

Original Research Article

Risk factors of acute heart failure after the first episode of acute coronary syndrome

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ABSTRACT

Background: Factors that speed up the development of acute heart failure (AHF) after acute coronary syndrome (ACS), are understudied in developing country like Pakistan. Therefore, this study was aimed to determine the risk factor of heart failure (HF) among the post-ACS patients.

Methods: This descriptive cross-sectional study was performed at Benazir Bhutto Hospital (BBH), Rawalpindi, Pakistan. 78 patients who were admitted with HF cardiology unit of BBH after ACS from March 2023 to April 2024 were enrolled in the study. An established inclusion and exclusion criteria along with consecutive sampling technique were used for patients' recruitment. A self-structured proforma was applied to gather data. Data analysis was done in the statistical package for the social sciences (SPSS) version 25.0.

Results: HF was more prevalent among those post-acute coronary syndrome patients who had an age group with 40 years or above (69.23%), male gender (62.82%), anterior wall myocardial infarction (38.46%), reduced ejection fraction (67.90%), left anterior descending artery pathology (17.95%), absence of myocardial revascularization procedure (46.15%), diabetes mellitus (52.56%), hypertension (78.20%), anemia (53.85%), hyperlipidemia (75.64%), and who had history of smoking (51.28%). A significant number of patients also had chronic kidney disease (23.10%).

Conclusions: Factors such as an age group with 40 years or above, male gender, anterior wall myocardial infarction, reduced ejection fraction, left anterior descending artery pathology, absence of myocardial revascularization procedure, diabetes mellitus, hypertension, anemia, hyperlipidemia, and history of smoking, all accelerate the development of HF among post-ACS patients.

Keywords: Risk, Factors, Acute, Heart, Failure, Coronary, Syndrome

INTRODUCTION

Acute coronary syndrome (ACS) is characterized by reduced heart muscle perfusion that leads to various symptoms and signs such as crushing chest pain with

radiation to jaw or left arm, increased heartbeat, sudden sweating, shortness of breath, dizziness, and nausea or vomiting.^{1,2} The primary pathogenic hallmark of ACS is the unstable plaque rupture or erosion in the vessel that causes total or incomplete occlusive thrombosis. It has

three subtypes which are characterized as non-ST-segment elevation on the electrocardiogram (ECG) trace, such as unstable angina (UA) and non-ST-segment elevation myocardial infarction (NSTEMI), or as ST-segment elevation, such as acute ST-segment elevation myocardial infarction (STEMI).^{3,4}

ACS is a fatal disease with the characteristics of acute onset, rapid progress, and poor prognosis. It is also associated with various lethal complications. One of the most common complications is heart failure (HF).^{5,6} Myocardial compromise caused by myocardial necrosis, myocardial stunning, and mechanical complications such as papillary muscle rupture, ventricular septal defect, and ventricular free wall rupture, all play a role in the pathogenesis of HF development after myocardial infarction. Cardiomyocyte structural alterations and edema begin within 30 minutes of ischemia, progressing to myocyte death after 3 hours. Reperfusion induces a second wave of harm by producing reactive oxygen species. Myocyte death activates an inflammatory response, which leads to the development of HF.^{7,8}

Furthermore, HF at this time can be triggered by the presence of co-morbidities such as diabetes mellitus, hypertension, anemia, chronic kidney disease, hyperlipidemia, and smoking.⁹⁻¹⁴

Identification of the risk factors that accelerates the HF development after ACS could help in the reducing the risk of HF and its early onset in patients after ACS. Therefore, this study aims to determine the possible risk factors of heart failure in patients after acute coronary syndrome.

METHODS

Study design and study population

This descriptive cross-sectional study was performed in the Cardiology Unit of Benazir Bhutto Hospital (BBH), Rawalpindi, Pakistan. 78 patients who were admitted with AHF cardiology unit of BBH after ACS from March 2023 to April 2024 were enrolled in the study. An established inclusion and exclusion criteria along with consecutive sampling technique were used for patients' recruitment.

Inclusion and exclusion criteria

All patients were included in the study who had, age 18 years or above, admitted in cardiac unit of BBH with diagnosed HF following ACS, history of only one episode of diagnosed ACS in last one year with complete medical record of their first admission with ACS.

While those admitted patients who had, history of stable angina, congenital heart disease, severe liver disease, autoimmune disease, active infectious disease, oncological conditions, and who were not willing to participate were excluded from the study.

Acute heart failure and acute coronary syndrome

To determine whether patients had AHF, the diagnostic criteria for AHF were based on the European Society of Cardiology's 2021 guidelines for the diagnosis and treatment of acute and chronic heart failure. AHF was diagnosed based on clinical symptoms such as dyspnea, fast heartbeat, third heart sound, elevated jugular vein pressure, lung rales, and lower limb edema. Furthermore, higher B-type natriuretic peptide (BNP) levels were taken into account. Similarly, ACS was diagnosed using the European Society of Cardiology's 2023 guidelines for the diagnosis and management of ACS. The diagnosis and classification of ACS was made on the basis of clinical features (chest pain (crushing, pressure like feeling in character) with radiation to jaw or left arm, racing heartbeat, shortness of breath, sudden sweating, dizziness, and nausea or vomiting), electrocardiographic (ECG), cardiac biomarker (enzymes) levels, coronary angiography, and echocardiography were also taken into account.

Data collection

A self-designed questionnaire was applied for data collection. It had three components. First component had sociodemographic features such as age (less than 40 years and 40 and above years), gender (male or female), and comorbidities presence or absence (diabetes mellitus, hypertension, anemia, chronic kidney disease, hyperlipidemia, and smoking). Second component was regarding the variables that were associated with findings of ECG (location of MI), coronary angiography (vessel involved), and echocardiography (ejection fraction: normal or reduced) during ACS before HF development. Third component was comprised of biochemical markers' values such as serum lipid level, hemoglobin, serum creatinine level, and cardiac biomarkers. Information about the revascularization (thrombolysis, percutaneous coronary intervention, coronary artery bypass, None) was also noted in this part of the questionnaire.

Data analysis

The statistical analysis of data was performed through statistical package for the social sciences (SPSS) 25.0 (Armonk, NY: IBM Corp.). By using descriptive statistics, numerical data were shown as mean±standard deviation and nominal data were presented as frequencies and percentages.

RESULTS

Means of various study variables such as age and ejection fraction were 59.09 with a standard deviation (SD) of ±12.12 year and 42.58 with SD of ±8.10 respectively.

Table 1 indicates that that incidence of HF was more common among the patients who had older age group (age 40 years or above) and male gender in contrast to the

patients who had younger age group (age less than 40 years) and female gender.

Table 1: Demographic characteristics of the study population.

Variables	Frequency (n)	Percentage
Age (years)		
Less than 40	24	30.77
40 and above	54	69.23
Gender		
Male	49	62.82
Female	29	37.18

Table 2: Frequency and percentages of cardiac risk factors in study population.

Variables	Frequency (N)	Percentage
ECG territory changes		
Anterior	30	38.46
Inferior	19	24.36
Lateral	9	11.54
Septal	8	10.25
Anterior and Inferior	6	7.70
Anterior and lateral	4	5.13
Inferior and lateral	2	2.56
Ejection fraction on echocardiography		
Normal	25	32.10
Reduced	53	67.90
Coronary angiography		
Not performed	37	47.44
Single-vessel disease	24	30.77
Left anterior descending artery	14	17.95
Right coronary artery	6	7.70
Circumflex artery	4	5.13
Two-vessel disease	13	16.70
Left anterior descending artery and circumflex coronary artery	7	8.97
Left anterior descending artery and right coronary artery	4	5.13
Circumflex coronary artery and right coronary artery	2	2.56
Triple-vessel disease	4	5.13
Myocardial revascularization		
Thrombolysis	14	17.95
Percutaneous coronary intervention	23	29.50
Coronary artery bypass graft	5	6.41
Not performed	36	46.15

Table 2 shows that frequency of HF was higher among the participants who had ECG changes in anterior territory followed by inferior, lateral, septal, anterior and inferior, anterior and lateral, and inferior and lateral territories. It also displays that patients with reduced ejection fraction, single-vessel disease which involved mainly left anterior descending artery, two-vessel disease involved left anterior descending artery and circumflex coronary artery, and with none myocardial revascularization procedures, had higher HF frequency in comparison to patients with normal ejection fraction, single-vessel disease which involved either right coronary artery or circumflex artery, two-vessel disease involved either left anterior descending artery and right coronary artery or circumflex coronary artery and right coronary artery and with different myocardial revascularization procedures, had lower HF frequency.

Table 3 manifests that HF incidence was more prevalent among the patients with who had diabetes mellitus, hypertension, anemia, hyperlipidemia, and history of smoking as compared to who had not above-mentioned comorbidities. However, a significant number of patients also had chronic kidney disease.

Table 3: Frequency and percentages of systemic risk factors in study population.

Variables	Frequency (N)	Percentage
Diabetes mellitus		
Yes	41	52.56
No	37	47.44
Hypertension		
Yes	61	78.20
No	17	21.80
Anemia		
Yes	42	53.85
No	36	46.15
Chronic kidney disease		
Yes	18	23.10
No	60	76.90
Hyperlipidemia		
Yes	59	75.64
No	19	24.36
History of smoking		
Yes	40	51.28
No	38	48.72

DISCUSSION

ACS is a fatal disease. It is characterized by an acute onset, fast progression, and a dismal prognosis. It is also linked to some deadly consequences. One of the most common consequences is heart failure. The study has provided crucial findings on the risk factors for heart failure after ACS.

Heart failure develops following MI hospitalization as a result of cardiomyocyte death and scar formation, which causes chronic neurohumoral activation (renin-angiotensin-aldosterone and sympathetic nervous system upregulation) and ventricular remodeling. Ventricular remodeling alters ventricular geometry, resulting in wall thinning, ischemic mitral regurgitation, and further cardiomyocyte loss.^{7,12,14}

Initially, we looked at how the research population's socio-demographic factor influenced the development of HF after ACS. It was observed that patients with older age group in study population had higher frequency of HF after ACS. Similar results about the impact of age on HF development was noted in a study that was conducted in United Kingdom.⁴ Regarding the gender difference in the frequency of HF after ACS, it was noted that patients with male gender had higher HF rate. Higher HF rate in male gender is also presented in a study that was performed Romania.¹ However, another study in the literature showed female dominance in HF after ACS.⁵ The differences in the findings could be due to racial, socio-demographic, and geographical variations in the different studies' populations.

During the assessment of cardiac risk factors for HF after ACS, it was found that ACS that involved anterior wall of heart and left anterior descending artery, had higher frequency of HF in contrast to ACS that affected other parts and vessels of heart. The higher risk of HF associated with anterior wall ACS is explained by the larger degree of irreversible of left ventricular damage, as compared to other locations' ACS. It is caused by severe lesions of left anterior descending artery. Different studies have been reported the results that are consistent with the findings of current study.^{6,9} Present study had also showed that reduced ejection fraction was also associated with greater chance to have HF. This was also endorsed by the results of the several studies all over the world.^{1,3,9} Patients who had not underwent any myocardial revascularization procedure had higher rate of post-ACS HF. This finding was also observed in different studies in various parts of the world.^{4,5}

Regarding the systemic risk factors of HF after ACS, it was noticed that presence of comorbidities such as diabetes mellitus, hypertension, anemia, hyperlipidemia, and history of smoking among the patients with ACS was found to raise HF rate in comparison to the patients who did not have comorbidities. Several studies in the literature have supported the current study findings regarding the role of comorbidities in rapid onset of HF after ACS.⁸⁻¹³

Presence of comorbidities in the patients with ACS causes HF to develop early by different mechanisms such as increasing the rate of vessels atherosclerosis and obstruction and injury of microvascular system. These mechanisms cause poor remodeling of left ventricle that raises the risk of post-ACS HF.

Study strengths and limitations

Merit of this study is that, it's the only study in study locality that has identified potential risk factors for heart failure in the population with one episode of acute coronary syndrome. Limitations of this study includes that's its single center study and has a small sample size. As a result, this study encourages other researchers to conduct future studies in multiple centers with larger sample sizes to prevent any bias in the results.

CONCLUSION

This present study results have suggested that frequency of heart failure in the post-acute coronary syndrome patients was higher among those who had the age 40 years or above and male gender. The main risk factors associated with the development of HF were anterior wall myocardial infarction, left anterior descending artery pathology, reduced ejection fraction, absence of myocardial revascularization procedure, and presence of comorbidities such as diabetes mellitus, hypertension, anemia, hyperlipidemia, and history of smoking. A significant number of patients also had chronic kidney disease. Health officials should raise people's awareness of risk factors for heart failure following acute coronary syndrome through public service announcements, regular health fairs, newsletters, and mass media campaigns. Heart failure incidence could be reduced by increasing public knowledge about risk factors and preventive actions. Furthermore, a proper assessment and forecasting could limit the risk of HF in post-ACS patients. It could also effectively overcome post-ACS problems and maximize their degree of recovery.

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