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Original Research Article

Effect of Risk Factors on LV Systolic Dysfunction After Acute ST Elevation Myocardial Infarction

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Abstract: *Left ventricular (LV) systolic dysfunction is a common complication following acute ST-elevation myocardial infarction (STEMI), particularly anterior wall infarctions. Several modifiable and non-modifiable cardiovascular risk factors, including diabetes, hypertension, smoking, obesity, and family history, have been implicated in the development of post-infarction LV dysfunction. However, the independent predictive value of these risk factors remains unclear in specific populations such as those in Pakistan.* ***Objective:*** *To assess the effect of major cardiovascular risk factors on the development of LV systolic dysfunction in patients presenting with a first episode of anterior STEMI.* ***Methods:*** *This observational cross-sectional study was conducted at the Department of Cardiology, Pervaiz Elahi Institute of Cardiology, Bahawalpur, Pakistan, over six months (July 2023 to January 2024). A total of 114 patients aged 25–70 years with first anterior STEMI were enrolled. Clinical and demographic data were recorded, and LV function was evaluated via echocardiography within 72 hours of admission. LV systolic dysfunction was defined as an ejection fraction <40%. Statistical associations between risk factors and LVD were assessed using chi-square tests.* ***Results:*** *The mean age of the cohort was 42.62 ± 10.13 years; 59.6% were male. Common risk factors included smoking (40.4%), diabetes (29.8%), hypertension (50%), and obesity (40.4%), while 59.6% had a positive family history of ischemic heart disease. LV systolic dysfunction was present in 20.2% of patients. No statistically significant association was found between LVD and age, gender, smoking, diabetes, hypertension, obesity, or family history ($p > 0.05$ for all).* ***Conclusion:*** *Although traditional cardiovascular risk factors were prevalent in patients presenting with anterior STEMI, none demonstrated a statistically significant association with early LV systolic dysfunction in this cohort. These findings suggest that additional pathophysiological or genetic factors may contribute to post-infarction LV impairment, underscoring the need for broader risk assessment and longitudinal studies in South Asian populations.*

Keywords: ST-elevation myocardial infarction, left ventricular dysfunction, risk factors, echocardiography, cardiovascular disease, Pakistan

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Introduction

In Pakistan, cardiovascular diseases (CVDs) are a significant public health concern and a major contributor to mortality rates. Among the various forms of CVDs, acute ST-elevation myocardial infarction (STEMI) is a critical condition that frequently leads to left ventricular (LV) systolic dysfunction. The development of LV dysfunction post-STEMI is associated with several risk factors, including diabetes mellitus, hypertension, obesity, and metabolic syndrome, all of which are prevalent in the Pakistani population.

Diabetes mellitus, in particular, is a recognized critical risk factor for the progression of LV systolic dysfunction following acute myocardial infarction (AMI). Studies indicate that subclinical LV systolic dysfunction may be prevalent in individuals with diabetes, potentially exacerbating post-infarction complications (1,2,3). Furthermore, uncontrolled diabetes has been shown to significantly impair cardiac performance, leading to poorer prognoses in diabetic patients after heart attacks (4,5).

Hypertension is one of the leading cardiovascular risk factors in Pakistan, with studies indicating a strong correlation between hypertension and LV systolic dysfunction (6,7). Elevated blood pressure increases afterload, resulting in ventricular hypertrophy and subsequent dysfunction, particularly during ischemic events such as acute myocardial infarction (8). The combination of increased myocardial oxygen demand and impaired coronary perfusion creates an environment conducive to LV systolic dysfunction.

Additionally, obesity significantly influences cardiac structural changes and the development of LV systolic dysfunction following acute ischemic episodes (9,4). Arterial stiffness and cardiovascular remodeling associated with obesity further heighten the risk of systolic dysfunction after AMI (10).

The impact of metabolic syndrome on cardiac function highlights the pressing need to address these interconnected risk factors within the Pakistani context. Individuals with metabolic syndrome present a higher prevalence of both diastolic and systolic dysfunctions, predisposing them to adverse outcomes post-STEMI (7,5). Furthermore, contributing factors such as smoking and a sedentary lifestyle, prevalent in the Pakistani population, continue to add to the burden of cardiovascular morbidity, underscoring the importance of a culturally tailored approach to prevention and management (11,12).

Given the multifactorial nature of LV systolic dysfunction after acute STEMI and the high incidence of modifiable risk factors in the Pakistani population, this study aims to elucidate the specific contributions of identified risk factors to LV systolic dysfunction post-AMI. By understanding the predominant risk factors, we can develop targeted interventions to improve patient outcomes following myocardial infarctions. This necessitates a comprehensive approach integrating clinical assessment, lifestyle modification, and familial health education to mitigate the impact of these risk factors across diverse demographic strata in Pakistan.

Methodology

This observational cross-sectional study was conducted at the Department of Cardiology, Pervaiz Elahi Institute of Cardiology, Bahawalpur, Pakistan, over six months from July 23, 2023, to January

24, 2024. Ethical approval was obtained from the institutional review board prior to data collection, and the study adhered to the ethical standards outlined in the Declaration of Helsinki (2013). All participants provided written informed consent before enrollment.

A total of 114 patients were included in the study through a non-probability consecutive sampling technique. Eligible participants were men and women aged between 25 and 70 years who presented with their first episode of acute anterior wall ST-elevation myocardial infarction (STEMI). The diagnosis of STEMI was based on clinical history, electrocardiographic findings showing ST-segment elevation in leads V1 to V4, and elevated cardiac enzymes. Patients were excluded if they had a history of previous myocardial infarction, known ischemic heart disease, cardiomyopathies, significant valvular heart disease, or evidence of hepatic or renal dysfunction.

Demographic information and cardiovascular risk factors were recorded for each patient using a structured proforma. These included age, gender, smoking status, diabetes mellitus, hypertension, obesity, and family history of ischemic heart disease. Smoking was defined as the current or past use of at least one cigarette per day for a minimum of one year. Diabetes mellitus was recorded if the patient had a previous diagnosis or if the fasting blood glucose level was ≥126 mg/dL. Hypertension was defined as a history of elevated blood pressure requiring medication or a blood pressure ≥140/90 mmHg on two or more readings. Obesity was defined using a body mass index (BMI) threshold of ≥30 kg/m², and a positive family history was defined as the presence of documented ischemic heart disease in a first-degree relative.

All patients underwent two-dimensional transthoracic echocardiography within 72 hours of admission to assess left ventricular systolic function. Echocardiograms were performed using a GE Vivid E95 machine equipped with a 2.5 MHz phased-array transducer. The left ventricular ejection fraction (LVEF) was calculated using Simpson's biplane method in accordance with the recommendations of the American Society of Echocardiography. An LVEF of less than 40% was considered indicative of left ventricular dysfunction (LVD).

Data analysis was performed using IBM SPSS Statistics version 23.0. Continuous variables such as age and BMI were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables including gender, smoking, diabetes mellitus, hypertension, obesity, family history of ischemic heart disease, and LVD status were summarized using frequencies and percentages. The association between LVD and the recorded risk factors was evaluated using the chi-square test, with a p-value of ≤0.05 considered statistically significant.

Results

A total of 114 patients with first anterior wall ST-elevation myocardial infarction (STEMI) were enrolled in the study. The mean age of the participants was 42.62 ± 10.13 years. The majority of patients were male (59.6%), and 55.3% of participants were in the 41–60 years age group. In terms of cardiovascular risk factors, 40.4% were smokers, 29.8% had diabetes mellitus, 50% had hypertension, and 40.4% were obese. A positive family history of ischemic heart disease (IHD) was reported by 59.6% of the patients. The overall prevalence of left ventricular dysfunction (LVD) among the cohort was 20.2%. Details of the demographic and clinical variables are summarized in Table 1.

Table 1. Demographic and Clinical Characteristics of Patients with First Acute Anterior STEMI (n = 114)

Variable	Categories	Frequency (n)	Percentage (%)
Age Group (years)	25–40	51	44.7
	41–60	63	55.3
Mean Age ± SD			42.62 ± 10.13
Gender	Male	68	59.6
	Female	46	40.4
Smoking Status	Smoker	46	40.4
	Non-smoker	68	59.6
Diabetes Mellitus	Yes	34	29.8
	No	80	70.2
Hypertension	Yes	57	50.0
	No	57	50.0
Obesity	Yes	46	40.4
	No	68	59.6
Family History of IHD	Yes	68	59.6
	No	46	40.4
LVD Status	Present	23	20.2
	Absent	91	79.8

The study cohort predominantly consisted of middle-aged males. Risk factors such as smoking, diabetes, hypertension, and obesity were common among participants. A significant proportion also had a positive family history of ischemic heart disease. LVD was observed in approximately one-fifth of the patients post-infarction. (Table 1)

To evaluate the association between LVD and various clinical and demographic variables, subgroup analysis using the chi-square test was performed. No statistically significant relationship was found between LVD and age group (p = 0.739), gender (p = 0.278), smoking (p = 0.278), diabetes (p = 0.145), hypertension (p = 0.102), obesity (p = 0.278), or family history of IHD (p = 0.413). These results suggest that although these traditional risk factors are prevalent, they do not independently predict the development of LVD following a first anterior STEMI in this cohort (Table 2).

Table 2. Association Between Risk Factors and Left Ventricular Dysfunction (LVD) Post-Anterior STEMI (n = 114)

Variable	Category	LVD Present n (%)	LVD Absent n (%)	p-value
Age Group (years)	25–40	11 (21.6%)	40 (78.4%)	0.739
	41–60	12 (19.0%)	51 (81.0%)	

Gender	Male	16 (23.5%)	52 (76.5%)	0.278
	Female	7 (15.2%)	39 (84.8%)	
Smoking	Yes	7 (15.2%)	39 (84.8%)	0.278
	No	16 (23.5%)	52 (76.5%)	
Diabetes Mellitus	Yes	4 (11.8%)	30 (88.2%)	0.145
	No	19 (23.8%)	61 (76.3%)	
Hypertension	Yes	8 (14.0%)	49 (86.0%)	0.102
	No	15 (26.3%)	42 (73.7%)	
Obesity	Yes	7 (15.2%)	39 (84.8%)	0.278
	No	16 (23.5%)	52 (76.5%)	
Family History of IHD	Yes	12 (17.5%)	56 (82.4%)	0.413
	No	11 (23.9%)	35 (76.1%)	

The comparative analysis between patients with and without LVD shows no statistically significant association between any of the studied risk factors and the presence of LVD. Although patients with diabetes, hypertension, and obesity exhibited numerically lower proportions of LVD, these differences were not statistically significant. This indicates that the development of LVD following a first anterior STEMI may be influenced by additional pathophysiological or ischemic factors beyond conventional risk profiles.

Discussion

The study results indicate a noteworthy demographic and clinical profile among patients with first anterior wall ST-elevation myocardial infarction (STEMI) in Pakistan, revealing that traditional cardiovascular risk factors such as diabetes, hypertension, smoking, and obesity are prevalent. With a mean age of 42.62 ± 10.13 years and a predominance of male patients (59.6%), the study aligns with trends in STEMI demographics, particularly among younger populations in low- to middle-income countries Moran et al. (13). This finding underscores the increasing burden of ischemic heart disease (IHD) in this cohort, reflecting a need for targeted public health strategies to mitigate these risk factors.

In our cohort, the overall prevalence of left ventricular dysfunction (LVD) was observed in 20.2% of patients post-infarction. This finding is consistent with the literature, which presents significant incidences of LV dysfunction following anterior myocardial infarction (14). Comparatively, Timmers et al. discuss that anterior myocardial infarction is particularly associated with heightened risks of early LV dysfunction, potentially due to the critical nature of the affected myocardium and its role in cardiac output (15). Interestingly, despite the high prevalence of risk factors in our study, the analysis revealed no statistically significant associations between these factors and the presence of LVD ($p > 0.05$ for all variables). This raises intriguing questions about the multifactorial etiology of post-STEMI LVD beyond conventional risk profiles.

Notably, our results diverge from studies indicating that traditional risk factors exhibit predictive capability for early LV dysfunction post-AMI, particularly in anterior myocardial infarction cases (16). The lack of statistically significant associations in our findings may suggest that additional pathophysiological mechanisms, such as microvascular dysfunction, inflammatory responses, or genetic predispositions, might contribute more critically to the development of LVD in our cohort (17, 18). This is consistent with speculation that acute hyperglycemic stress, often prevalent among patients with diabetes, may hinder LV recovery through complex biochemical pathways following AMI (19).

Further, the 40.4% prevalence of obesity among our participants aligns with global concerns regarding obesity as a cardiovascular risk factor. Previous research has established that obesity complicates the prognosis of myocardial infarction due to its association with increased systemic inflammation and subsequent adverse cardiac remodeling (20,21). Moreover, while correlations between obesity and LV dysfunction have been observed (22), our results indicate a need to reassess this relationship in different populations, particularly given the intricate interplay of socioeconomic and genetic factors unique to the Pakistani context.

Lastly, despite the adverse effects observed in the presence of these traditional risk factors, our findings indicate that a family history of ischemic heart disease was notably prevalent (59.6% positive history), suggesting a potential genetic vulnerability within this population, which echoes findings in other regions (23,24). This familial predisposition, combined with the observed high-risk factor prevalence, emphasizes the importance of recognizing the inherited component of cardiovascular disease in creating effective preventive strategies.

Thus, our study highlights a complex landscape of cardiovascular risk factors and their association—or lack thereof—with LV dysfunction post-STEMI among patients in Pakistan. The discrepancies between our findings and those of international studies suggest the necessity for further investigations focusing on genetic markers, inflammatory mechanisms, and improved risk stratification methods to delineate the predictive capacity of traditional risk factors in diverse populations.

Conclusion

This study found a high burden of conventional cardiovascular risk factors among patients presenting with anterior STEMI in Pakistan. Despite their prevalence, none of these factors—including diabetes, hypertension, smoking, obesity, or family history—were independently associated with early left ventricular systolic dysfunction. These findings challenge the predictive utility of traditional risk profiles in this context and highlight the potential role of unmeasured variables such as microvascular dysfunction, genetic predisposition, or inflammatory mechanisms. A nuanced, multifactorial approach to risk stratification and post-MI management may therefore be warranted in regional populations. Future large-scale, longitudinal studies are essential to validate these observations and guide targeted interventions.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-MMS-033-24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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