Original Research Article

Comparative Analysis of Angiographic Characteristics in Acute Coronary Syndrome Among Patients Below 40 and Above 60 Years of Age

Prantik Bhattacharya[1], Subhashis Chakraborty[2], Sanat Kumar Jatua[3], Swapan Kumar Halder[4], Debarshi Jana[5]

[1]Senior Resident, MD (Medicine), DM (Cardiology), Department of Cardiology, IPGMER and SSKM Hospital, Kolkata, West Bengal 700023

[2]RMO cum Clinical Tutor, Department of Cardiology, Nil Ratan Sarkar Medical College and Hospital, Kolkata, West Bengal 700014

[3]Associate Professor, Department of General Medicine, Diamond Harbour Government Medical College and Hospital, West Bengal 743331

[4]Professor, Department of Cardiology, Nil Ratan Sircar Medical College and Hospital, Kolkata, West Bengal 700014.

[5]PhD (Cal), Biostatistics and Epidemiology (IBRI), Consultant Biostatistician and Epidemiologist, Young Scientist (Associate Professor), Department of Science & Technology, Government of India, IPGMER and SSKM Hospital, Kolkata, West Bengal 700023

Abstract:

Introduction: Acute Coronary Syndrome (ACS) is a significant cause of morbidity and mortality globally with differing risk profiles and pathophysiological mechanisms across age groups.

Objectives: To compare the angiographic characteristics of coronary artery involvement in patients diagnosed with ACS in two distinct age groups: those aged <40 years and those aged >60 years.

Methods: This analytical cross-sectional study was conducted over 18 months, from March 1, 2023 to August 31, 2024at the Department of Cardiology, Nilratan Sircar Medical College and Hospital, Kolkata. The study population comprised adult patients below 40 years and above 60 years of age admitted with acute coronary syndrome.

Results: In this study of 192 Acute Coronary Syndrome (ACS) patients, two age groups were compared: those below 40 years and those above 60 years. Younger patients showed a marked male predominance (84%), whereas the elderly group had a more balanced gender distribution. The mean TIMI score was significantly higher in older patients (3.56 ± 1.51) compared to the younger group (2.87 ± 1.69), indicating a greater risk profile in the elderly. Single-vessel disease was most common in the younger cohort (69%), while older patients had a higher prevalence of triple-vessel disease (29%). The left anterior descending artery (LAD) was the most frequently involved vessel across both groups, with higher involvement in the elderly. Additionally, left main coronary artery (LMCA) disease was significantly more common in older patients (29% vs. 11%). SYNTAX II scores further supported these findings, with younger patients more often falling into the low-risk category, whereas a significant portion of older patients had intermediate to high scores.

Conclusion: Younger ACS patients tend to have less extensive but more thrombotic coronary involvement, often limited to a single vessel, with modifiable lifestyle-related risk factors predominating. Older patients, however, typically present with diffuse, multi-vessel atherosclerotic disease, correlating with higher rates of comorbidities. These findings underscore the need for age-specific preventive and interventional strategies in the management of ACS.

Keywords: Acute Coronary Syndrome, Coronary Angiography, Young ACS, Elderly ACS, Coronary Artery Disease, Risk Factors, Single Vessel Disease, Multi Vessel Disease.

Introduction

Acute Coronary Syndrome (ACS), encompassing a spectrum of clinical presentations ranging from unstable angina to ST-elevation and non-ST-elevation myocardial infarction remains a leading cause of cardiovascular morbidity and mortality worldwide. While traditionally considered a disease of older adults, there has been a concerning increase in the incidence of ACS among younger

populations, particularly those under 40 years of age, in recent decades [1,2]. This epidemiological shift necessitates a detailed understanding of age-specific differences in the pathogenesis, clinical features, and angiographic characteristics of ACS to enable effective, tailored management.The pathophysiology of ACS is multifactorial and varies significantly across age groups. In elderly individuals (>60 years), the development of atherosclerosis is typically chronic, diffuse, and often associated with long-standing comorbidities such as hypertension, diabetes mellitus, and dyslipidemia. The coronary lesions observed in this group tend to be calcified, multivessel, and complex, frequently accompanied by chronic total occlusions (CTOs) and reduced left ventricular ejection fraction [3,4]. In contrast, younger patients with ACS often present with non-atherosclerotic causes such as coronary vasospasm, hypercoagulable states, or plaque erosion rather than rupture. Angiographically, they are more likely to have single-vessel disease, thrombus-laden lesions, and normal or near-normal coronaries [5].

Multiple studies have reported that traditional risk factors manifest differently between younger and older patients with ACS. Smoking, hyperlipidemia, obesityand a positive family history of premature coronary artery disease are more frequently observed in the younger cohort [6]. In contrast, diabetes, hypertension and sedentary lifestyle predominate in the elderly population, contributing to more diffuse coronary artery disease (CAD) [7]. These differences in risk profile not only influence the clinical presentation but also determine the extent and nature of coronary involvement seen during angiographic evaluation.

Coronary angiography remains the gold standard in evaluating the extent and severity of CAD in ACS patients. Previous studies suggest that younger individuals are more likely to have non-obstructive or single-vessel involvement, most frequently affecting the left anterior descending artery (LAD), whereas older patients tend to present with extensive three-vessel or left main coronary artery disease [8]. Furthermore, younger patients often exhibit high thrombus burden without significant underlying plaque, suggesting a role of acute plaque erosion and heightened thrombogenicity in the pathogenesis of their disease [9].

Understanding the angiographic differences in ACS between the younger and older age groups is crucial for several reasons. First, it guides revascularization strategies, including percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG). Second, it informs prognostication, as extensive coronary involvement in older adults is associated with worse outcomes. Third, it aids in identifying modifiable risk factors in

the younger population for targeted primary prevention [10].

Despite the growing interest in premature coronary artery disease, data comparing angiographic characteristics across age groups in the Indian population remain limited. Given the unique genetic, dietary and lifestyle factors prevalent in South Asia, it is vital to generate region-specific evidence to support clinical decision-making. This study aims to bridge that gap by conducting a comparative analysis of angiographic findings in ACS patients aged below 40 years and above 60 years, thereby contributing to the growing body of literature on age-stratified cardiovascular care.

In light of these considerations, the present study investigates the angiographic patterns, number of vessels involved, and lesion characteristics in two distinct age groups of ACS patients. By comparing the burden and complexity of coronary lesions between younger and older adults, this study seeks to provide actionable insights into age-specific preventive and therapeutic strategies in the management of ACS.

Materials and Methods

Study Design: Analytical study, Cross Sectional design

Place of study: Department of Cardiology, Nilratan Sircar Medical College and Hospital, 138 A.J.C. Bose Road, Kolkata 700014.

Period of study: 18 months from 1st March 2023 to 31st August 2024.

Study population: Adult patients of below 40 years and above 60 years age groups admitted in the department of cardiology at NRSMCH with Acute coronary syndrome

Study Variables

- TIMI score
- No. of vessels
- Syntax II
- Vessels

Sample Size: 192 Patients diagnosed with Acute Coronary Syndrome (ACS).

Inclusion Criteria

- Patients giving consent to be a participant in this study
- Patients of at least 18 years of age
- Patients who are planned for coronary angiography

Exclusion Criteria

- Patients with rheumatic heart diseases
- Patients with congenital heart diseases
- Patients with chronic stable angina

- Patients with deranged renal function
- Patients with deranged hepatic function

Statistical Analysis: Data has been put into the Microsoft office excel sheet and statistical calculation has been done using SPSS software version 23. Continuous variables have been presented as Mean ± Standard deviation. Categorical variables have been given as number and percentage. Comparison between groups has been done by appropriate statistical tests and methods. P value <0.05 has been considered as statistically significant.

Result

Table 1: Distribution of gender in both age groups

Gender	< 40 years	> 60 years
Male	33 (84%)	95 (62%)
Female	6 (16%)	58 (38%)

Table 2: Distribution of TIMI Risk Score in both age groups

TIMI score	Mean	SD	p-value
>60 years	3.555556	1.511995	0.015
<40 years	2.871795	1.688654	

Table 3: Distribution of number of diseased coronary arteries in both age groups

No. of vessels	SVD	DVD	TVD	p-value
<40 years	27 (69%)	10 (26%)	2 (5%)	0.0017
>60 years	64 (42%)	45 (29%)	43 (29%)	

Table 4: Distribution of type of diseased coronary arteries in both age groups

Vessels	<40 years	>60 years
LMCA	4 (11%)	44 (29%)
LAD	22 (56%)	106 (69%)
LCx	14 (36%)	92 (60%)
RCA	17 (44%)	80 (52%)

Table 5: Distribution of Syntax score in both age groups

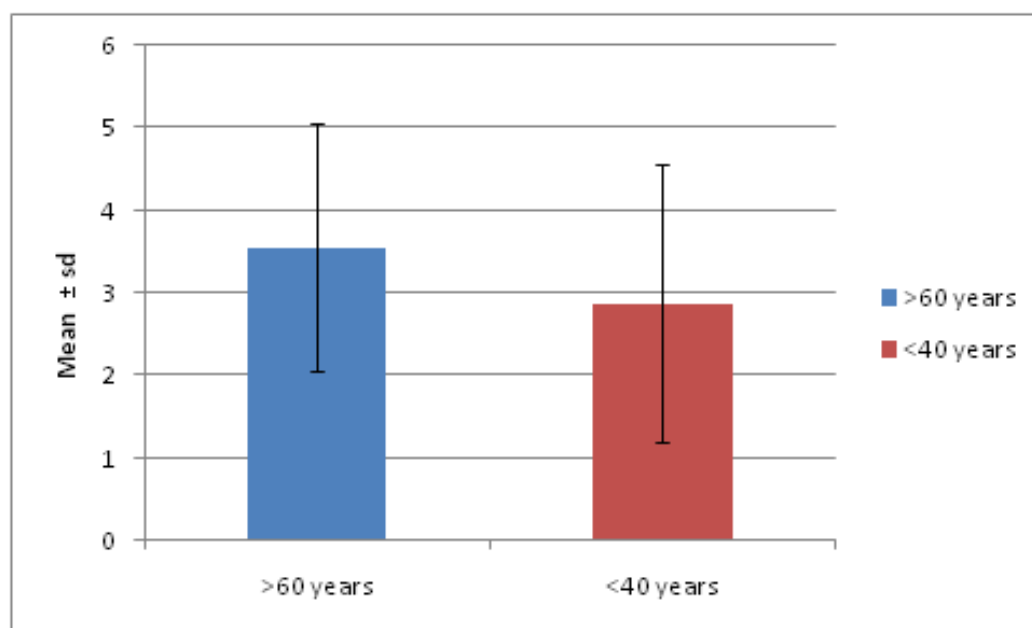| Syntax II	<22	22-32	>32	p value
>60 years	73 (48%)	45 (29%)	35 (23%)	0.0189
<40 years	28 (72%)	8 (20%)	3 (8%)	

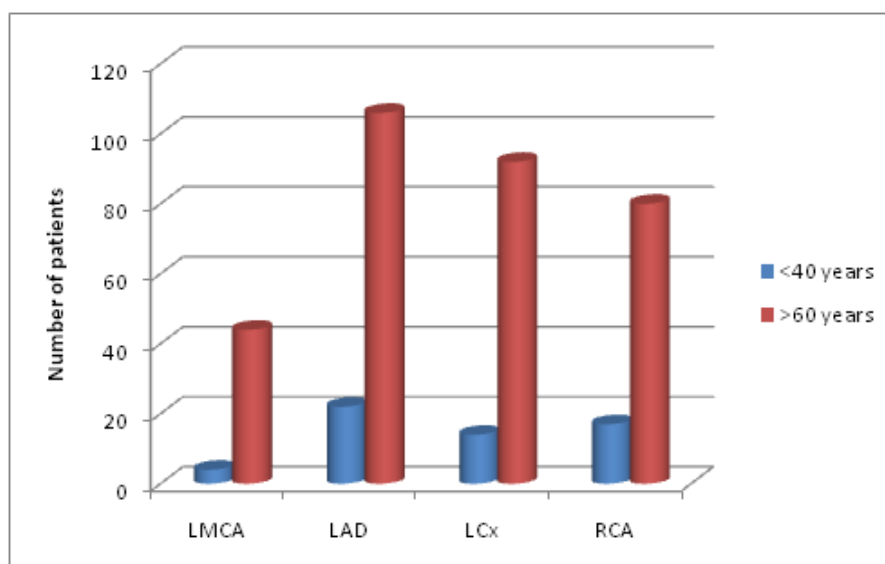**Figure 1: Distribution of TIMI Risk Score in both age groups**

Figure 2: Distribution of type of diseased coronary arteries in both age groups

In the present study, a total of 192 patients diagnosed with Acute Coronary Syndrome were included, comprising two age-based groups: those aged below 40 years and those above 60 years. In the <40 years age group, males constituted a predominant majority with 33 patients (84%), while females accounted for only 6 patients (16%). In contrast, among patients aged >60 years, males were 95 (62%) and females were 58 (38%). This indicates a significantly higher male predominance in the younger ACS cohort compared to the elderly group, suggesting that younger males are more commonly affected by ACS than their female counterparts.

In the present study, the mean TIMI (Thrombolysis In Myocardial Infarction) score among patients aged above 60 years was 3.56 ± 1.51, which was significantly higher compared to those aged below 40 years, who had a mean TIMI score of 2.87 ± 1.69. This difference was statistically significant with a p-value of 0.015, indicating a higher risk profile in the elderly population presenting with acute coronary syndrome.

In the current study, among patients aged below 40 years, single-vessel disease (SVD) was most prevalent, observed in 69%, followed by double-vessel disease (DVD) in 26%, and triple-vessel disease (TVD) in only 5% of cases. In contrast, patients aged above 60 years demonstrated a more diffuse pattern of coronary involvement, with SVD in 42%, DVD in 29%, and a notably higher prevalence of TVD at 29%. This distribution difference between the two age groups was statistically significant (p = 0.0017).

In the analysis of vessel-wise involvement, the left anterior descending artery (LAD) was the most commonly affected vessel in both age groups, seen in 56% of patients aged below 40 years and in a higher proportion (69%) among those above 60

years. The left circumflex artery (LCx) was involved in 36% of younger patients and 60% of older patients, while the right coronary artery (RCA) was affected in 44% of the <40 age group compared to 52% in the >60 age group. Notably, left main coronary artery (LMCA) involvement was significantly lower in younger patients (11%) compared to the elderly group (29%).

In the present study, the SYNTAX II score distribution revealed that a greater proportion of younger patients (<40 years) had lower scores, with 72% falling in the <22 category, 20% in the 22–32 range, and only 8% scoring >32. Conversely, among patients aged >60 years, 48% had scores <22, 29% between 22–32, and a higher proportion (23%) had scores >32. This difference in SYNTAX II score distribution between the two age groups was statistically significant (p = 0.0189).

Discussion

In the present study, a distinct age-related variation in the angiographic and clinical profile of Acute Coronary Syndrome (ACS) patients was observed. Among individuals aged below 40 years, there was a marked male predominance (84%), a finding that is consistent with prior studies indicating that young males are at higher risk for premature coronary artery disease, potentially due to greater prevalence of smoking, dyslipidemia, and lifestyle-related factors [11,12]. Older patients (>60 years) showed a relatively balanced gender distribution, aligning with findings by Zhang et al., who reported increasing ACS incidence among elderly females, possibly due to the loss of estrogen's protective effect post-menopause [13]. The mean TIMI score was significantly higher in elderly patients (3.56 ± 1.51) than in the younger cohort (2.87 ± 1.69), suggesting a higher ischemic risk in the former. This is in agreement with studies by Lee et al. and El-

Menyar et al., which demonstrated that elderly ACS patients often present with higher risk scores and more comorbidities [14,15]. Moreover, our study revealed that young patients predominantly exhibited single-vessel disease (69%), while elderly patients had a significantly higher prevalence of triple-vessel disease (29%), mirroring findings from Sinha et al. and Khan et al., who also reported a diffuse pattern of coronary involvement in older populations [16,17]. Vessel-wise analysis showed LAD as the most commonly involved artery in both age groups, but with a higher frequency in the elderly (69%). This is corroborated by Sharma et al., who noted that LAD involvement is a dominant pattern across age groups but tends to be more severe in older patients [18]. The higher prevalence of LMCA disease in the elderly (29% vs. 11% in younger patients) further underlines the advanced coronary atherosclerosis in older individuals, consistent with reports by Vyas et al. [19]. The SYNTAX II score distribution reinforced these findings, with a significantly greater proportion of younger patients falling in the low-risk category (<22), while elderly patients were more likely to present with intermediate or high SYNTAX scores. This aligns with observations by Patel et al., who reported that younger ACS patients tend to have focal lesions and lower SYNTAX scores, whereas older patients often require complex revascularization strategies due to multivessel disease [20].

Conclusion

The present study highlights significant age-related differences in the clinical and angiographic profiles of patients presenting with Acute Coronary Syndrome. Younger patients (<40 years) exhibited a striking male predominance, predominantly single-vessel involvement, lower TIMI and SYNTAX II scores, and less extensive coronary artery disease. In contrast, elderly patients (>60 years) demonstrated a more balanced gender distribution, higher risk scores, and a greater burden of multivessel and left main coronary artery disease. The importance of tailored risk assessment and management strategies based on age-specific presentations and coronary anatomy. Early detection and aggressive risk factor modification in younger individuals, along with comprehensive evaluation and optimal revascularization planning in older patients, are essential for improving outcomes across all age groups.

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