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Coronary Angiography Profile in Young Adults with Acute Coronary Syndrome: A Retrospective Study

Dr Amjad Ali *

Corresponding Author: Dr Amjad Ali, Chief Intervention Cardiologist, Baderia Metroprime Hospital Jabalpur India.

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Abstract

Objective: *To study the angiographic profile of young adults (≤40 years) with the acute coronary syndrome (ACS)*

Methods: *In this retrospective study, data of young adults aged ≤40 years with ACS from a single center in central India was analyzed.*

Results: *In total, 95 patients included in the analysis. The mean age was 36.2±4.0 years and 93.7% of patients were males. On coronary angiography, single-vessel disease (58.9%) was the most common finding, followed by double and triple vessel disease (16.8% and 9.5% respectively). Non-obstructive disease was seen in 9.5% of patients. Among coronaries, left anterior descending (LAD) (66.3%) was the most involved artery followed by the right coronary artery (RCA) (31.6%) and left circumflex (LCX) artery (24.2%). 6.3% of patients had left main involvement. Lesion site was proximal in the majority of the vessels involved (42.9% in LAD, 20% in RCA and 39.1% in LCX). More younger patients had a non-obstructive or single-vessel disease. Recanalization was seen in 21.2% of patients.*

Conclusion: *In younger adults with ACS, a single-vessel disease with the involvement of LAD is the most common angiographic finding. The non-obstructive disease is not uncommon and therefore, young adults with ACS should undergo angiographic assessment.*

Keywords: *Acute coronary syndrome, Myocardial infarction, Age, Coronary angiography, India*

Introduction

Worldwide, coronary heart disease is the leading cause of morbidity and mortality both in developing as well as developed countries and is responsible for one-third or more of all deaths in persons above 35 years of age **[**1**]**. Young patients with acute myocardial infarction (MI) are a specific subset of a population with different risk factor profiles, etiologies, clinical presentation and prognosis as compared to older acute MI patients. The term 'Young' varies from <45 years to < 55 years in terms of MI as there is no universally acceptable definition of young with respect to coronary artery disease (CAD) **[**2**]**. Acute MI in the young can lead to death and disability in the prime of life with devastating consequences for the patients and their families **[**3**]**. Although the incidence of acute coronary events and hospitalization has a declining trend in older populations, younger patients who present with acute MI have not had similar declines **[**4**]**.

The number of patients having premature MI is not insignificant. The INTERHEART study confirmed the early age of onset of incident myocardial infarction among patients from South Asia. The median age of myocardial infarction in South Asians was 52 years in comparison with 62 years of European origin **[**5**]**. About 5%–10% of heart attacks occur in Indian men and women younger than 40 years **[**6**]**. Analysis of INTERHEART data revealed an acute MI prevalence of 11.7% in India in patients aged below 40 years **[**7**]**. The incidence of CAD is likely to increase further because of ever-increasing risk factors- lifestyle changes, physical inactivity, smoking, drug, and alcohol intake, as well as an increase in the prevalence of diabetes, hypertension and obesity **[**8**]**.

There are unique etiologies that must be considered in the evaluation of these patients. Atheromatous CAD in the young is related to conventional risk factors. Non-atherosclerotic causes of acute MI in the young include coronary artery dissection, coronary artery trauma, congenital coronary anomalies, inflamma¬tory diseases, metabolic or pro¬liferative diseases and hypercoagulable states. Acute MI in the young is also related to substance abuse- especially cocaine **[**9**]**. Acute MI in young patients is an important clinical entity because of the associated risk of mortality and long-term morbidity. Though the general perception is that prognosis for these young patients with acute MI is good, the 15 years mortality could be as high as 30% among those having diabetes and poor left ventricular ejection fraction (LVEF) **[**10**]**. Also, young patients with first-time MI have a two-fold increase in long-term mortality (1 to 10 years after first MI) relative to the general population. **[**11-13**]**

Coronary angiography studies performed in young acute MI patients have shown comparatively higher rates of normal coronary arteries. The younger age group may represent the natural progression of the disease, which is extraluminal in the initial stages, as the vessel wall initially compensates to maintain

unrestricted luminal blood flow [14]. Mild luminal irregularities and nonobstructive coronary lesions are also observed frequently. The single-vessel disease is common in young patients as compared to older counterparts [15-17]. The present study was conducted to evaluate coronary angiographic characteristics in young adults aged 40 years or lower who presented with first acute MI as limited literature is available for this important clinical entity in the Central Indian population.

Materials and Methods

Study design and setting

This study was a single-center, retrospective, and observational study conducted at a private, tertiary-level Cardiology unit in central India. The center provides expert Cardiology services to urban, semi-urban and rural populations. The study was conducted according to the principles of the Declaration of Helsinki and good clinical practice recommendations as well as by the applicable local regulatory guidelines.

Study population

We included young patients aged 40 years or lower who were underwent coronary angiography for the acute coronary syndrome (ACS).

Data collection

Data on demographic, clinical diagnosis and angiographic profile was captured from the database. Patients were categorized into different ACS diagnoses as per standard criteria. All patients were subjected to complete hematological and biochemical investigations including troponin-T and electrocardiogram for the evaluation of ACS.

Angiographic profile

Coronary angiography (CAG) was performed through a standard radial artery approach. Angiograms were interpreted by a single, experienced interventional cardiologist. Stenosis of the vessels was defined as a diameter reduction of >50%. Based on the number of vessels affected, the patients were classified as having the single-vessel disease (SVD), double vessel disease (DVD), triple vessel disease (TVD), and left main coronary artery disease. Further management of patients was done as per

atherosclerotic lesions. All other lesions not amounting to the above-mentioned severity were grouped together as nonobstructive disease.

Statistical analysis

Data from patient files were entered into the Microsoft Excel sheet and were analyzed with the same. Categorical data presented with numbers and percentages. Continuous variables expressed as mean ± standard deviation (SD). Chi-square test was applied to test the statistical significance in categorical variables. P-value <0.05 was considered statistically significant.

Results

We identified 95 patients who were ≤40 years and had undergone CAG between January 2020 to December 2020. Baseline characteristics are shown in Table 1. The mean age was 36.2±4.0 years and it ranged from 25 to 40 years. The majority of them were in the age group of 36 to 40 years. By gender, 89 (93.7%) were males and 6 (6.3%) were females. Anterior wall MI (60 **[**63.2%**]**) was the most common clinical diagnosis followed by inferior wall MI (27 **[**28.4%**]**).

Parameters	**Observation**
Age (years)	
Mean±SD	36.2±4.0
Range	25 to 40
Age groups	
25 to 30	13 (13.7)
31 to 35	23 (24.2)
36 to 40	59 (62.1)
Gender	
Male	89 (93.7)
Female	6 (6.3)
Diagnosis	
Anterior wall MI	60 (63.2)
Inferior wall MI	27 (28.4)
Inferolateral wall MI	3 (3.2)
Posterolateral wall MI	2 (2.1)
Unstable angina	3 (3.2)

Table 1: Baseline characteristics

Table 2 shows the angiographic profile of young adults. Overall, left anterior descending (LAD) artery (63 [66.3%]) was most involved coronary followed by right coronary artery (RCA - 30 [31.6%]) and left circumflex (LCX – 23 [24.2%]). Fifty-six (58.9%) patients had single-vessel disease (SVD). In SVD, involvement of LAD was the most common (39 [69.6%]). Double vessel disease (DVD) was present in 16 (16.8%) patients of which LAD and RCA involvement most common (8 [50%]). Triple vessel disease with involvement of LAD, RCA and LCX was seen in 9 (9.5%) patients. Fourteen (14.7%) had a non-obstructive disease. The rate of recanalization was 21.2% (Figure 1). Coronary dissection was observed in four, two and one patient with LAD, RCA and LCX involvement respectively.

Vessel involvement	**Observation**
Overall coronaries involvement	
LAD	63 (66.3)
LCx	23 (24.2)
RCA	30 (31.6)
Number of vessels	
Single-vessel disease	56 (58.9)
LAD only	39 (69.6)
RCA only	11 (19.6)
LCX only	6 (10.7)
Double-vessel disease	16 (16.8)
LAD + RCA	8 (50.0)
LAD + LCX	6 (37.5)
RCA + LCX	2 (12.5)
Triple vessel disease	9 (9.5)
Non-obstructive disease	14 (14.7)

Table 2: Angiographic profile

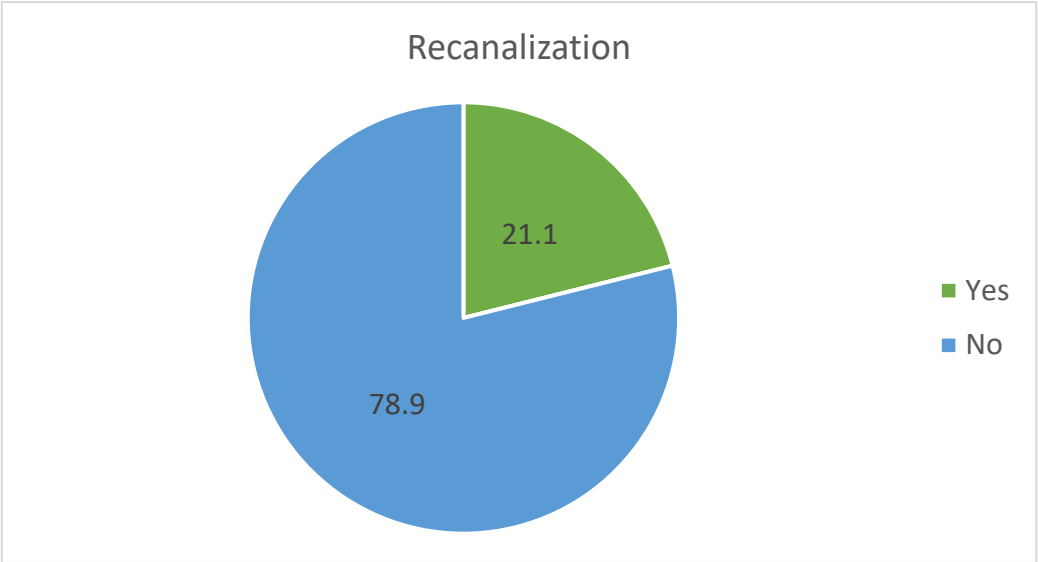

Figure 1: Rate of vessel recanalization

Table 3 depicts the lesion sites in coronaries involved. In LAD involvement, lesion site was proximal, mid, and ostial in 27 (42.9%), 19 (30.2%), and 17 (27%) patients respectively. In RCA involvement, an equal proportion of patients (9 **[**30%**]**) had proximal, mid, and distal sites whereas diffuse RCA involvement was seen in three (10%) patients. With LCX, proximal involvement was most common (9 **[**39.1%**]**) followed by distal (26.1%), ostial (8.6%), and major obtuse major (OM) (8.6%).

Coronary lesion site	**Observation**
LAD	
Ostial	17 (27.0)
Osteo-proximal	1 (1.6)
Osteal + diffuse	1 (1.6)
Proximal	27 (42.9)
Mid	19 (30.2)
RCA	
Ostial	2 (6.7)
Proximal	6 (20.0)
Mid	9 (30.0)
Distal	9 (30.0)
Diffuse	3 (10.0)
PDA	1 (3.3)
LCX	

Ostial	2 (8.6)
Osteo-proximal	1 (4.3)
Ostial + diffuse	1 (4.3)
Major OM	2 (8.6)
Proximal	9 (39.1)
Mid	1 (4.3)
Distal	6 (26.1)
Diffuse	1 (4.3)

Table 3: Lesion site in the culprit coronaries

Association of CAG profile with age and gender is shown in Table 4. Patients in the age group of 25 to 30 years had the only non-obstructive disease (3 **[**23.1%**]**) and SVD (10 **[**76.9%**]**). A similar pattern was seen in those aged 31 to 35 years (3 **[**13%**]** and 19 **[**82.6%**]** respectively) with only one patient having TVD. Among patients aged 36 to 40 years, SVD (8 **[**61.8%**]**) was most common followed by DVD (14 **[**15.7%**]**) and non-obstructive disease (12 **[**13.5%**]**). Only 8 (9%) patients had TVD. This distribution was statistically significant. Among males and females, there was no significant difference in the distribution of coronary disease (p=0.185).

Coronary disease	**Age group**			**Gender**	
	25 to 30 (n=13)	31 to 35 (n=23)	36 to 40 (n=59)	Male (n=89)	Female (n=6)
Non-obstructive (n=14)	3 (23.1)	3 (13.0)	8 (13.6)	12 (13.5)	2 (33.3)
SVD (n=56)	10 (76.9)	19 (82.6)	27 (45.8)	55 (61.8)	1 (16.7)
DVD (n=16)	0	0	16 (27.1)	14 (15.7)	2 (33.3)
TVD (n=9)	0	1 (4.3)	8 (13.6)	8 (9.0)	1 (16.7)
P value	0.006			0.185	

Table 4: Association of vessels involved with age and gender

Study (year)	Bhardwaj et al. (n=124) [23]	Prakash et al. (n=117) [22]	Batra et al.(n=50) [25]	Maroszyńska-Dmoch et al. (n=239) [26]	Prajapati et al.(n=109) [27]	Our study (n=95)
Defining age	<40 years	<40 years	<40 years	<40 years	<40 years	<40 years
Number of vessels						
SVD	51.35%	55.5%	62.0%	61.9%	52.3%	58.9%
DVD	27.3%	11.96%	26.0%	34.7%	13.8%	16.8%
TVD	6.3%	3.41%	12.0%		5.5%	9.5%
Non-obstructive disease	10.4%	21.3%	-	37.2%	4.6%	14.7%
Coronary involved						
LAD	62.4%	51.3%	68.0%	61.6%	58.7%	66.3%
RCA	20.0%	44.4%	22.0%	27.4%	21.1%	31.6%
LCX	17.6%	35.0%	10.0%	11.0%	18.3%	24.2%
Left main	0.9%	0.8%	-	3.4%	1.8%	6.3%

Table 5: Angiographic profile of coronary artery disease among young adults in different studies

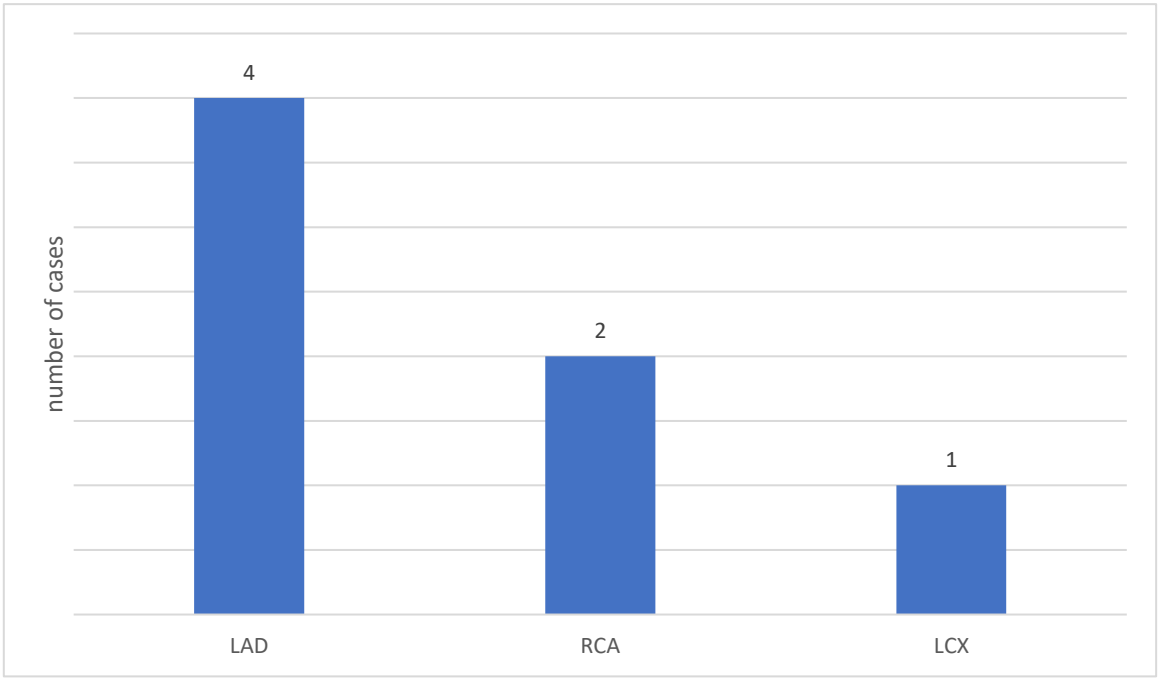

Figure 2: Distribution of coronaries dissection observed on angiography

Discussion

Indian population is at higher risk of CAD than people living in America, China, and Japan [18]. INTERHEART data in South Asians showed an MI prevalence of 11.7% in patients aged <40 years [7]. In young MI, the in-hospital mortality rate is reported to be over 30% [19]. In this population, both obstructive and non-obstructive CAD is common. Non-obstructive CAD is more common in younger adults that necessitate an assessment of such patients angiographically [20]. In our observation of 95 cases, the mean age was 36.2±4.0 years. Deora et al. in their study, observed mean age of 35±18.6 years among young STEMI patients [21]. Young CAD is observed mainly in males. However, we observed six (6.3%) females with young CAD. Prakash and colleagues reported 18.8% of females below <40 years having CAD [22]. Bhardwaj et al. observed it almost exclusively in males [23]. This is because of the protective effect of estrogen. Young women with endogenous estrogen deficiency have a more than sevenfold increased risk of CAD [24].

Angiographically, SVD was the most common finding with LAD being the most common coronary involved. A similar angiographic profile has been reported in multiple studies [22,23, 25-27]. The prevalence of the different coronary diseases in young adults in different studies is shown in Table 5. Single vessel disease was more common in younger ages whereas DVD and TVD were more common in patients aged >35 years. Similar results reported by Chhabra and colleagues. Among patients aged <30 years and >30 years, they observed SVD in 45.6% and 33.9% of patients respectively whereas DVD (12.2% vs. 16.4%) and TVD (0.87% vs. 27.8%) were more frequent in those aged >30 years [28]. Such distribution of vessel involvement is also observed with age increase. Therefore, younger patients are likely to have a lesser number of vessels involved and non-obstructive disease is more common.

In our study, the non-obstructive disease was observed in 14.7% of adults. This is comparatively higher to 4.6% reported by Prajapati et al. [27] but is lower than 21.3% as identified by Prakash et al. [22] More younger patients had the non-obstructive disease. The non-obstructive disease showed slight preponderance in females than males. The VIRGO study involving patients with MI with nonobstructive coronary arteries (MINOCA) five-times higher odds in women than men [29]. In all the coronaries, a proximal lesion site was common. A study from Colkesen et al. reported similar findings with proximal lesion location in 62% of patients followed by mid (28%) and distal location (10%) [30]. Recanalized vessels were observed in 21.1% of patients. This is similar to the observation of Prajapati et al. who reported recanalized single vessel in 21.2% of patients [27]. Coronary dissection is another important cause of MI in young adults. We observed dissection in four (4.2%) patients.

Nearly 10% of young adults with non-plaque etiology may have spontaneous coronary dissection. It is reported to be more common in younger women [31].

Though the study brings out significant findings in young adults with ACS, there are certain limitations in our study. We did not assess the risk factors in the patient population. These would provide which risk factors contribute more strongly to the development of ACS. Further, considering the detailed lesion characteristics might provide greater insight in the disease in such populations.

Conclusion

In young patients with myocardial infarction, the single-vessel disease is a more commonly observed angiographic finding though more than one vessel involvement is not uncommon. LAD remains the most involved vessel. The non-obstructive disease is more common which is common in more younger and female patients. Coronary dissection is also observed in young adults which could be the cause of MI in such patients. Our results match with previously reported literature. Further studies are necessary to determine the long-term outcome of these patients from the Central Indian region.

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