Original Article

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Internal Medicine Section

Evaluation of Risk Factors, Clinical and Angiographic Profile of Young Patients with Acute Coronary Syndrome: An Observational Study

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ABSTRACT

Introduction: The incidence of Acute Coronary Syndrome (ACS) in the young population has begun to rise. There is not enough data regarding the characteristics of young patients with ACS.

Aim: To evaluate risk factors, clinical and angiographic profile of young patients with ACS.

Materials and Methods: A prospective observational study was conducted from December 2017 to December 2020 at SSWH, Burdwan Medical College and Hospital, Burdwan, West Bengal, Kolkata, India among 100 patients. Patients with ACS and aged ≤45 years were enrolled in the study. Patients were divided into two groups: patients with and without obstructive Coronary Artery Disease (CAD). Clinical parameters and coronary angiography data were collected and analysed. The p-value <0.05 was considered significant.

Results: The mean age of the study participants was 37.42±5.18 years, and 82 (82%) participants were male. Smoking was the most common risk factor observed in 71 (71%) of the study population, and the majority of these patients had obstructive CAD. The young population suffered more with a high incidence of ST-segment Elevation Myocardial Infarction (STEMI), with 37 (56.06%) had Anterior Wall Myocardial Infarction (AWMI). When analysed angiographically, Obstructive CAD was most commonly found 82 (82%); among those with obstructive CAD, Single-vessel diseases were predominant in 47 (47%) individuals. The percentage of stable angina was significantly higher among patients with obstructive CAD (53.6%) compared to non obstructive CAD (11.1%), (p=0.001).

Conclusion: Two leading risk factors, smoking, and tobacco, were significantly associated with the onset of young ACS. The prevalence of single-vessel disease was higher in young patients with ACS compared to double and triple-vessel disease.

Keywords: Coronary artery disease, Left ventricular dysfunction, Smoking, Young adult

INTRODUCTION

The Acute Coronary Syndrome (ACS) is a clinical spectrum of ischaemic heart disease, ranging from unstable angina, ST-segment Elevation Myocardial Infarction (STEMI), and non ST Segment Elevation Myocardial Infarction (NSTEMI) [1]. ACS is a major health problem for a large proportion, which increase in the total number of hospitalisations and mortality all over the world. Although the characteristics and clinical course of this disease in older age groups have been reported, clinical practice guidelines contain a section devoted specifically to older patients. Younger patients have rarely been studied. The incidence of ACS among young adults is on the rise globally [2]. In the Global Registry of Acute Coronary Events (GRACE) study, the prevalence of young ACS was 6.3% [2].

Younger populations are more likely to have a history of smoking, dyslipidemia, and a family history of ACS [3]. The proportion of females with ACS is significantly lower than males, which may be related to a lower incidence of smoking/tobacco use in this subgroup [3]. Limited data is available about the risk factors among young patients with ACS. Also, a higher incidence of STEMI is observed compared to NSTEMI among the young population [3]. An elevation in the rate of ACS among young patients aged ≤40 years is noted, and thus there is a requirement for a study to fill the knowledge gap by evaluating the clinical and angiographic profile of this population. The purpose of present study was to evaluate the risk factors, and clinical and angiographic profile in young patients with ACS.

MATERIALS AND METHODS

This prospective observational study was conducted from December 2017 to December 2020 at SSWH, Burdwan Medical College and Hospital, Burdwan, West Bengal, Kolkata, India. The study was conducted after obtaining permission from the Ethics Committee, and the letter number was BMC/1406.

Inclusion and Exclusion criteria: All patients who were ≤45 years of age with ACS and underwent angiography were included in the study. Patients with congenital heart disease, rheumatic heart disease, and cardiovascular diseases resembling ACS, like pericarditis, myocarditis, and aortic dissection, were excluded from the study. Also, patients who underwent angiography for stable angina, Myocardial Infarction (MI) associated with Percutaneous Coronary Intervention (PCI), stent thrombosis, and Coronary Artery Bypass Grafting (CABG) were excluded from the study.

Sample size calculation: A total of 100 patients were enrolled in present study. The sample size was calculated based on the given formula:

$$n' = n / \left(1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2 N}\right)$$

Where,

Z is the z score

ε is the margin of error

$\hat{p}$ is the population proportion

N is the population size

Level of confidence 95%, Margin of error 10%, Population proportion 50%; the calculated sample size was 97, which was rounded off to 100.

Study Procedure

Detailed history, along with a complete physical examination and biochemical investigation, was recorded for the study population. Enrolled patients underwent coronary angiography. Biochemical investigation like lipid tests, glucose tests, and thyroid tests, was done whereas blood pressure was also performed. After proper diagnosis, patients were treated according to standard national guidelines. Young patients with ACS were divided into two groups according to coronary angiography findings: patients with and without obstructive CAD. Left ventricular systolic function assessment was done using a Phillips echocardiography machine in 2D mode, M-mode, colour flow, and Doppler. Based on this assessment, patients were categorised as having mild, moderate, or severe LV dysfunction. Outcomes in terms of mortality were observed during hospitalisation, and patients were followed-up until discharge. Also, certain complications like heart failure, shock, arrhythmia, and ventricular septal rupture were noted, and these complications were managed through medicines, CABG, Percutneous Coronary Intervention (PCI), and ventricular septal rupture closure.

STATISTICAL ANALYSIS

The statistical software Stastistical Packages for Social Sciences (SPSS) version 20.0 was used for the analysis of data. The data were expressed in numbers, percentages, and mean±Standard Deviation (SD). The p-value and relative risk were used to determine the correlation between various variables in patients with obstructive and non obstructive CAD using a two-tailed student t-test and Chi-square/Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 100 patients aged ≤45 years, presenting with ACS, were included in the study. The predominance of male gender was observed in the present study, with 82 patients (82%). The mean age of the population in the study was 37.42±5.18 years, with the youngest being 19 years of age. The most common risk factor in present population was smoking, with 71 patients (71%) reporting this habit. Among the population, 46 patients (46%) had a history of stable angina. Dyslipidemia was observed in 44% of the patients, while 41 patients (41%) were hypertensive. Diabetes was slightly higher compared to hypertension, in enrolled patients (43%) having diabetes. Only 1% of the population had vasculitis and polycythemia. From the current data, 13 patients (13%) had hypothyroidism [Table/Fig-1].

Among young patients with obstructive CAD, the rate of single-vessel disease was high at 47 patients (47%), followed by double-vessel disease at 17 patients (17%). However, 2% of the population were found to have isolated Left Main Coronary Artery (LMCA). The coronary angiographic profiles are summarised in [Table/Fig-2]. Younger patients suffered more from STEMI, with the incidence of Anterior Wall Myocardial Infarction (AWMI) at 56.06% of STEMI. Among young patients with ACS, the rate of NSTEMI and unstable angina were 17 patients (17%) each. Most of the patients in the study had mild LV dysfunction (40%), 29 patients (29%) had moderate LV dysfunction, and 6 patients (6%) had severe LV dysfunction [Table/Fig-3].

Variables	n (%)
Age (Mean±SD, years)	37.42±5.18
Male	82 (82)
BMI (Mean±SD, Kg/m^2)	22.98±3.14
Risk factors	
Family history of premature CAD	23 (23)
Smoking habits	71 (71)
Tobacco	47 (47)
Hypertension	41 (41)
Diabetes	43 (43)
Hypothyroid	13 (13)
Dyslipidemia	44 (44)
History of stable angina	46 (46)
Vasculitis	1 (1)
Polycythemia	1 (1)

[Table/Fig-1]: Demographic characteristics and coronary risk factors among young population with ACS.
BMI: Body mass index; CAD: Coronary artery disease

	Lesion location	n (%)	Percentage (%)
Non obstructive CAD	Normal coronary	1 (1)	18%
	Minor CAD	4 (4)	
	Recanalised vessel	13 (13)	
Obstructive CAD	Single vessel disease	47 (47)	82%
	Double vessel disease	17 (17)	
	Triple vessel disease	10 (10)	
	Isolated LMCA	2 (2)	
	MVCAD+LMCA	6 (6)	

[Table/Fig-2]: Coronary angiographic profile among young patients with ACS.
CAD: Coronary artery disease; LMCA: Left main coronary artery; LV: Left ventricular; NSTEMI: Non ST segment elevation myocardial infarction; MVCAD: Multivessel coronary artery disease; STEMI: ST segment elevation myocardial infarction

Variables	n (%)	
NSTEMI	17 (17)	
Unstable angina	17 (17)	
STEMI	66 (66)	AWMI 37 (56.06%)
		IWMI 29 (43.9%)
LV systolic function		
Variables	**n (%)**	
Normal	25 (25)	
Mild LV dysfunction	40 (40)	
Moderate LV dysfunction	29 (29)	
Severe LV dysfunction	6 (6)	

[Table/Fig-3]: Clinical and echocardiographic profile.
AWMI: Anterior wall myocardial infarction; IWMI: Inferior wall myocardial infarction; NSTEMI: Non-ST segment elevation myocardial infarction; STEMI: ST segment elevation myocardial infarction

In present study, the mean syntax score was 15.6±8.78. Among the population, 21 patients (21%) had received medical management, and 55 patients (55%) had undergone PCI. In the present study, 53 patients (94.64%) had TIMI 3 flow, signifying full perfusion with normal blood flow. Only 1 patient (1.76%) had TIMI 1 flow. The percentage of mortality in the hospital was 4 patients (4%), and 96 patients (96%) were discharged. Most of the patients recovered well without complications (58%), but 28 patients (28%) had developed Left Ventricular Ejection Fraction (LVEF) [Table/Fig-4].

Variables	n (%)
Syntax score (Mean±SD)	15.6±8.78
Management	
Medical management	21 (21)
CABG referral	23 (23)
PCI	55 (55)
PCI+Ventricular septal rupture closure	1 (1)
TIMI flow after PCI	
TIMI 1	1 (1.76)
TIMI 2	2 (3.57)
TIMI 3	53 (94.64)
Outcome	
In hospital mortality	4 (4)
Discharge	96 (96)

Complication encountered	
No complication	58 (58)
Heart failure	23 (23)
Shock	4 (4)
Shock+Heart failure	6 (6)
Arrythmia	6 (6)
Arrythmia+Shock+Heart failure	2 (2)
Shock+Heart failure+Ventricular septal rupture	1 (1)

[Table/Fig-4]: Management and outcome in young patients with ACS.
CABG: Coronary artery bypass graft; PCI: Percutaneous coronary intervention; TIMI: Thrombolysis in myocardial infarction

On comparing risk factors among young patients with ACS based on obstructive and non obstructive CAD, the group with obstructive CAD had a higher number of patients with a history of stable angina (44 patients, 53.6%), and the age was higher in present group, which was statistically significant (p=0.001). Smoking, tobacco use, dyslipidemia, hypertension, diabetes, and hypothyroidism were highly associated with obstructive CAD, though not statistically significant. The clinical and laboratory characteristics of patients with or without obstructive CAD has been depicted in [Table/Fig-5].

Parameters	Obstructive CAD (n=82 patients)	Non obstructive CAD (n=18 patients)	Relative risk	p-value
Age (Mean±SD, years)	38.12±4.48	34.22±6.9	-	<0.001
Male	66 (80.4)	16 (88.8)	0.91	0.515
BMI (Mean±SD, kg/m^2)	23.14±3.11	22.55±3.12		0.2302
Family history of premature CAD	20 (24.3)	3 (16.6)	1.08	0.75
Smoking	57 (69.5)	14 (77.7)	0.93	0.57
Tobacco	42 (51.3)	5 (27.7)	1.18	0.116
Hypertension	37 (45.1)	4 (22.2)	1.18	0.113
Diabetes mellitus	40 (48.7)	3 (16.6)	1.26	0.0170
Hypothyroid	13 (15.8)	0 (0)	1.26	0.117
Dyslipidemia	40 (48.7)	4 (22.2)	1.21	0.0646
History of stable angina	44 (53.6)	2 (11.1)	1.36	0.0012

[Table/Fig-5]: Clinical and laboratory characteristics of patients with and without obstructive coronary disease.
BMI: Body mass index; CAD: Coronary artery disease

DISCUSSION

The present study evaluated the risk factors and clinical and angiographical profile of young patients with ACS. The majority of the patients were male (82%). Similar observations were made in studies by Avezum A et al., and Wadkar A et al., which found that 93% were male [2,4]. In the Framingham Heart Study, only 5-10% of the population were young females with ACS [5]. It has been shown that in females, oestrogen plays a major role in delaying the progression of atherosclerosis. Oestrogen may have protective effects on the cardiovascular system, including modification of the composition of circulating lipoproteins, such as decreased Low-Density Lipoprotein-Cholesterol (LDL-C), increased High-Density Lipoprotein-Cholesterol (HDL-C), and decreased insulin resistance [6]. Cigarette smoking accelerates the development of CAD with increased thrombus formation, which may contribute to the onset of ACS at an earlier age [7]. Among the risk factors, the incidence of smoking was quite high in the present study (71%). A similar observation was made by Hbejan K et al., in a study, which reported a very high incidence of smoking (60%-95%) [8]. Hypertension is also a well known risk factor for CAD but appears to be less important in the young population compared to older patients. A study by Schoenenberger AW et al., reported that only 17.8% of young patients were hypertensive [9]. Similarly, in the study by Puricel S et al., 15% of young patients were hypertensive [10]. However, the results of present study did not match with the abovementioned studies as 41% of young patients were hypertensive in the present study. A comparison of hypertension in various studies among young patients with ACS has been done in [Table/Fig-6] [9,10].

According to Wolfe CMW and Vacek JL, there was a significantly lower incidence of diabetes mellitus in young patients with ACS [11]. A study performed by Esteban MR et al., reported that 14.6% of diabetic patients have ACS at a young age [12]. However, 43% of the population had diabetes mellitus in the present study, which is inconsistent with other studies. Schoenenberger AW et al., in a study observed a small proportion of diabetes (6.3%) in young patients with ACS [9]. A comparison of diabetes in various studies among young patients with ACS has been done in [Table/Fig-7] [9,12].

Among the population, 44% of patients had dyslipidemia. This parallels the findings of various studies that have reported a higher incidence of dyslipidemia in young patients with ACS [13,14]. It has also been reported that the basic dyslipidemia pattern in young patients includes a high triglyceride level and a low HDL-C level. Young patients had a higher prevalence of modifiable risk factors. This finding is similar to the clinical characteristics and cardiovascular outcomes among young patients with acute myocardial infarction in Kerala, India [15].

Among patients with abnormal coronary angiography in the present study population, single-vessel disease was most prevalent (47%), which is consistent with most previously published studies. A study

S. No.	Author name and year	No. of subjects	Objectives	Parameters	Conclusion
1	Present study	100	To evaluate the risk factors, clinical and angiographic profile in young patients with ACS.	Total 41% among all were hypertensive in the present study	Two leading risk factors: smoking and tobacco had been shown to be significantly associated with the onset of young patients with ACS.
2	Schoenenberger AW et al., [9] (2011)	28,778	To evaluate the clinical presentation, treatment and outcome of young patients who were admitted with ACS.	Total 17% of young patients were hypertensive	Young patients with ACS differ from older patients in their clinical treatment and outcome.
3	Puricel S et al., [10] (2013)	27	To investigate the incidence, and long-term clinical outcome of ACS in young patients.	15% among all were hypertensive	The ACS in young patients is an uncommon condition with a variety of possible aetiologies and distinct risk factors. In hospital and 5 years clinical outcome is satisfactory.

[Table/Fig-6]: Comparison of hypertension in various studies among young patients with ACS [9,10].

S. No.	Author name and year	No. of subjects	Objectives	Parameters	Conclusion
1	Present study	100	To evaluate the risk factors, clinical and angiographic profile in young patients with ACS.	Total 43% of the population was diabetic	Two leading risk factors: smoking and tobacco had been shown to be significantly associated with the onset of young patients with ACS.
2	Schoenenberger AW et al., [9] (2011)	28,778	To evaluate the clinical presentation, treatment and outcome of young patients who were admitted with ACS.	Total 6.3% of young patients were diabetic	Young patients with ACS differ from older patients in their clinical treatment and outcome.
3	Esteban MR et al., [12] (2014)	123 cases 369 controls	To determine the risk factors, clinical and prognostic characteristics in young patients.	Total 14.6% of patients were diabetic	The ACS in people younger than 40 years is associated with diabetes and unhealthy lifestyle smoking. The readmission rate is high and readmission is associated with smoking and decreased ejection fraction.

[Table/Fig-7]: Comparison of diabetes in various studies among young patients with ACS [9,12].

done by Cole JH et al., shows that 58% of young patients with ACS had single-vessel disease [16]. Esteban MR et al., in their study reported 44.7% of patients with single-vessel disease [12]. In the present study, most of the patients presented with STEMI (66%). A similar finding was noticed in a study conducted by Narayanaswami A et al., [17]. More than half, i.e., 59.3% of the patients were diagnosed with STEMI in a study by Esteban MR et al., [12]. Studies comparing STEMI among patients with ACS have been given in [Table/Fig-8] [9,12].

S. No.	Author name and year	No. of subjects	Objectives	Parameters	Conclusion
1	Present study	100	To evaluate the risk factors, clinical and angiographic profile in young patients with ACS.	Total 66% of the patients were presented with STEMI	Two leading risk factors: smoking and tobacco had been shown to be significantly associated with the onset of young patients with ACS.
2	Schoenenberger AW et al., [9] (2011)	28,778	To evaluate the clinical presentation, treatment and outcome of young patients who were admitted with ACS.	Total 71% patients presented with STEMI	Young patients offer present with STEMI receive early aggressive treatments, and have a favorable outcome.
3	Esteban MR et al., [12] (2014)	123 cases 369 control	To determine the risk factors, clinical and prognostic characteristics in young patients.	Total 59.3% patients were diagnosed with STEMI	ACS in people younger than 40 years is associated with diabetes and unhealthy lifestyle smoking. The readmission rate is high and readmission is associated with smoking and decreased ejection fraction.

[Table/Fig-8]: Studies comparing STEMI among patients with ACS [9,12].

According to angiographic results, 82% of patients had obstructive CAD, and 18% of them had non obstructive CAD. Similar results were found by Jha R et al., in their study [18]. Anh DT et al., in their study, stated that smoking was a risk factor for obstructive CAD in young patients [19]. In the present study, 69.5% of patients who had obstructive CAD had a history of smoking, which is not significant in present study (p=0.57).

Limitation(s)

The present was an observational study that did not include any control group or older group for comparison of the data. Patients with angiographically diagnosed non obstructive CAD did not undergo Fractional Flow Reserve (FFR) or imaging like Intravascular Ultrasound (IVUS), which are often beneficial in borderline lesions. The present study lacks long-term follow-up and larger data collection, which are required for determining outcomes and arriving at any firm conclusion.

CONCLUSION(S)

The ACS in young adults has a higher incidence in males, accompanied by smoking and tobacco use. The prevalence of STEMI was also higher compared to NSTEMI and unstable angina. Angiography reports showed a higher involvement of single-vessel disease in young patients. Mortality was observed less among young patients. A greater number of young populations were observed with obstructive CAD. For further advancement in the study, future research could explore the long-term impacts of the identified interventions on disease progression and patient outcomes across diverse demographic groups.

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