ORIGINAL ARTICLE

FREQUENCY OF ACUTE HEART FAILURE IN NON ST ELEVATION ACUTE CORONARY SYNDROME; CAN WE PREDICT THE HEART FAILURE ON CLINICAL AND ELECTROCARDIOGRAPHY (ECG) BASIS?

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Objectives: Non-ST elevation acute coronary syndrome (NSTE-ACS) comprises NSTE myocardial infarction (NSTEMI) and unstable angina. A common complexity of NSTE-ACS is heart failure (HF). The objective of this study was to assess the incidence of in-hospital HF in NSTE-ACS patients and to link clinical and electrocardiographic (ECG) abnormalities to HF.

Methodology: This study was performed at National Institute of Cardiovascular Diseases (NICVD) Karachi, from January 1, 2018 to June 30, 2018. The study included all adult patients who were hospitalized with a diagnosis of non-ST elevation ACS. Their socio demographic profile, clinical findings, ECG findings, and occurrence of heart failure during hospital stay was recorded. Data was entered and analyzed using SPSS v.23.

Results: In this study 265 patients with NSTE-ACS were included. Mean age of 55.39±10.40 years was observed. There were 195 (73.6%) male patients. T-wave inversion was observed in 73 (27.5%) patients, ST-segment depression in 77 (29.1%), and both T-wave inversion and ST-segment depression in 71 (26.8%) patients. During their stay in the hospital, 28 patients (10.6 percent) developed HF. Diabetes, hypertension, smoking, a genetic susceptibility of ischemic heart disease, and combination of T-wave inversion and ST-segment depression on ECG was significantly correlated with HF ($P \leq 0.05$).

Conclusion: The determinants of HF were diabetes, hypertension, smoking, family history of ischemic heart disease, and combination of T-wave inversion and ST depression on ECG.

Keywords: Acute Coronary Syndrome, Non ST elevation changes, acute heart failure

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INTRODUCTION

On a global basis, cardiovascular diseases (CVDs) constitute the main cause of fatalities accounting for more than seventeen million deaths annually. Not only in the developed countries but CVDs are becoming extremely common in developing countries too. Public health experts have attributed this global transition to urbanization, changes in lifestyle and prolonged life span in these countries. Furthermore, population based studies have revealed that the incidence of ST elevation myocardial infarction (STEMI) is decreasing while the rate of non-STEMI (NSTEMI) is increasing.[1] According to the American College of Cardiology, non-ST elevation acute coronary syndrome (NSTE-ACS), which includes NSTE myocardial infarction (NSTEMI) and unstable angina, affects up to 70% of patients with acute coronary syndrome (ACS). Every year, more than 625,000 people are diagnosed with ACS as a result of these factors.[2] Clinicians associate this rise to diagnostic advancements and use of more sensitive assays for ACS detection. In NSTE-ACS there is partial to almost total occlusion of one or more coronary arteries. It compromises the blood flow to cardiac tissues resulting in myocardial injury. Since NSTE-ACS patients have a varying extent of coronary occlusion, their presentation, severity, and hence, their management is also heterogeneous.[3]

Among complications of NSTE-ACS, the most frequent ones are heart failure (HF), cardiogenic shock, and arrhythmias. During follow-up, the incidence rate of HF was 31 (95 % CI, 30–32) per 1000 person years for males and 46 (95% CI, 44–47) per 1000 person years for women, according to a recent population-wide cohort from Norway. Highest incidence of HF was seen during the first 6 months of follow- up.[4] Other studies have reported a varying frequency of HF in ACS patients. Myftiu et al. reported that 27% of their ACS patients developed HF[5] whereas Saejueng and colleagues reported 45% of NSTE-ACS patients to develop HF during their

hospital stay[6] and Franco et al reported that 15% of their NSTEMI patients had developed HF at the time of hospital admission.[7] Mehta et al. followed their NSTE-ACS patients for 6 months and reported that by the first week, 501/10,141 (4.9%) developed HF and by 6-month follow-up 643 (6.3%) had developed HF. Further, they reported that patients who developed HF were at increased risk of mortality (odds ratio (OR) 3.4, 95% CI 2.7-4.3) and new onset ACS (OR 2.8, 95% CI 2.2-3.6).[8]

Despite the fact that HF is a frequent consequence of NSTE-ACS and is linked to a poorer prognosis, the absence of substantial local literature casts doubt on the relevance of this link. As a result, this research was started to see how common HF occurs in NSTE-ACS patients. Furthermore, we aimed to assess if Electrocardiogram (ECG) changes in these patients (ST depressions and T wave inversions) on admission could help predict the development of HF during the hospital stay.

METHODOLOGY

From January 1, 2018 to June 30, 2018, the National Institute of Cardiovascular Diseases (NICVD) in Karachi performed a prospective, cross-sectional study. The research was carried out after obtaining the institutional review board approval.

Consecutive patients fulfilling the inclusion criteria during the study period were included. The inclusion criteria consisted of patients of both genders of age 30-80 years admitted in NICVD with new onset NSTE-ACS as diagnosed on ECG changes. All patients were included after attaining written informed consent. Patients with a history of ischemic heart disease, valvular heart disease, low ejection fraction, renal dysfunction, prior ECG abnormalities like arrhythmias and left ventricular hypertrophy were excluded from the study.

For all patients, sociodemographic profile, comorbidity status, ECG changes (Symmetrical T wave inversions, and/or ST depressions of ≥ 1 mm in 2 contagious leads), and incidence of HF was recorded. ECG changes were reported at the time of admission by a cardiologist who was blinded from the study objectives. Data was entered and analyzed using SPSS version 23. Continuous variables were computed as mean and standard deviation (SD), whereas categorical variables were computed as frequency and percentage. A chi square test was applied after stratification to assess the relationship and p-values less than or equal to 0.05 was considered as significant.

RESULTS

In this study 265 patients of new onset NSTE-ACS were included. With a mean age of 55.39± 10.40 years, there were 195 (73.6%) male and 70 (26.4%) female patients. Among 265 patients, 123 (46.4%) were diabetic, 150 (56.6%) were hypertensive, 128 (48.3%) were smokers, 74 (27.9%) were obese, and 59 (22.3%) had strong genetic susceptibility of ischemic heart disease. T-wave inversion was observed in 73 (27.5%) individuals ST-segment depression was observed in 77(29.1%) patients, both T-wave inversion and ST-segment depression was found in 71(26.8%) patients. No change was observed in 44(16.6%) patients. Their sociodemographic and clinical profile is summarized in Table 1.

Table 1: Sociodemographic and clinical profile of the study participants

Characteristics	**Frequency (%)**
Total (N)	**256**
Gender	
Male	195 (73.6%)
Female	70 (26.4%)
Age in years	55.39 ±10.4
Comorbidity	
Diabetes mellitus	123 (46.4)
Hypertension	150 (56.6)
Obesity	74 (27.9)
Smoking	128 (48.3)
Family history of ischemic heart disease	59 (22.3)
ECG changes	
T wave inversion	73 (27.5)
ST segment depression	77 (29.1)
Combination of T wave inversion and ST segment depression	71 (26.8)
No changes	44 (16.6)
Duration of hospital stay in days	3.94 ± 0.98

In our study, 28 (10.5 %) patients were diagnosed with heart failure during the hospital stay. Most of these were males and of age 50 years and above (n=23; 82.1%). Table 2 shows how diabetes, hypertension, smoking, obesity, and a genetic susceptibility of ischemic heart disease were differentiated for HF. All these factors (except obesity) were significantly associated with HF ($p \leq 0.05$). ECG changes such as combination of both T-wave inversion and ST-segment depression were found in 16 (57.1%) patients of HF ($p=0.002$).

DISCUSSION

NSTE-ACS is a common cause for admission to the hospital, myocardial infarction, and mortality.[9] Because of a complicated interplay of anatomical, neurohormonal, and hemodynamic maladaptations, acute heart failure worsens acute myocardial infarction. Myocardial injury and subsequent

contractile dysfunction is an obvious mechanism of HF in these patients. The degree of cardiac biomarker elevation is directly related to the extent of functional recovery and outcome.[10]

Table 2: Correlation of in-hospital heart failure with sociodemographic and clinical characteristics

Characteristics	Acute Heart Failure		P-value
	Yes (n=28)	No (n=237)	
Age in years			
≤ 50	5 (17.9)	85 (35.9)	0.06
> 50	23 (82.1)	152 (64.1)	
Gender			
Male	23 (82.1)	172 (72.6)	0.28
Female	5 (17.9)	65 (27.4)	
Comorbidity			
Diabetes mellitus	18 (64.3)	105 (44.3)	0.05
Hypertension	21 (75)	129 (54.4)	0.04
Obesity	9 (32.1)	65 (27.4)	0.68
Smoking	23 (82)	105 (44.3)	<0.001
Family history of ischemic heart disease	02 (7.1)	57 (24.1)	0.04
ECG Changes			
T wave inversion	03 (10.7)	70 (29.5)	0.002
ST segment depression	06 (21.4)	71 (30.0)	
Combination of both	16 (57.1)	55 (23.2)	
No changes	03 (10.7)	41 (17.3)	

It has been reported that 4.5% patients developed heart failure during one week follow-up and 6.3% developed during a six month period.[11-13] In GULFRACE study conducted on the Arab Middle East population on the acute heart failure complicating ACS demonstrates 20% heart failure during hospital stay; proportion increased with the age almost 50% above 70 years of age.[14]

In this study, 10.6% of NSTE-ACS patients developed HF during their hospital stay. In comparison, recent literature reported HF frequency in NSTE-ACS ranging from 5% to 45%.[5-7] The variations in frequencies reported in different studies can be attributed to the discrepancy in diagnostic criteria of HF, differences in inclusion or exclusion criteria or patient follow-up, or maybe due to differences of treatment seeking behavior.

Keeping in view the strong association of NSTE-ACS with acute heart failure, it becomes critical for the clinicians to keep in mind the determinants of HF in this subset of patients. Comorbid diabetes, hypertension, and smoking, as well as a substantial family history of ischemic heart disease and ECG abnormalities typical of NSTEMI, were all shown to be significantly linked to the onset of HF in this research. The work of Zhou et al. also reported a higher frequency of HF in their diabetic NSTE-ACS patients as compared to non-diabetic (12% vs. 7%) [15]. Diabetes itself is a proinflammatory, and prothrombotic state which renders a person more susceptible to cardiovascular events, which have worse consequences and greater death rates. Furthermore, long-standing type 2 diabetes also results in independent subclinical changes in myocardial structure and function which aids in development and progression of ACS and HF.[16]

ECG is an extremely important and readily available tool which not only helps in diagnosis but also in risk stratification of NSTE-ACS patients. These individuals' ECG alterations might vary from minor/nonspecific ST-T wave changes to T-wave inversion alone, ST depression with or without T-wave inversion. In this study, the most common finding in NSTE-ACS patients developing HF was a combination of ST depression and T-wave inversion (57.1%; P=0.002). Other literature has also supported adverse outcomes in NSTEMI patients with ECG changes such as ST depression.[17] This finding in this research is critical as it highlights the prediction of acute heart failure in patients with NSTE-ACS, particularly people with concomitant diabetes, hypertension, and smoking.

CONCLUSION

The conclusions of this research indicate that NSTE-ACS patients are likely to develop acute heart failure. Moreover, in the sample, older age, diabetes, hypertension, smoking, and a personal history of ischemic heart disease were all predictors for HF. Patients having a combination of ST depression and T-wave inversion on their ECG at the time of admission were more likely to have HF. The findings of this study are also important in underlining the need of using an ECG to diagnose NSTEMI and stratify high-risk individuals. HF is more prevalent in patients with combination of ST depression and T-wave inversion both.

AUTHORS' CONTRIBUTION

RY, MTF, MH and NK: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. JAS, and TS: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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