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Original article

Age-Related Variations in Risk Factors, Clinical Presentations, and Coronary Angiographic Outcomes among Female Patients with Acute Myocardial Infarction: A Prospective Observational Study

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Abstract

Background: Coronary heart disease (CHD) is a leading cause of mortality globally, with acute myocardial infarction (AMI) being a significant contributor. Historically considered a "men's disease," CHD is increasingly diagnosed in women, who often present with atypical symptoms, making diagnosis challenging and leading to suboptimal care. Age-specific differences in risk factors, clinical presentations, and angiographic outcomes in female AMI patients have not been extensively studied. ***Objective:*** This prospective observational study aimed to delineate age-related variations in risk factors, clinical presentations, and coronary angiographic outcomes among female patients with AMI, comparing younger (<55 years) and older (≥55 years) age groups. ***Methods:*** A total of 115 female patients with AMI were enrolled from December 2018 to November 2020 at Jawaharlal Nehru Medical College and Hospital. Participants underwent coronary angiography, and risk factors such as hypertension, diabetes, dyslipidemia, and smoking were assessed. Statistical analyses included chi-square and Student's t-test. ***Results:*** Among the participants, 38 were younger (<55 years) and 77 were older (≥55 years). Dyslipidemia was the most prevalent risk factor in both groups, with significant differences in hypertension (p=0.041), hypothyroidism (p=0.022), and family history of CAD (p=0.003) between age groups. Clinical presentation revealed typical angina as the most common in both age groups, with acute LVF significantly more prevalent in the elderly (p=0.021). Coronary angiography showed high prevalence of significant CAD in both groups, with age-related variations in the extent of disease. ***Conclusion:*** This study highlights age-specific differences in risk factors, clinical presentations, and coronary angiographic outcomes among female patients with AMI. These findings underscore the importance of tailored management strategies and targeted interventions for improving outcomes in female AMI patients of different age groups.

Keywords: ***acute myocardial infarction; coronary artery disease; age differences; risk factors; clinical presentation; coronary angiography.***

Introduction

Coronary heart disease (CHD) is a leading cause of mortality worldwide, with acute myocardial infarction (AMI) being a significant contributor [1]. Historically considered a "men's disease," coronary artery disease (CAD) is increasingly diagnosed in women [2]. Despite this, women have long been underdiagnosed and undertreated for AMI. Significant differences exist in the prevalence of various risk factors such as diabetes mellitus, hypertension, family history of CAD, dyslipidemia, obesity, and cigarette smoking, likely due to the advanced age at which women typically present and the greater coexistence of comorbidities like diabetes and hypertension compared to men. Women also tend to present with atypical symptoms, such as neck pain, nausea, fatigue, and dyspnea, making diagnosis more challenging and often resulting in suboptimal and less aggressive care [3-5].

These disparities contribute to higher mortality rates after the first episode of myocardial infarction and a greater incidence of complications among women, highlighting the need for a gender-specific approach to both primary and secondary prevention. Furthermore, previous studies have indicated that the interaction between female sex and the management and outcomes of MI might be age-specific. Notably, CAD tends to manifest at a younger age in the Indian population compared to Western countries, leading to a

substantial loss of productive years [6]. Understanding the age-based differences in risk factors, clinical presentations, and coronary angiographic outcomes in women with AMI is crucial for developing targeted interventions and improving clinical care.

This prospective observational study aims to delineate age-specific differences in risk factors, clinical presentations, and angiographic outcomes among female patients with AMI. By categorizing participants into younger (<55 years) and older (≥55 years) age groups, the study seeks to provide valuable insights that could facilitate better clinical decision-making and enhance patient outcomes.

Material and Method

The study was a prospective, observational, hospital-based investigation conducted in the Department of Medicine and the Department of Cardiology at Jawaharlal Nehru Medical College and Hospital (JNMCH) from December 2018 to November 2020. The study protocol received approval from the JNMCH Board of Studies in September 2018 and the institution's Ethical Committee in December 2018.

A total of 115 female patients with acute myocardial infarction (MI), who visited the Medicine/Cardiology outpatient department (OPD) and emergency department, and were subsequently admitted to the general medicine ward or the coronary care unit (CCU), were enrolled. These patients underwent coronary angiography between December 2018 and November 2020, as per the Fourth Universal Definition of Myocardial Infarction (2018). The study excluded individuals who presented with conditions other than acute MI or those with coexisting diseases, such as inflammatory disorders, sepsis, chronic kidney disease, malignancy, severe anemia, or severe thrombocytopenia. All participants were informed of the potential risks and benefits associated with the study and provided written informed consent before enrollment.

AMI was diagnosed based on symptoms, ECG changes, and elevated serum biochemical markers of myocardial necrosis.

To assess age-related variations, the participants were classified into two groups: the younger group (age <55 years) and the older group (age ≥55 years). This classification allowed the study to examine age-specific risk factors, clinical presentations, and treatment responses among women with acute MI.

Demographic profiles: Included age only.

Assessment of risk factors: Traditional risk factors such as hypertension, diabetes, smoking, dyslipidemia, and hypothyroidism were evaluated for each patient. Risk factors for this study were defined using established medical guidelines and laboratory measures. Hypertension was identified in patients with two or more blood pressure readings of 140 mmHg or higher for systolic, or 90 mmHg or higher for diastolic pressure, or if the patient was already taking antihypertensive medication, according to the JNC-VII classification. Diabetes was determined based on fasting plasma glucose levels (with fasting defined as no caloric intake for at least 8 hours) of 126 mg/dL or higher, or a 2-hour plasma glucose of 200 mg/dL or higher after a 75-gram glucose load, consistent with the World Health Organization (WHO) criteria. Additionally, an HbA1c of 6.5% or higher indicated diabetes, as per the American Diabetes Association (ADA 2015). Smoking was considered a risk factor if the patient was a regular smoker of tobacco in any form within the last year. Dyslipidemia was diagnosed when LDL cholesterol was 130 mg/dL or higher, triglycerides were 150 mg/dL or higher, or HDL cholesterol was below 50 mg/dL for women (or below 40 mg/dL for men), following the ATP III guidelines. These lipid profiles were measured using commercial kits from Boehringer Mannheim. Hypothyroidism was defined by elevated thyroid-stimulating hormone (TSH) levels exceeding 3.65 mIU/L. Overt hypothyroidism was indicated when free thyroxine (fT4) levels were below 9.0 pmol/L, while subclinical hypothyroidism was diagnosed when fT4 was within the range of 9.0–23.0 pmol/L. Overt hypothyroidism also included patients who were receiving thyroxine supplementation. These definitions provided a comprehensive framework for identifying and assessing risk factors in the study participants.

Coronary angiography was performed in all the patients according to standard protocols. Angiographic outcomes were assessed, such as the extent and severity of coronary artery disease.

Statistical analysis: Statistical analyses were conducted using SPSS software version 20. Categorical data were analyzed using the chi-square test, and continuous data were compared using the Student t-test. A p-value of less than 0.05 was considered statistically significant. Results were presented as mean ± standard deviation for continuous variables and as percentages in tables, pie charts, or bar diagrams for categorical data.

Result

Out of the 115 patients in the study population, there were 38 females in the younger group (< 55 years) and 77 females in the elderly group (≥ 55 years). The mean age of females presenting with AMI was 57.93 ± 11.20 years.

The table 1 compares the risk factor profiles of younger and elderly female patients with acute myocardial infarction (AMI). Among the elderly, the most prevalent risk factor is dyslipidemia, followed by hypertension, diabetes mellitus, and old CAD. Family history of CAD and smoking are less common. In younger females, dyslipidemia is also the most prevalent, followed by family history of CAD, hypertension, diabetes mellitus, hypothyroidism, and old CAD. Smoking is the least prevalent risk factor. Statistically significant differences between the age groups are noted for hypertension (p=0.041), hypothyroidism (p=0.022), and family history of CAD (p=0.003), with these conditions being more prevalent in either younger or elderly females. Other risk factors such as smoking, diabetes, dyslipidemia, and old CAD did not show significant differences between the groups.

Table 1: Risk factor profiles of younger and elderly female patients.

Risk Factors	**Younger females** (n=38)	**Elderly females** (n=77)	**P-value**
Smoking	1(2.6%)	3(3.9%)	0.728
Hypertension	14(36.8%)	44(57.1%)	0.041
Diabetes mellitus	14(36.8%)	33(42.9%)	0.537
Dyslipidemia	24(63.2%)	53(68.8%)	0.537
Hypothyroidism	4(10.5%)	1(1.3%)	0.022
Old CAD	3(7.9%)	10(13.0%)	0.417
Family history	11(29.0%)	6(7.8%)	0.003

The table 2, presents the dyslipidemia profile among the study population, comparing overall, younger, and elderly females with acute myocardial infarction (AMI). Among the lipid parameters, low HDL cholesterol is the most prevalent condition in both younger and elderly females, followed by high triglycerides (TG). Elevated LDL cholesterol is the least prevalent condition. The p-values indicate that there are no statistically significant differences between younger and elderly females for any of the lipid parameters: low HDL (p=0.342), high LDL (p=0.795), and high TG (p=0.345). This suggests that the prevalence of these dyslipidemia markers is similar across both age groups.

Table 2: Dyslipidemia profile among the study population.

Lipid parameters	**Overall females** (n=115)	**Younger females** (n=38)	**Elderly females** (n=77)	**P-values**
HDL (<50 mg/dL)	65 (56.5%)	22 (57.9%)	43 (55.8%)	0.342
LDL (≥130 mg/dL)	7 (6.1%)	2 (5.3%)	5 (6.5%)	0.795
TG (≥150 mg/dL)	68 (59.1%)	20 (52.6%)	48 (62.3%)	0.345

(Statistical test = chi-square)

Clinical profiles: On comparing the signs and symptoms at presentation and initial diagnosis of AMI among younger and elderly females [**Table 3**], we found that the most common clinical presentation in both age groups is typical angina, followed by NSTEMI and then STEMI. Acute left ventricular failure (LVF) and cardiogenic shock are less prevalent. The p-values indicate that the differences in prevalence between younger and elderly females are not statistically significant for most parameters: typical angina (p=0.417), STEMI (p=0.388), NSTEMI (p=0.388), and cardiogenic shock (p=0.153). However, there is a statistically significant difference for acute LVF (p=0.021), suggesting that this condition is more prevalent in the elderly group.

Table 3: Clinical profiles of younger and elderly group females of the study group.

Parameters	**Younger females** (n=38)	**Elderly females** (n=77)	**P-value**
Typical angina	35 (92.1%)	67 (87%)	.417
STEMI	16 (42.1%)	39 (50.6%)	.388
NSTEMI	22 (57.9%)	38 (49.3%)	.388
Acute LVF	4 (10.5%)	19 (24.7%)	.021
Cardiogenic shock	0	4 (5.2%)	.153

STEMI: ST-segment elevation MI; NSTEMI: Non-ST-segment elevation MI; LVF: Left ventricular failure.

Coronary Angiographic Profile: The coronary angiographic profile of the study population, including both younger and elderly women with acute myocardial infarction (AMI), reveals several key findings regarding the extent of coronary artery disease (CAD).

The majority of the study population had significant coronary artery disease, with 92.2% overall, 86.8% in younger women, and 94.8% in elderly women (p=0.135). Single vessel disease (SVD) was observed in 28.7% of the overall population, being slightly more prevalent in younger women (34.2%) compared to elderly women (26.0%) (p=0.358). Double vessel disease (DVD) was the most common form of significant CAD, affecting 34.8% of the overall population, with a higher prevalence in elderly women (39.0%) than in younger women (26.3%) (p=0.180). Triple vessel disease (TVD) was also prevalent, found in 28.7% of the overall population, with similar rates between younger (26.3%) and elderly women (29.9%) (p=0.692). A smaller proportion had triple vessel disease plus left main (TVD+LM) involvement, noted in 3.4% of the overall group, with no significant difference between younger (5.3%) and elderly women (2.6%) (p=0.463).

Less commonly, non-significant lesions were found in 6.1% of the overall population, being more frequent in younger women (10.5%) than in elderly women (3.9%) (p=0.162). Only a small fraction had normal coronaries, with no significant difference between younger (2.6%) and elderly women (1.3%) (p=0.607). These findings underscore the high prevalence of significant CAD in women with AMI, with some variations in the extent of disease between younger and older patients.

Table 4: Showing coronary angiographic extent of coronary artery disease in the study population.

Parameters	**Overallfemales**(n=115)	**Youngerwomen** (n=38)	**Elderlywomen**(n=77)	**P-value**
Normal coronaries	2 (1.7%)	1 (2.6%)	1 (1.3%)	0.607
Non-significantlesion	7(6.1%)	4 (10.5%)	3 (3.9%)	0.162
Significant CAD	106 (92.2%)	33 (86.8%)	73 (94.8%)	0.135
SVD	33 (28.7%)	13 (34.2%)	20 (26.0%)	0.358
DVD	40 (34.8%)	10 (26.3%)	30 (39.0%)	0.180
TVD	33 (28.7%)	10 (26.3%)	23 (29.9%)	0.692
TVD+LM	4 (3.4%)	2 (5.3%)	2 (2.6%)	0.463

[SVD: Single vessel disease; DVD: Double vessel disease; TVD: Triple vessel disease; LM: Left main]

Discussion

The present study provides a comprehensive analysis of risk factors, clinical angiographic outcomes among female patients with acute myocardial infarction AMI. The findings reveal significant differences across age groups, highlighting the need for age-specific strategies in the management of AMI in women. In our study, the elderly females exhibited a higher prevalence of hypertension as compared to younger females. The study by Chapagain et al. [7] identified various risk factors among Nepalese females, where hypertension was reportedly present in 54.5% of women admitted with AMI. Our findings, align with the established understanding that these conditions increase with age and contribute significantly to cardiovascular risk. Several studies have indicated that a history of hypertension is linked to a higher incidence of adverse outcomes following an AMI, including stroke, heart failure, and cardiovascular

death [8-10]. While the precise mechanisms remain unclear, the heightened risk of AMI or sudden death in hypertensive patients appears to be associated with endothelial damage, atherosclerosis, insulin resistance, left ventricular hypertrophy, and ventricular arrhythmias [10,11]. Moreover, identification of a positive family history of AMI among younger females, highlight the importance of early screening and awareness among the female population.

AMI among our study participants typically presented with symptoms of angina, whose prevalence was comparable between younger and elderly females. Also, lipid profile is comparable between groups indicating that alteration in cholesterol and its components plays a key role in the pathophysiology of AMI irrespective of age and gender [12-15]. In this study, acute LVF was significantly higher among the elderly females, which is indicative of the development of heart failure following the attack of MI, which serves as an important prognostic indicator. Similar presentation has been reported by Jenča et al. [16] and Miller et al. [17].

Coronary angiographic imaging revealed the presence of significant coronary artery disease, in either of the age categories, namely, single vessel disease (SVD) (28.7%) double vessel disease (DVD) (34.8%) and triple vessel disease (TVD) (28.7%) Typically, the left anterior descending artery (LAD) is the most commonly involved vessel, followed by the right coronary artery (RCA) [18,19].

The present study underscores the need to prevent and control hypertension among the elderly females. The presence of multiple comorbidities and the resultant polypharmacy further complicate the cardiovascular risk profile of elderly women, necessitating comprehensive management strategies that address these complexities. However, the lack of significant differences in clinical presentations between age groups challenges the commonly held perception that age substantially alters the symptomatic presentation in female AMI patients. The uniformity in clinical presentations suggests that diagnostic protocols and therapeutic interventions for AMI in women can be standardized across age groups. This could streamline clinical practices and ensure that all female patients receive prompt and effective care.

Limitations

Several limitations should be considered when interpreting the results of this study. Firstly, the observational design may introduce selection bias. Secondly, our study population was drawn from a single center, which may limit the generalizability of the findings. Lastly, the potential influence of unmeasured confounding variables cannot be excluded.

Conclusion

The findings of our study underscores the need for a unified approach in both prevention and clinical management. Recognizing the commonality of risk factors and symptoms across age groups can enhance the effectiveness of healthcare strategies, leading to better outcomes for all female patients experiencing AMI.

Conflict of Interest

None

Funding Statement

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