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Original Research Article

Risk Factors and Clinical Profile of Young Patients (<45 Years) Presenting with Acute Coronary Syndrome

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Abstract:

Background: The clinical and epidemiological peculiarities of Acute Coronary Syndrome (ACS) among young adults (under 45 years) are unique and are associated with increasing prevalence under the impact of changeable lifestyle factors.

Aim: To assess the risk factors, clinical presentation, angiographic pattern, and in-hospital outcomes of the young patients in ACS presentations.

Methodology: An observational study (prospective) was carried out in Fortis Escorts, Heart Institute, New Delhi, India. by registering 80 consecutive ACS patients under 45 years of age, who received coronary angiography. Elaborate demographic, clinical, laboratory, echocardiographic and angiographic data were gathered and the results noted up to time of discharge.

Findings: The median age was 38.1 +- 5.4 years, and male (82.5). The smoking (67.5%), dyslipidemia (41.25%), hypertension (37.5%), diabetes (35%), and family history of CAD (22.5) were major risk factors. The most frequent presentation was STEMI (66.25). Eighty percent had had obstructed CAD which was mostly a single-vessel disease (47.5%). Seventy-five percent of patients had LV dysfunction. The main treatment was PCI and the TIMI 3 flow was realized in 93.4. Mortality in the hospital was minimal (3.75%), which was accompanied by the occurrence of complications like heart failure (22.5%).

Conclusion: ACS patients of young age have a high prevalence of modifiable risk factors, and obstructive CAD is predominant, which points to the necessity of early control of risk factors and specific preventive measures.

Keywords: Acute Coronary Syndrome, Young Adults, Risk Factors, Angiographic Profile, STEMI, Coronary Artery Disease.

Introduction

Acute Coronary Syndrome (ACS) is a wide spectrum of coronary artery disease clinical presentation, and includes unstable angina, ST-segment Elevation Myocardial Infarction (STEMI), and non-ST-segment Elevation Myocardial Infarction (NSTEMI) [1]. All of these have a common pathophysiological pathway- acute myocardial ischemia caused by coronary plaque rupture, erosion or thrombotic occlusion. ACS is an issue that continues to be a major burden of worldwide health by being one of the most common causes of hospitalization, morbidity, and mortality in both developed and developing countries. Over the past several decades, the application of preventive measures, the enhancement of diagnostic options, and treatment options and methods have led to a reduction in ACS-related mortality in the elderly population. Nevertheless, the epidemiology, clinical, and socioeconomic peculiarities of the onset of ACS among younger adults (under 45 years old) are not well known [1].

Historically, coronary artery disease (CAD) was perceived as a disease of the older generations, which is predetermined by an accumulated effect of cardiovascular risk factors. Consequently, the elderly continue to take pre-eminence in clinical guidelines and risk stratification models which still represent most of the cases of ACS. Although the clinical features, prognosis, and management of geriatric patients with ACS have been studied extensively, the same has not been given the same emphasis to younger patients. Not many studies have explored ACS among the young population, and those that have are usually small sized with no in-depth clinical and angiographic analysis. Therefore, although ACS is becoming more and more acknowledged, its presence in young adults is under-researched, and its features are not thoroughly integrated into the modern group of clinical practice guidelines [2].

The recent epidemiological data indicates a slow increase in the occurrence of ACS in young adults across the globe. In the Global Registry of Acute Coronary Events (GRACE) study, it was stated that young patients with ACS represent about 6.3 percent of all ACS presentations [3]. This number is quite insignificant, but it is a significant clinical finding, as the long-term effects of premature cardiovascular disease can be revolutionary in terms of productivity, quality of life, and healthcare spending. The rising rate of changeable risk factors through sedentary living and unhealthy eating and psychosocial stress has added to the earlier onset of atherosclerosis. In addition, there is rapid urbanization and globalization that have been attributed to the change in risk-enhancing behavior that may increase atherosclerotic in younger age groups.

A number of studies have noted that young ACS patients have a unique risk factor profile as opposed to their older counterparts. Smoking is also the most common and strongest risk factor in premature CAD, and it is predominantly prevalent in young adults with ACS [4]. Dyslipidemia, especially, high levels of low-density lipoprotein (LDL) and low levels of high-density lipoprotein (HDL) also have a significant contribution to early atherogenesis. Moreover, a high level of premature CAD in the family history has also been noted in this group which indicates a great genetic predisposition. Conversely, conventional metabolic risk factors like diabetes mellitus and hypertension are not as prevalent among the younger patients, but there seems to be an increasing prevalence depending on increased rates of obesity and insulin resistance.

The gender distribution is also significantly different among young cohorts of ACS. The overall majority of the victims are men, and the percentage of females is much less. Such a difference can be explained by both biological and behavioral factors. The Vaso protective properties of endogenous estrogen are helpful to pre-menopausal women since they prevent atherosclerosis. Moreover, smoking and tobacco consumption, which are key risk determinants, are less common in young females in most populations and this is a factor of gender imbalance in ACS incidence [5]. Although the proportion of young women with ACS is lower, the symptom presentation in young women, the delay in diagnosis, and poor prognosis highlight the necessity of raising awareness and developing specific preventive measures.

Regarding clinical manifestation, STEMI is more frequently prevalent in younger patients with ACS than NSTEMI [6]. This increased rate of STEMI implies a propensity to acute thrombotic occlusion, as opposed to chronic deposition of atherosclerotic plaque, which may be mediated by endothelial dysfunction and hypercoagulability with smoking and a plaque unstable to its usual state. The hypothesis that other mechanisms other than advanced multivessel atherosclerosis such as vasospasm, thrombophilia or spontaneous coronary artery dissection may contribute to the disease is also supported by previous studies, which found that single-vessel disease and angiographically normal coronary arteries are higher in younger patients. Yet, these are not consistent findings, and the inconsistency of studies highlights the need to conduct more region-oriented and thorough studies.

The escalating prevalence of ACS among the adult population of age 40 to <45 years old has far reaching consequences on the health of the populace. Early coronary heart disease causes prolonged medical treatment, repeated hospitalization, shortened life span, and high psychosocial impact. Socially, such patients are usually in their prime of economic productivity, and the early occurrence of cardiovascular disease is a tremendous financial and healthcare strain to families and healthcare systems. Moreover, the only barrier to timely diagnosis of high-risk people in the given demographic is the reluctance to have periodic health check-ups and the ignorance of their cardiovascular risks as young adults.

Since there is scanty information on the trends of risk factors, clinical manifestation, and angiographic features of young ACS patients, especially in certain geographical or demographic locations, there is an apparent gap in the literature [7] it. A better insight on this population is needed in order to make specific preventive measures, enhance the quality of early diagnoses, and streamline management guidelines. In particular, region-specific research is required, because the interaction of genetic, lifestyle, cultural, and environmental-specific factors might have an impact on the clinical profile of young adults with ACS.

Thus, the current research would help to assess in more detail the risk factors, clinical features, and angiographic appearance of young patients with ACS. The study aims to add some valuable information to the understanding of the distinct patient population by analyzing the relationships that will allow distinguishing risks patterns earlier and making clinical decisions, as well as eventually enhancing cardiovascular outcomes among young adults. Better insights into the ACS in younger populations will contribute to filling the gap in knowledge and assist in developing age-specific prevention and treatment plans that the population growing in importance will require.

Methodology

Study Design: This was a prospective observational study conducted to evaluate the risk factors and clinical profile of young patients (<45 years) presenting with Acute Coronary Syndrome (ACS).

Study Area: The study was carried out in the Department of Cardiology, Fortis Escorts Heart Institute, New Delhi, India.

Study Duration: The study was conducted over a period of from November 2023 to October 2024.

Sample Size: A total of 80 patients aged <45 years presenting with ACS were enrolled in the study.

Study Population: The study population included all consecutive young patients (<45 years) who presented clinical features suggestive of ACS and underwent coronary angiography at the study centre during the study period.

Inclusion Criteria

- Patients ≤45 years of age.
- Patients presenting with Acute Coronary Syndrome (ACS), including:
    - ST-elevation myocardial infarction (STEMI)
    - Non-ST elevation myocardial infarction (NSTEMI)
    - Unstable angina
- Patients who underwent coronary angiography for evaluation of ACS.

Exclusion Criteria

- Patients with congenital heart disease, rheumatic heart disease, or other structural heart diseases.
- Patients with conditions mimicking ACS, such as:
    - Pericarditis
    - Myocarditis
    - Aortic dissection
- Patients undergoing angiography for conditions other than ACS, including:
    - Stable angina
    - MI associated with Percutaneous Coronary Intervention (PCI)
    - Stent thrombosis
    - Coronary Artery Bypass Grafting (CABG)

Data Collection: The structured proforma was used to collect data in terms of demographic characteristics, clinical history, lifestyle risk factors, and other pertinent comorbidities. Precise records of these presenting symptoms, smoking behavior, hypertension, diabetes, family history of premature coronary artery diseases, and other orthodox or non-orthodox risk factors were taken at admission. The results of physical examination were observed in a systematic manner. All participants underwent laboratory studies, including lipid profile, fasting and random blood glucose, tests of thyroid functions, and cardiac biomarkers. Outcomes of coronary angiography and echocardiographic factors such as the left ventricular systolic functioning were also measured. Arrhythmias, heart failure, shock, mechanical complications, revascularization requirements and mortality occurrences were recorded until discharge in-hospital.

Study Procedure: Some patients were found to be eligible upon admission and a comprehensive clinical assessment involving detailed medical history and a complete physical examination was done. After the first stabilization, relevant laboratory investigations were performed. Coronary angiography has been done to provide a final judgment about the coronary arteries upon which patients were categorized into obstructive and non-obstructive groups of coronary artery disease. The echo-cardio graphic analysis was performed through the regular 2D, M-mode, color flow, and Doppler techniques to determine the systolic functioning of the left ventricle and classify it as mild, moderate, or severe dysfunction. The management of ACS was done in line with the existing national guidelines. The patients were followed during their hospitalization, and the results of clinical outcomes, complications, and the interventions administered to them during the hospitalization, including PCI, CABG, and medical treatments, were all noted up to the moment of discharging the patients.

Statistical Analysis: The Statistical Package of Social Sciences (SPSS) version 20.0 was used to conduct the statistical analysis. Mean +- standard deviation was used to summarize the continuous variables whereas frequencies and percentages were used to summarize the categorical variables. Student t-test of quantitative data and Chi-square test or Fisher exact test of categorical variables based on the distribution and the number of expected cells were employed to conduct comparative analysis between the groups. Relative risks were determined where necessary to assess the correlation between risk factors and the nature of coronary artery involvement. All analysis shows p-value of below 0.05 was regarded as statistically significant."

"**Result**

Table 1 demonstrates that the ACS population was young with a mean age of 38.10 +- 5.42 years and was predominantly male (82.5%). The mean BMI was 23.25 +- 3.05 kg/m2, which represented a non-obese group in general. The coronary-related risk factors were vastly common, especially smoking (67.5%), tobacco consumption (40%), dyslipidemia (41.25%), high blood pressure (37.5%), and diabetes (35%). Family history of premature CAD (22.5) and other minor contributors such as hypothyroidism (12.5) and rare ones such as vasculitis and polycythemia (1.25 each) were found. Also, 38.75% were previously stable angina, which means that ischemic symptoms exist in a large proportion of patients.

Table 1: Demographic Characteristics and Coronary Risk Factors Among Young Population with ACS	
Variables	**n (%)**
Demographic Variables	
Age (Mean±SD, years)	38.10 ± 5.42
Male	66 (82.5)
BMI (Mean±SD, kg/m²)	23.25 ± 3.05
Risk Factors	
Family history of premature CAD	18 (22.5)
Smoking habits	54 (67.5)
Tobacco use	32 (40.0)
Hypertension	30 (37.5)
Diabetes	28 (35.0)
Hypothyroid	10 (12.5)
Dyslipidemia	33 (41.25)
History of stable angina	31 (38.75)
Vasculitis	1 (1.25)
Polycythemia	1 (1.25)

Table 2 shows that obstructive CAD was dominant in young ACS patients (80 percent), and that the single-vessel disease was most prevalent (38 cases, 47.5 percent), with the next common being the double-vessel (17.5 percent) and triple-vessel disease (10 percent). Left main involvement was also less common, observed as isolated LMCA disease in 2.5 and LMCA and multivessel CAD in another 2.5. The non-obstructive CAD was 20 percent which consisted of normal coronaries (1.25%), minor CAD (3.75%), and recanalised vessels (15%). In general, the angiographic profile may well reveal that there is a high incidence of severe coronary obstruction within this young population.

Table 2: Coronary Angiographic Profile Among Young Patients with ACS		
Lesion Location	**n (%)**	**Percentage (%)**
Non obstructive CAD		
Normal coronary	1 (1.25)	**20%**
Minor CAD	3 (3.75)	
Recanalised vessel	12 (15.0)	
Obstructive CAD		
Single vessel disease	38 (47.5)	**80%**
Double vessel disease	14 (17.5)	
Triple vessel disease	8 (10.0)	
Isolated LMCA	2 (2.5)	
MVCAD + LMCA	2 (2.5)	

Table 3 indicates that the majority of young ACS patients had STEMI (66.25%), whereas NSTEMI (16.25) and unstable angina (17.5) were less prevalent. Of the cases of STEMI 56.6% were anterior wall (AWMI) and 43.4% inferior wall (IWMI). Only a quarter of them had normal LV systolic function, and most of them displayed an impairment: 40% had mild, 28.75% moderate and 6.25% severe LV dysfunction, demonstrating that there was a significant load of myocardial damage in this young group.

Table 3. Clinical and Echocardiographic Profile	
Variables	**n (%)**
Clinical Presentation	
NSTEMI	13 (16.25)
Unstable angina	14 (17.5)
STEMI	53 (66.25)
AWMI	30 (56.6%)
IWMI	23 (43.4%)
LV Systolic Function	
Normal	20 (25.0)
Mild LV dysfunction	32 (40.0)
Moderate LV dysfunction	23 (28.75)
Severe LV dysfunction	5 (6.25)

Table 4 demonstrates that young ACS patients had an average SYNTAX score of 14.85 +- 7.92, which is associated with low-to-intermediate angiographic complexity. The majority of patients were provided with PCI (57.5%), then 22.5% were treated with medical management, and 18.75% were referred to CABG; a single patient (1.25) was treated with PCI and ventricular septal rupture repair. The results were positive after PCI with TIMI 3 flow attained in 93.4%. There was low in-hospital mortality of 3.75 and 96.25 discharge. In terms of complications, 60% never had any adverse events, heart failure was 22.5, shock was 3.75, shock with heart failure (6.25), arrhythmias (5), or severe mixed complications (VSR) (1.25).

Table 4: Management and Outcome in Young Patients with ACS

Variables	n (%)
General Variables	
Syntax score (Mean±SD)	14.85 ± 7.92
Management	
Medical management	18 (22.5)
CABG referral	15 (18.75)
PCI	46 (57.5)
PCI + Ventricular septal rupture closure	1 (1.25)
TIMI Flow After PCI	
TIMI 1	1 (2.1)
TIMI 2	2 (4.3)
TIMI 3	43 (93.4)
Outcome	
In-hospital mortality	3 (3.75)
Discharge	77 (96.25)
Complications	
No complication	48 (60.0)
Heart failure	18 (22.5)
Shock	3 (3.75)
Shock + Heart failure	5 (6.25)
Arrhythmia	4 (5.0)
Arrhythmia + Shock + HF	1 (1.25)
Shock + HF + VSR	1 (1.25)

Table 5 demonstrates that most clinical and laboratory characteristics were comparable between patients with obstructive and non-obstructive coronary artery disease. Although individuals with obstructive CAD tended to be slightly older and had higher frequencies of risk factors such as smoking (68.7%), hypertension (40.6%), diabetes (39.1%), and dyslipidemia (45.3%), none of these differences reached statistical significance. Relative risk values suggested a trend toward higher risk among obstructive CAD patients—for example, diabetes (RR 2.08) and history of stable angina (RR 2.33)—but the associated p-values indicate that these associations were not statistically meaningful in this sample. Overall, no parameter showed a significant difference between the two groups.

Table 5: Clinical and Laboratory Characteristics of Patients with and Without Obstructive Coronary Disease

Parameters	Obstructive CAD (n=64)	Non-obstructive CAD (n=16)	Relative Risk	p-value
Age (Mean±SD, years)	38.62 ± 4.95	35.81 ± 6.15	–	0.105
Male	52 (81.2)	14 (87.5)	0.93	0.724
BMI (Mean±SD, kg/m²)	23.38 ± 3.01	22.72 ± 3.22	–	0.26
Family history of CAD	15 (23.4)	3 (18.8)	1.25	1
Smoking	44 (68.7)	10 (62.5)	1.1	0.766
Tobacco	28 (43.7)	4 (25.0)	1.75	0.255
Hypertension	26 (40.6)	4 (25.0)	1.62	0.234
Diabetes mellitus	25 (39.1)	3 (18.8)	2.08	0.154
Hypothyroid	10 (15.6)	0 (0.0)	Not estimable	0.198
Dyslipidemia	29 (45.3)	4 (25.0)	1.81	0.166
History of stable angina	28 (43.7)	3 (18.8)	2.33	0.088

Discussion

The current research corroborates the emerging data that acute coronary syndrome in the youthful adults is strongly male-dominated with over four-fifths of the syndrome being caused in men and the average age of the affected persons is about 38 years. This observation is consistent with that of Avezum et al. (2005) [3], who discovered that more than 90 percent of young ACS patients were men, and with Wadkar et al. (2014) [8], who also found that the majority of Indian cohorts were dominated by men. The low percentage of affected women in our study is in line with previous epidemiologic reports of Framingham Heart Study that found that only between 5-10 percent of young ACS patients are women, due to the protective nature of estrogen on lipid profiles and vascular functioning (Reslan & Khalil, 2012) [9]. Our data hence support the known trends on sex factors and highlight the hormonal protection observed among premenopausal women."

An impressive characteristic of the current generation was the overwhelming level of smoking prevalence, which was reported in over two-thirds of the participants. This is in close correspondence to the findings of the many kinds of populations that have found that smoking is the single most powerful modifiable risk factor in young ACS that accelerates atherosclerosis and triggers plaque rupturing (Hbejan, 2011; Hong et al., 1994) [10,11]. Although a narrowly different higher smoking prevalence in our obstructive CAD subgroup was observed (69.5%), the relationship was not statistically significant, which may be explained by the small sample size. However, the association direction is similar to the past studies by Mirghani et al. (2016) [12] that promoted smoking as a main factor of obstructive lesions among the younger people.

The importance of traditional metabolic risk factors was also evident in our study as the mean body mass index was in normal range. One-third to almost a half of the patients had hypertension, diabetes mellitus as well as dyslipidemia, which is comparable to the study by Esteban et al. (2014) [13] as the prevalence of metabolic abnormalities in young ACS groups had the same frequency. Our 44% dyslipidemia rate is consistent with what Chen et al. (1995) and Mohammad et al. (2015) [14,15] recorded in their reports - that is, the predominant pattern of dyslipidemia in premature CAD, i.e., elevated levels of triglycerides and low levels of HDL-cholesterol. Large registry studies also indicate the genetic role in early coronary artery disease, and the positive family history in our cohort is also associated with a positive statistical association with having the disease, although studies vary in the degree to which it follows (Cole et al., 2003) [16].

In our study, the clinical presentation indicated that two-thirds of cases were ST-elevation myocardial infarction of which anterior wall was affected, and this was as a result of the left anterior descending artery being frequently implicated. Narayanaswamy et al. (2018) [17] and Esteban et al. (2014) [13] are among the researchers who have documented similar distributions and reported that young ACS patients present with STEMI, as opposed to NSTEMI or unstable angina. This trend can be connected with increased susceptibility to plaque due to smoking and metabolic risk factors that predispose the younger people to sudden coronary blockage.

Angiographic examination showed obstruction disease of the coronary arteries in 82 percent of the group with single-vessel disease constituting almost half of all instances. These results are very consistent with the results that Cole et al. (2003) [16] reported: in their study, single-vessel disease was observed in 58% of young adults with CAD, and almost equal proportions were obtained in their study. Non-obstructive CAD were 18% of our population, which is similar to those recorded by Jha et al. (2015) [18], indicating that although non-obstructive coronary artery disease is not rare, it is the traditional obstructive disease that is the most common. Interestingly, the similarity of recanalized vessels in the non-obstructive group shows that there is spontaneous reperfusion, or delayed presentation, which also complicates the etiological picture of ACS in young adults.

Our study showed management patterns based on the severity of the diseases where more than half of the patients have been subjected to percutaneous coronary intervention and close to one-fifth had to have their coronary artery bypassed. These rates are aligned with the findings of Asian and Western research where early invasive approaches are more preferred since the nature of the coronary lesions is usually focal in young adults (Yagis et al., 2021) [3]. Most of our patients reported TIMI 3 reperfusion which proved to have high procedural success, but few patients experienced complications which included heart failure, arrhythmia, shock or in some exceptional cases mechanical sequelae like ventricular septal rupture. These complications are rather rare but, also, they were reported in the previous literature showing that these patients, being younger than they are, are not deprived of the entire range of complications related to ACS.

Obstructive and non-obstructive groups were compared, and it was found that there were more prevalent traditional cardiovascular risk factors, such as smoking, hypertension, diabetes, dyslipidemia, and family history, in the obstructive diseases, but the differences were not statistically significant. This is a trend, without statistical validation, which concurs with larger evidence that clustering of modifiable risk factors promotes obstructive and not non-obstructive pathology (Schoenenberger et al., 2011) [19]. The fact that no major differences were found

in our study is probably due to the insufficient sample size as opposed to actual equivalence.

In general, the results of the present study are similar to the worldwide trends in young ACS, as there is an evident focus of modifiable risk factors, obstructive single-vessel disease, and the prevalence of STEMI. The data highlights that there is an urgent necessity of vigorous primary prevention, specifically, smoking cessation and correction of metabolic risk to reduce premature coronary events in this at-risk group.

Conclusion

The study emphasizes that the modifiable lifestyle-related factors are strong determinants of acute coronary syndrome among young people, with tobacco exposure and dysmetabolic states being observed to be the most prominent ones, and a significant burden of conventional risk factors (hypertension, diabetes, and dyslipidemia) is also noted. A majority of patients who presented with overt myocardial infarction demonstrated an overt preponderance of single-vessel obstructive disease on angiography, suggesting a trend of selective atherosclerotic obstructive disease, and not diffuse multivessel obstructive disease. Nevertheless, a significant percentage showed a certain level of left ventricular dysfunction, which highlights the great number of myocardial effects even in a younger group of individuals. Good procedural success in percutaneous intervention was used as a major part of management, and the overall in-hospital outcome was positive although heart failure, hemodynamic instability and so on occurred in a significant minority. Collectively, these findings emphasize that young ACS patients represent a distinct clinical subgroup characterized by preventable risk exposures, predominantly localized coronary disease, and generally good short-term outcomes, while still demonstrating considerable vulnerability to adverse cardiac events, highlighting the need for aggressive risk-factor modification and early preventive strategies.

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