatment of ectatic infarct-related coronary artery. Minerva Cardioangiol 2014; 62(4): 327-33.
3. Hartnell GG, Parnell BM, Pridie RB. Coronary artery ectasia. Its prevalence and clinical significance in 4993 patients. Br Heart J 1985; 54(4): 392-95.
4. Markis JE, Joffe CD, Cohn PF, Feen DJ, Herman MV, Gorlin R. Clinical significance of coronary arterial ectasia. Am J Cardiol 1976; 37(2): 217-22.
5. Jarcho S. Bougon on coronary aneurysm (1812). Am J Cardiol 1969; 24(4): 551-53.
6. Díaz-Zamudio M1, Bacilio-Pérez U, Herrera-Zarza MC, Meave-González A, Alexanderson-Rosas E, Zambrana-Balta GF, et al. Coronary artery aneurysms and ectasia: role of coronary CT angiography. Radiographics 2009; 29(7): 1939-54.
7. Farrag A, Faramawy A El, Salem MA, Wahab RA, Ghareeb S. Coronary artery ectasia diagnosed using multidetector computed tomography: Morphology and relation to coronary artery calcification. Int J Cardiovasc Imaging 2013; 29(2): 427-33.
8. Latt H, Aung S, Kyaw K, Seher R. Coronary artery ectasia presenting with acute inferior wall myocardial infarction in a young adult. J Community Hosp Intern Med Perspect 2017; 7(4): 262-64.
9. Cagirci G, Kucukseymen S, Yuksel IO, Bayar N, Koklu E, Guven R, et al. The Relationship between vitamin D and coronary artery ectasia in subjects with a normal C-Reactive protein level. Korean Circ J 2017; 47(2): 231.
10. Demir Ş, Karakoyun G, Kanadasi M. Elevated high sensitivity C-reactive protein and uric acid levels in coronary artery ectasia. Acta Biochim Pol 2014; 61(4): 687-91.
11. Giannoglou GD, Antoniadis AP, Chatzizisis YS, Damvopoulou E, Parcharidis GE, Louridas GE. Prevalence of ectasia in human coronary arteries in patients in northern greece referred for coronary angiography. Am J Cardiol 2006; 98(3): 314-8.
12. Endoh S, Andoh H, Sonoyama K, Furuse Y, Ohtahara A, Kasahara T. Clinical features of coronary artery ectasia. J Cardiol 2004; 43(2): 45-52.

13. Yilmaz H, Sayar N, Yilmaz M, Tangürek B, Cakmak N, Gürkan U, et al. Coronary artery ectasia: Clinical and angiographical evaluation. Turk Kardiyol Dern Ars 2008; 36(8): 530-5.
14. Akyürek Ö, Berkalp B, Sayın T, Kumbasar D, Kervancıoğlu C, Oral D. Altered coronary flow properties in diffuse coronary artery ectasia. Am Heart J 2003; 145(1): 66-72.
15. Zografos TA, Korovesis S, Giazitzoglou E, Kokladi M, Venetsanakos I, Paxinos G, et al. Clinical and angiographic characteristics of patients with coronary artery ectasia. Int J Cardiol 2013; 167(4): 1536–41.
16. Campanile A, Sozzi FB, Consonni D, Piscione F, Sganzerla P, Indolfi C. Primary PCI for the treatment of ectatic infarct-related coronary artery. Minerva Cardioangiol 2014; 62(4): 327-33.
17. Yip HK, Chen MC, Wu CJ, Hang CL, Hsieh KYK, Fang CY, et al. Clinical features and outcome of coronary artery aneurysm in patients with acute myocardial infarction undergoing a primary percutaneous coronary intervention. Cardiol 2002; 98(3): 132–40.
18. Tomioka T, Takeuchi S, Yoshitaka B, Shioiri HD, Koyama J, Inoue K. Recurrent acute myocardial infarction in a patient with severe coronary artery ectasia: implication of antithrombotic therapy. Am J Case Rep 2016; 17(6): 939–43.