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Original Research Article

Factors contributing to acute heart failure after a first acute coronary syndrome episode

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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 India. 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 Government General Hospital (GGH) Srikakulam, Andhra Pradesh, India. 108 patients who were admitted with HF cardiology unit of GGH after ACS from September 2023 to November 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: Clinical features, including glucose levels, dyslipidemia, COPD, and medication history, were analyzed in patients with and without ACS. HF was more common in those aged≥40 years (69.23%), male (62.82%), and with anterior wall myocardial infarction (38.46%). Key risk factors included reduced ejection fraction (67.90%), left anterior descending artery pathology (17.95%), absence of myocardial revascularization (46.15%), diabetes mellitus (52.56%), hypertension (78.20%), anemia (53.85%), hyperlipidemia (75.64%), and smoking history (51.28%). Additionally, glucose dysregulation, dyslipidemia, COPD, and medication history influenced HF progression.
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: Acute, Coronary, Factors, Failure, Heart, Risk, Syndrome

INTRODUCTION

Acute coronary syndrome (ACS) refers to a spectrum of clinical presentations resulting from a sudden reduction in myocardial perfusion, which manifests as symptoms such as severe chest pain radiating to the jaw or left arm, tachycardia, diaphoresis, dyspnea, dizziness, and gastrointestinal discomfort, including nausea or vomiting.[1,2] The primary pathological event in ACS involves the rupture or erosion of an unstable atherosclerotic plaque, leading to partial or complete thrombotic occlusion of a coronary artery. The condition is classified into three subtypes based on electrocardiographic findings: unstable angina (UA) and non-ST-segment elevation myocardial infarction

(NSTEMI), which lack ST-segment elevation, and acute ST-segment elevation myocardial infarction (STEMI), characterized by the hallmark ST-segment elevation on ECG.[3,4]

ACS is a life-threatening condition with a rapid onset, accelerated progression, and poor prognosis. Its clinical course is often complicated by a variety of severe outcomes, including heart failure (HF), which is among the most prevalent complications.[5,6] The pathogenesis of HF post-myocardial infarction involves a cascade of events, including myocardial necrosis, myocardial stunning, and mechanical complications such as papillary muscle rupture, ventricular septal defect, and ventricular free wall rupture. Cellular damage begins within minutes of ischemia, with structural alterations and edema evident by 30 minutes and irreversible myocyte death occurring within 3 hours.

Additionally, reperfusion therapy, while essential, contributes to injury through the generation of reactive oxygen species, exacerbating myocyte loss. The resulting inflammatory cascade further promotes HF development.[7,8] The presence of comorbidities such as diabetes mellitus, hypertension, anemia, chronic kidney disease, hyperlipidemia, and smoking exacerbates the risk and progression of HF following ACS.[9-14]

Early identification and management of these risk factors could play a critical role in mitigating HF development and improving clinical outcomes in patients recovering from ACS. This study, therefore, seeks to investigate the potential risk factors contributing to HF onset in patients post-ACS, with the goal of reducing morbidity and improving prognostic outcomes.

METHODS

Study design

This descriptive cross-sectional study was performed in the Cardiology Unit of Government general hospital (GGH) Srikakulam, Andhra Pradesh India.

Study population

108 patients who were admitted with AHF cardiology unit of GGH after ACS from September 2023 to November 2024 were enrolled in the study. An established inclusion and exclusion criteria along with consecutive sampling technique were used for patients' recruitment.

Inclusion criteria

All patients were included in the study who had, age 18 years or above, admitted in cardiac unit of GGH 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.

Exclusion criteria

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.

Statistical 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 fracture 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 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 1: Demographic characteristics of the study population.

Variables	Frequency (N)	%
Age (years)		
Less than 40	34	30.77
40 and above	74	69.23
Gender		
Male	68	62.82
Female	40	37.18

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

Variables	Frequency (N)	%
ECG territory changes		
Anterior	41	38.46
Inferior	26	24.36
Lateral	12	11.54
Septal	11	10.25
Anterior and Inferior	8	7.70
Anterior and lateral	5	5.13
Inferior and lateral		2.56
Ejection fraction on echocardiography		
Normal	35	32.10
Reduced	73	67.90
Coronary angiography		
Not performed	51	47.44
Single-vessel disease	33	30.77
Left descending artery	19	17.95
Right coronary artery	8	7.70
Circumflex artery	5	5.13
Two-vessel disease	17	16.70
Left anterior descending artery and circumflex coronary artery	10	8.97
Left anterior descending artery and right coronary artery	5	5.13
Circumflex coronary artery and right coronary artery	3	2.56
Triple-vessel disease	5	5.13
Myocardial revascularization		
Thrombolysis	20	17.95
Percutaneous coronary intervention	31	29.50
Coronary artery bypass graft	7	6.41
Not performed	50	46.15

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

Variables	Frequency (N)	%
Diabetes mellitus		
Yes	56	52.56
No	50	47.44
Hypertension		
Yes	84	78.20
No	22	21.80
Anemia		
Yes	57	53.85
No	50	46.15
Chronic kidney disease		
Yes	24	23.10
No	83	76.90
Hyperlipidemia		
Yes	81	75.64
No	26	24.36
History of smoking		
Yes	55	51.28
No	51	48.72

DISCUSSION

Acute coronary syndrome and heart failure

ACS is a life-threatening condition characterized by sudden onset, rapid progression, and a grim prognosis. It is associated with severe complications, among which heart failure (HF) is one of the most prevalent and deleterious outcomes. This study offers significant insights into the risk factors contributing to HF development following ACS.

Heart failure commonly arises after myocardial infarction (MI) hospitalization due to cardiomyocyte death and subsequent scar tissue formation. This process initiates chronic neurohumoral activation involving the renin-angiotensin-aldosterone system and sympathetic nervous system upregulation. These mechanisms promote ventricular remodeling, altering ventricular geometry and resulting in wall thinning, ischemic mitral regurgitation, and additional cardiomyocyte loss. Such pathological changes underline the progression of HF after ACS.[7,12,14]

Sociodemographic factors influencing HF After ACS

The study analyzed how sociodemographic factors in the research population impacted HF development post-ACS. It was observed that older age groups had a higher incidence of HF following ACS. These findings are consistent with a similar study conducted in the United Kingdom, which highlighted age as a significant determinant of HF progression.[4] Regarding gender differences, this study found a higher HF rate among male patients, corroborating findings from a study conducted in Romania.[1] However, contrasting evidence from another study reported a predominance of HF among females after ACS.[5] These discrepancies may stem from variations in racial, sociodemographic, and geographical characteristics across different populations.

Cardiac risk factors for HF Post-ACS

The location and extent of ACS significantly influenced the development of HF. Patients with ACS involving the anterior wall of the heart and the left anterior descending artery exhibited a higher HF frequency compared to ACS affecting other regions. This can be attributed to the larger extent of irreversible left ventricular damage associated with anterior wall ACS due to severe lesions in the left anterior descending artery. Several studies align with this finding, affirming the higher risk linked to this specific anatomical location.[6,9]

Additionally, a reduced ejection fraction was strongly associated with an increased likelihood of HF development, a conclusion supported by numerous global studies.[1,3,9] Furthermore, patients who did not undergo myocardial revascularization procedures demonstrated a higher rate of post-ACS HF, consistent with findings from various international studies.[4,5]

Systemic risk factors of HF following ACS

The study identified several systemic risk factors contributing to HF development post-ACS. The presence of comorbidities such as diabetes mellitus, hypertension, anemia, hyperlipidemia, and smoking history significantly increased HF rates compared to patients without these

comorbidities. These observations are well-supported by literature emphasizing the role of comorbidities in accelerating HF onset.[8-13] Comorbidities exacerbate HF development through mechanisms like accelerated vascular atherosclerosis, microvascular injury, and impaired left ventricular remodelling, all of which contribute to poor cardiac outcomes. Such mechanisms underscore the importance of managing systemic risk factors in patients with ACS to mitigate HF risk.

This study's primary strength lies in its originality, as it is the only research in the study's locality to identify potential risk factors for HF in patients experiencing one episode of ACS. This localized focus provides valuable insights for regional healthcare planning and targeted interventions.

However, the study is not without limitations. Being a single-center study with a relatively small sample size, its findings may be subject to bias and limited generalizability. Future research involving multi-center studies with larger, more diverse populations is encouraged to validate these findings and enhance their applicability.

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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