ORIGINAL ARTICLE

ASSOCIATION OF HEART RATE AT HOSPITAL DISCHARGE AND REHOSPITALIZATION OF PATIENTS WITH HEART FAILURE AND REDUCED EJECTION FRACTION

Kaleem Ullah Shaikh[1], Abeer Sarfaraz[1], Amna Farooq[1], Sana Sarfaraz[2], Sana Shoaib[1], Sanjna Devi[1]

[1]Department of Cardiology, Liaquat National Hospital and Medical College, Karachi-Pakistan
[2]Department of Pharmacy and Pharmaceutical Sciences, University of Karachi-Pakistan

Background: One of the major causes of cardiovascular morbidity and mortality is heart failure. The study aims to assess the effect of heart rate on the incidence of rehospitalization in patients with heart failure and reduced ejection fraction. **Methods:** It is a cross-sectional, analytical research conducted over six months, from June to December 2022, at the cardiology department of a tertiary care hospital. Patients who satisfied the modified Framingham heart failure criteria at admission and were discharged with an initial diagnosis of heart failure and those readmitted within 6 months or less of their discharge were included in the study. Pregnant women, patients diagnosed with cognitive impairment, and patients who had contraindications for taking any of the beta-blockers, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker /angiotensin receptor -neprilysin inhibitor, Sodium-Glucose co-transport inhibitor, and mineralocorticoid inhibitors were excluded from the study. **Result:** A total of 77 patients were included in the study. At discharge, approximately 71 patients had a heart rate of less than 70 beats/min and had no readmissions whereas, 6 patients had a heart rate of greater than 70 beats/min with 5 patients requiring readmission in the following 6 months. This relationship was statistically significant with a *p*-value of 0.000. **Conclusion:** According to the study, heart rate is a significant factor in the rehospitalization of individuals with heart failure and a low ejection fraction. At discharge, if the heart rate is not optimized then the rate of readmissions is increased.

Keywords: Heart Failure; Systolic Heart failure; Outcome Assessment; Health Care

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INTRODUCTION

Heart failure (HF) is a clinical condition brought on by anatomical and functional myocardial abnormalities that limit ventricular filling or ejection of blood and is the main reason for readmissions and hospitalizations. The prevalence of HF has been on the rise in most of the developed as well as developing countries due to an increase in high blood pressure, obesity, the prevalence of diabetes, in the elderly population, and the lack of efficacy in treatment options available.[1] Heart failure affects more than 6.5 million of the population, with an estimated 550,000 new cases diagnosed each year and accounts for >1.9 million hospitalizations nationwide.[2] Although less than the United States in total burden, HF-related admissions in South Asian countries were about 1.3–2.3 million in 2010**.** It is no secret, that while tremendous progress at the forefront of medical treatments is being made every day, the current situation is that hospital readmission rates remain high, with more than 50% of patients getting readmitted within the first six months of discharge.[3] Rehospitalisation is a problem for patients with HF, as it could severely impact their lives; it could become an economic burden, and in some cases, may even be fatal. Hence, lowering readmission rates is the key to ensuring patient safety and overall lower healthcare costs for the common man. According to studies, a higher resting heart rate is an indicator of all-cause mortality as well as sudden cardiac death.[4] HR and blood pressure change at all times based on physical activity and mental state and are primarily controlled by autonomic nerve activity via a baroreceptor feedback loop. Additionally, the association between heart rate and adverse consequences is arbitrated through effects on coronary blood flow, cardiac contractility, and energy expenditure.[5,6]

Heart rate has been linked to recent randomized clinical trial data from HF patients as a risk factor that may be treatable. Increased resting heart rate correlates with worse outcomes across the board, including cardiovascular and all-cause mortality, according to several prospective and retrospective studies undertaken over the past several decades.[7] These studies suggest that heart rate reduction is an important parameter clinicians target to improve disease outcomes. Although the pre-discharge phase presents a chance to begin potentially helpful drug therapies, identifying modifiable prognostic factors is necessary before outcomes can be enhanced.[7] Numerous studies have

been conducted to determine the most important risk factors for HF readmission, the results of which are widely disparate. According to the American Heart Association, older age, hypertension, diabetes mellitus (DM), and low socioeconomic status are all related to a greater prevalence of HF; although the resting heart rate at the time of discharge has been studied previously, its association with hospital readmissions – as a significant predictor of mortality – remains understudied.[8] In our study we focused on the role of this parameter and its contribution to the rate of hospital readmissions.

MATERIAL AND METHODS

This was six-month cross-sectional analytical research that was undertaken at the cardiology department of a tertiary care hospital from June to December 2022. Patients diagnosed with HF and reduced ejection fraction, who were admitted and those readmitted within the last six months to the cardiac ward were included. All patients, regardless of gender, over the age of 19 who satisfied the modified Framingham HF criteria at admission and were discharged with an initial diagnosis of HF[9] and those readmitted within 6 months or less of their discharge were included in the study. The study was initiated after informed consent and Ethical board committee approval. Patients were required to have regular sinus rhythms for the duration of their hospital stay (those who developed atrial fibrillation or any other non-sinus rhythm during any point of hospital stay were excluded). Pregnant women, patients diagnosed with cognitive impairments, and the ones who had contraindications for taking any of the four drugs were also not included in the trial. The research is based on a designed questionnaire containing minimal personal information, that would be age and gender. The questionnaire also included clinical data, including medical history, admission vital signs, heart rate at previous discharge, and baseline investigations that were obtained in the emergency department or the outpatient clinics, whereas medications and co-morbidities were also recorded. All patients were started on the four pillars of heart failure therapy including beta blockers, Angiotensin-converting enzyme (ACE) inhibitor/Angiotensin receptor blocker (ARB) /Angiotensin receptor neprilysin inhibitor (ARNI), Sodium-Glucose cotransporter (SGLT-2) inhibitors, and mineralocorticoid inhibitors before discharge.[9]

Data was analyzed by using SPSS version 26. Continuous variables like heart rate at discharge and number of readmissions were measured by using mean ±SD and frequency distributions for categorical variables. The major statistical test applied was the chi-square test. *p*-value of less than 0.05 was considered significant at a 95% confidence level for all cases.

RESULTS

The study involved a total of 77 patients, 63.6% of whom were male, 71.4% of whom were hypertensive, and 51.9% of whom were diabetic. At discharge, almost 92.2% of patients had a heart rate of less than 70 beats/min, and only 6.5% of patients were readmitted. A statistically significant correlation was found between heart rate and the likelihood of rehospitalizations. Specifically, five out of six patients with heart rates above 70 beats/min were readmitted, while patients with a heart rate below 70 beats/min did not require readmission. The study analyzed factors associated with readmissions in heart failure patients and calculated the odds ratio using the chi-square test. The analysis found that hypertension (OR: 0.57; 95% CI: 0.09-3.714; p=0.559) was less likely to occur in heart failure patients with readmissions than in those without readmissions. On the other hand, the odds of having diabetes mellitus (DM) in heart failure patients with readmissions were not significantly different from those without readmissions (OR: 1.4, p>0.05). This suggests that there is no association between readmissions and DM or hypertension. However, the study found a statistically significant association between male heart failure patients with readmissions and the odds of having heart failure, which were eight times higher compared to male heart failure patients without readmissions (OR: 8.000; CI: 0.84-75.55; p=0.03), as shown in Table-2.

Table-1: Baseline Descriptive statistics of the study population

Variables	**N (%)**
Age (years); Mean± Std. Dev	60.65±11.62
Age Group	
≤50 years	14(18.2)
>50 years	63(81.8)
Gender	
Male	49(63.6)
Female	28(36.4)
Hypertension	
Yes	55(71.4)
No	22(28.6)
Diabetes Mellitus	
Yes	40(51.9)
No	37(48.1)
Re-Admission	
Yes	5(6.5)
No	72(93.5)
Heart Rate at Discharge	
≤70 b.p.m	71(92.2)
>70 b.p.m	6(7.8)
Medications with dosage	
Carvedilol 6.25 mg BID	5(6.5%)
Bisoprolol 10 mg OD	22(28.6%)
Bisoprolol 2.5 mg OD	5(6.5%)
Bisoprolol 5 mg OD	33(42.9%)
Ivabradine 2.5mg BID	1(1.3%)
Ivabradine 5mg BID	7(9.1%)
Nebivolol 5mg OD	4(5.2%)

Table-2: Factors associated with readmissions in heart failure patients

Factors	Heart failure patients with readmissions	Heart failure patients without readmissions	OR	95%Cl	p-value
Age					
<50	1(25%)	3(75%)	5.75	0.48-68.49	0.123
>50	4(5.5%)	69(94.5%)			
Gender					
Female	4(14.3%)	24(85.7%)	8.00	0.84-75.55	0.036
Male	1(2%)	48(98%)			
Hypertension	3(5.5%)	52(94.5%)	0.57	0.90-3.71	0.559
DM	3(7.5%)	37(92.5%)	1.14	0.22-9.00	0.709

OR=odds ratio, Cl=confidence interval, DM= Diabetes Mellitus, HTN=hypertension

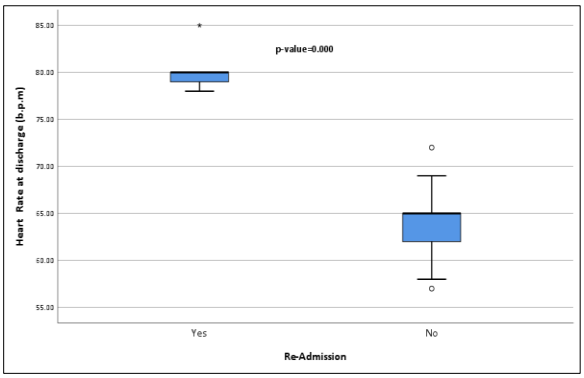

Figure-1: Box plot representing heart rate at discharge according to re-admission

DISCUSSION

The present study aimed to assess the effect of heart rate on the incidence of rehospitalisation in patients with heart failure and reduced ejection fraction. Results from our study showed that out of 28 female patients, 4 (14.3%) of them were readmitted and out of 52 male patients only 1 (2%) was readmitted. A similar result was reported in a study with higher readmissions of females.[10] In our study, a statistically significant association was reported between gender and readmission of patients with heart failure. (OR:8.000; Cl:0.84-75.55; *p*=0.036)

Previous studies have found a link between heart failure (HF) and certain diseases, resulting in an increase in readmission rates for HF patients. However, our study showed no statistically significant association between diabetes (DM), hypertension, and readmission rates for heart failure patients. In contrast, Akkineni *et al.*[11] reported a statistically significant association between DM, hypertension, and readmission rates for heart failure patients in their study. The inconsistency in findings may be due to differences in the population or treatment methods used.

A linear relation is found in this cross-sectional analytical study, which indicates a relationship between the heart rate of HF patients at the time of discharge and rehospitalization in a cardiac care facility over 6 months. Hence, a decreased heart rate was related to a reduction in the frequency of rehospitalization of patients with HF.[12] This association can be clearly explained as a raised heart rate results in increased myocardial oxygen consumption and a shortening of the duration of diastole, reducing diastolic filling and coronary blood flow.[13,14]

Our study positively correlates with literature demonstrating heart rate on discharge as a predictive marker for rehospitalization of HF patients and their associated morbidity and mortality. In this effect, the SHIFT trial showed that using Ivabradine to selectively lower heart rate in patients with HF with a heart rate of >70 bpm, considerably improved their symptoms and prognosis. It is recommended to use Ivabradine in addition to guideline-recommended heart failure treatment with a resting heart rate >70/min.[15] Another trial found a positive association between pulse rate at diagnosis of heart failure with reduced ejection fraction (HFrEF) and over subsequent follow-ups with morbidity and mortality of HFrEF patients Increased heart rate was found to cause adverse outcomes regardless of beta-blocker use.[16]

Another study showed increased heart rate at discharge of heart failure patients linked to an increase in all-cause mortality in a community-based setting. A discharge heart rate of >90 beats/min was linked with a higher risk of heart failure hospitalization and readmissions.[17,18] Moreover, the DIAMOND study showed that there was increased mortality risk with every 10-bpm increase in resting heart rate of patients with LV dysfunction who were previously hospitalized for MI heart failure.[19]

Limitations: The short time duration of the study, single-center, and relatively small sample size were genuine limitations of the study. Further experimental studies on large sample sizes with long-term duration are recommended. However, our findings will serve as a framework for future studies on similar topics.

CONCLUSION

The study focuses on a significant predictor of rehospitalizations in patients with heart failure and low ejection fraction, which is optimizing heart rate at discharge, which can minimize the risk of re-admissions and hence enhance the quality of life.

Conflict of Interest: none.
Source of funding: none.

AUTHORS' CONTRIBUTION

KS: conceived the idea, KS, AS: study design, SS, AS, AF: Data collection, AF, SS, AS: write up, SS, SD: review, KS, AS: supervised the whole project.

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Address for Correspondence:

Abeer Sarfaraz, Liaquat National Hospital and Medical College, Karachi-Pakistan
Cell: +92 333 038 2468
Email: abeer_sana@hotmail.com