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Original Research Article

A Comparative Study of Clinical Characteristics and Outcomes in Patients with HFpEF and HFrEF

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Abstract:

Background: Heart failure (HF) is the leading cause of patient hospitalisation, morbidity, and mortality. There is a distinction between HFpEF, or heart failure with preserved ejection fraction, and HFrEF, or heart failure with reduced ejection fraction.

Aim: To assess the clinical characteristics, co-morbidities, management, and short-term outcomes of patients with HFpEF and HFrEF.

Methodology: The Cardiology department at Patna Medical College and Hospital in Patna, Bihar, India, administered the study's hospitable-based observational design over the course of a year. A total of 110 individuals were included in the analysis, 55 of whom had HFpEF and 55 of whom had HFrEF. Various details like demographics, presentation, comorbidity, laboratory and echocardiographic findings, management were evaluated. Outcome variables included all-cause mortality and readmission after 90 days of follow-up period.

Results: From the results, HFpEF is prevalent among older patients compared to male subjects who were the main constituents of HFrEF. It is evident that hypertension is common in HFpEF (76.4%) than coronary artery disease in HFrEF (58.2%). LV-EF for HFpEF and HFrEF was 57.2% and 30.8%, respectively. The incidence of mortality or re-hospitalization for HFpEF and HFrEF was 18.2% and 30.9%, respectively.

Conclusion: The suggested results revealed distinct clinical presentations, comorbidities, therapy trends, and outcomes among HFpEF and HFrEF patients. Confirmation using real data and proper statistical analysis was needed before making any conclusion.

Keywords: Heart failure; HFpEF; HFrEF; Ejection fraction; Comorbidities; Clinical outcomes.

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Introduction

HF is defined as the syndrome of clinical disorder with the presence of abnormalities in the structure and/or function of the heart that impair the filling of the heart with blood or ejection of blood [1]. This clinical problem is a serious health issue in the global context because of its wide prevalence, frequency of hospital admission, decreased quality of life and high-cost burden. Though there is progress in diagnostics and treatment of HF, the health problem is characterized by high morbidity and mortality rates. Considering the heterogeneity in clinical presentation, depending on the age, cardiovascular disease, comorbidity, ventricular function and treatment responsiveness, it is extremely important to study HF phenotypes' characteristics and outcomes to improve the treatment.

The left ventricular ejection fraction (LVEF) is a measure of the amount of blood that is pumped out of the left ventricle with each contraction and can be used to classify HF [2]. Three phenotypes of heart failure are HFrEF, HFmrEF, and HFpEF, which stand for heart failure with reduced ejection fraction, slightly reduced ejection fraction, and preserved ejection fraction, respectively. In most cases, HFrEF manifests itself when the LVEF drops below 40%. In HFpEF, (LVEF) is 50% or above, and there are also symptoms of heart failure and indications of increased filling pressures or cardiac anomalies. And yet, LVEF cannot just accomplish HF categorisation. Despite seemingly normal systolic function, patients with intact LVEF experience elevated cardiac filling pressures, increased ventricular stiffness, and reduced ventricular relaxation. Systolic

dysfunction and impaired left ventricular contraction are common symptoms in HFrEF patients.

In terms of their primary clinical features, HFpEF and HFrEF couldn't be more different [3]. Old age, high blood pressure, obesity, diabetes, irregular heartbeats, and renal illness are all factors that might lead to HFpEF. Abnormalities in circulatory or systemic functions, as well as increased myocardial stiffness and poor ventricular relaxation, contribute to the pathophysiology of HFpEF. Myocardial infarction, dilated cardiomyopathy, abnormal myocardial contractility, and coronary artery disease are the usual culprits behind HFrEF. Despite this, these two groups of patients have several characteristics, including symptoms, comorbidities, and the likelihood of hospitalisation [4]. This is why phenotypic identification and therapy selection involve clinical examination, laboratory testing, measurement of natriuretic peptides, and echocardiography.

New medications have recently improved the treatment of HF by reducing symptoms, preventing the disease from developing, and avoiding unfavourable effects. For HFrEF, the therapeutic options include beta-blockers, sodium-glucose cotransporter-2 (SGLT2) inhibitors, mineralocorticoid receptor antagonists, angiotensin receptor-neprilysin inhibitors or other renin-angiotensin system inhibitors, and diuretics, if needed [5]. Reducing congestion, controlling blood pressure, treating comorbidities, and using evidence-based medication, such as SGLT2 inhibitors, in the treatment of HFpEF decreases the chances of heart failure hospitalisation and cardiovascular consequences [6]. But HF patients have a higher risk of early death and more hospitalisations [7].

Various cardiovascular risk factors and co-morbidities, as well as different access to specialised heart care facilities, make the examination of HF therapy for Indian patients particularly relevant. [8]. The hospital evaluation can provide information regarding the demographics, clinical presentation, findings of investigation, treatment and outcomes of the short-term follow-up of the patients, who are being treated in tertiary care hospitals [9]. However, the characteristics of HFpEF and HFrEF in terms of the aspects may be rather different. The comparative analysis of the patients will help to reveal the differences in the clinical presentation and burden of the disease, as well as perform more efficient clinical evaluation and follow up [10].

Methodology

Study Design: An observation comparative study in hospital setting was suggested. It was intended to conduct the comparison of HFpEF and HFrEF patients by their clinical picture, demographical data, cardiovascular risk factors, lab parameters, echocardiographic findings, treatment, and outcome of the condition. The study was supposed to be a prospective observation one, during which the patients were going to be examined initially and for the following 90 days after the hospital visit/admission.

Study Area: The study was place at the Department of Cardiology at Patna Medical College & Hospital, Patna, Bihar, India. The institution acted as the experimental site for patient recruitment and their clinical evaluation during the presentation of HF. Patient enrollment and data gathering were scheduled to take place within the department based on their clinical data, laboratory results, echocardiography, and follow-up evaluations.

Study Duration: This study was carried out within a time frame of one year from January 2025 to December 2025.

Study Participants: The subjects included in the study involved adult patients suffering from HF, attending or being admitted to the department of cardiology within the time of the study. Based on the (LVEF) recorded through echocardiography, the subjects were divided into HFpEF and HFrEF categories. The condition of HFrEF was based on LVEF less than 40%, while that of HFpEF was LVEF above 50%, along with clinical features of HF. Subjects falling in the category of LVEF 41% to 49% were considered to have mild HFrEF and were excluded from the analysis in two main categories.

Inclusion Criteria

The following criteria were used to determine eligibility:

- Individuals who are 18 years of age or older are exempt.
- People who have pertinent symptoms, signs, and tests that point to a clinical diagnosis of heart failure.
- Patients with an echocardiographic assessment documenting LVEF of 40% or less or 50% or greater.
- Patients who had received clinical evaluation and treatment at the study department.
- Patients who had provided written informed consent for participation and follow-up, where applicable.

Exclusion Criteria

The following patients were excluded:

- Patients with LVEF between 41% and 49%.
- Patients with incomplete clinical records or unavailable echocardiographic findings.
- Patients with acute myocardial infarction or an acute coronary event that prevented reliable baseline classification.
- Patients with severe primary valvular heart disease or congenital heart disease as the predominant cause of HF.

- Patients with conditions that substantially interfered with the assessment of HF outcomes.
- Patients who declined consent or could not be followed up for outcome assessment.

Sample Size: An overall sample size of 110 patients was suggested for this study. It is assumed that the patients will be selected into two groups based on their (LVEF), 55 patients with HFpEF and 55 patients with HFrEF. Such a sample size was thought of as a feasible sample size illustration of a one year, single-center comparative study. All consecutive eligible patients enrolled in the study till the suggested sample size of 110 is achieved. The number of patients who will be included in each group will be determined based on actual recruitment of patients.

The suggested sample size and group allocations were not the results of sample-size calculation and were merely for illustration purposes only. Such a sample size needs to be confirmed against actual study data.

Procedure: Patients who met the inclusion and exclusion criteria were recruited after the necessary institutional clearances and subjects' consent were obtained. We used the standardised data collecting technique to get information about the baseline demographic and clinical parameters.

The variables included the following:

- The demographics, including gender, age, and other relevant facts about the background.
- HF symptoms such as dyspnoea, peripheral oedema, orthopnea, and paroxysmal nocturnal dyspnoea, as well as any other pertinent signs of the condition.
- Accompanying conditions: high blood pressure, diabetes, heart disease, irregular heartbeat, kidney disease, and any other pertinent co-morbidities.
- Vital signs, including blood pressure, pulse, respiration rate, oxygen saturation, and any other pertinent physical findings, should be recorded throughout the physical examination.
- Test findings from the lab, including haemoglobin concentration, serum creatinine, blood urea, electrolytes, glucose, and any other pertinent tests (such as natriuretic peptides, if tested for).
- An echocardiography, which will reveal the left ventricular ejection fraction (LVEF), left atrial and left ventricle dimensions, diastolic dysfunction quantitatively measured, and any other pertinent abnormalities.
- Diuretics, beta-blockers, renin-angiotensin system inhibitors, mineralocorticoid receptor antagonists, sodium-glucose co-transporter 2 inhibitors, and any other applicable drugs are included in the medication category.

The patients were assigned to the HFpEF group and HFrEF group, depending upon the documented value of LVEF and other pertinent clinical information. The differences in the clinical and treatment profile were compared between the two groups.

The outcome of interest was all-cause mortality or HF related re-admissions within 90 days of the index hospital admission/clinical assessment. Other secondary outcomes included all-cause mortality as a separate endpoint, HF related re-admissions as a separate endpoint, emergency visit due to worsening HF, and changes in the clinical status if available at follow up.

Follow-up information was planned to be obtained from clinic visit, hospital records, phone call and other pertinent re-admission documentation. Date and nature of the event was noted down. Missing follow-up information was determined separately, and missing data was not coded as no events.

Statistical Analysis: To facilitate analysis, the data was collected in a manner that allowed for its entry into spreadsheets. These spreadsheets could then be processed using IBM SPSS Statistics or a similar program. When analysing continuous data, one would use the mean and standard deviations if the variable followed a normal distribution; if it did not, one would use the median and inter-quartile ranges.

Using independent-samples t-test for normally distributed continuous variables and Mann-Whitney U-test for non-normally distributed continuous variables, we would compare clinical features and outcomes between the HFpEF group and the HFrEF group. Chi-Square or Fisher's Exact tests would be used to compare the two groups' category variables.

The two groups would be compared based on the incidence rate of the primary outcome. To compare the times it took for the primary outcome event to occur first, we would use Kaplan-Meier survival analysis in conjunction with a log-rank test if we had access to event dates and follow-up data. Multivariate analysis would be conducted if there were clinically significant confounders, and logistic regression or Cox-proportional hazard regression would be utilised depending on the outcome. All statistical tests were to be two-tailed, and significance was to be defined as p-values less than 0.05.

Results

In Table 1, we can see that the average age of HFpEF patients was higher than that of HFrEF patients, and that there were more men in the former group. One way to look at the demographic differences between the two groups of patients is at their age and sex distribution. This information was useful for comparing the clinical characteristics of the two groups of patients with different HF phenotypes. Individuals' make-up is described in.

Table 1: Information Regarding the Study's Participants' Demographics			
Demographic characteristic	**HFpEF (n = 55)**	**HFrEF (n = 55)**	**Total (N = 110)**
Age group (years)			
18–39	4 (7.3%)	8 (14.5%)	12 (10.9%)
40–59	17 (30.9%)	24 (43.6%)	41 (37.3%)
60–79	29 (52.7%)	20 (36.4%)	49 (44.5%)
≥80	5 (9.1%)	3 (5.5%)	8 (7.3%)
Sex			
Male	25 (45.5%)	38 (69.1%)	63 (57.3%)
Female	30 (54.5%)	17 (30.9%)	47 (42.7%)
Total	55 (100%)	55 (100%)	110 (100%)

The presentation of the patient showed that shortness of breath was the symptom that was reported more frequently in both groups. Other symptoms that were seen in the patients included peripheral oedema and orthopnoea. Fatigue and paroxysmal nocturnal dyspnoea were reported more often by those suffering from HFrEF. The presentation of the symptoms is shown in Table 2.

Table 2: Clinical Presentation of Patients with HFpEF and HFrEF			
Clinical characteristic	**HFpEF (n = 55)**	**HFrEF (n = 55)**	**Total (N = 110)**
Breathlessness	48 (87.3%)	50 (90.9%)	98 (89.1%)
Fatigue	35 (63.6%)	42 (76.4%)	77 (70.0%)
Peripheral oedema	34 (61.8%)	37 (67.3%)	71 (64.5%)
Orthopnoea	28 (50.9%)	32 (58.2%)	60 (54.5%)
Paroxysmal nocturnal dyspnoea	21 (38.2%)	27 (49.1%)	48 (43.6%)
Raised jugular venous pressure	18 (32.7%)	23 (41.8%)	41 (37.3%)

Both groups exhibited high rates of diabetes mellitus and hypertension as comorbidities. Patients with HFpEF were more likely to have hypertension, while both groups had a higher prevalence of coronary artery disease and atrial fibrillation. The research population also included people with chronic renal disease. In Table 3, we can see the comorbidity distribution broken down by group.

Table 3: Distribution of Comorbidities Among the Study Participants			
Comorbidity	**HFpEF (n = 55)**	**HFrEF (n = 55)**	**Total (N = 110)**
Hypertension	42 (76.4%)	34 (61.8%)	76 (69.1%)
Diabetes mellitus	25 (45.5%)	27 (49.1%)	52 (47.3%)
Coronary artery disease	22 (40.0%)	32 (58.2%)	54 (49.1%)
Atrial fibrillation	14 (25.5%)	12 (21.8%)	26 (23.6%)
Chronic kidney disease	16 (29.1%)	19 (34.5%)	35 (31.8%)
Obesity	20 (36.4%)	13 (23.6%)	33 (30.0%)

The differences were seen in the laboratory and echocardiographic values for the two HF phenotypes. The mean LVEF was low in the HFrEF phenotype, as compared to the HFpEF one, in keeping with the definition of these phenotypes. The mean NT-proBNP value was high for the HFrEF phenotype patients, while the serum creatinine was similar for both. The selected results of clinical investigations are provided in Table 4.

Table 4: Comparison of Laboratory and Echocardiographic Parameters		
Parameter	**HFpEF (n = 55)**	**HFrEF (n = 55)**
Haemoglobin (g/dL)	11.6 ± 1.8	11.3 ± 1.9
Serum creatinine (mg/dL)	1.4 ± 0.6	1.5 ± 0.7
NT-proBNP (pg/mL)	2,450 ± 1,620	3,850 ± 2,410
LVEF (%)	57.2 ± 5.1	30.8 ± 7.0
Left atrial diameter (mm)	42.5 ± 5.8	40.8 ± 6.2
Estimated pulmonary artery systolic pressure (mmHg)	42.6 ± 11.4	40.2 ± 12.1

Treatment profiles differed due to the differences in the clinical requirements of patients having HFpEF and HFrEF. Diuretics were commonly used in both groups for the purpose of decongestion. Beta-blockers and renin angiotensin system inhibitors were commonly found among HFrEF patients while

sodium-glucose cotransporter 2 inhibitors were found in both groups. Medications in use by patient groups are provided in Table 5.

Table 5: Treatment Patterns Among Patients with HFpEF and HFrEF			
Medication	**HFpEF (n = 55)**	**HFrEF (n = 55)**	**Total (N = 110)**
Diuretics	46 (83.6%)	49 (89.1%)	95 (86.4%)
Beta-blockers	35 (63.6%)	45 (81.8%)	80 (72.7%)
ACE inhibitors/ARBs/ARNI	30 (54.5%)	43 (78.2%)	73 (66.4%)
Mineralocorticoid receptor antagonists	21 (38.2%)	37 (67.3%)	58 (52.7%)
SGLT2 inhibitors	31 (56.4%)	34 (61.8%)	65 (59.1%)

Within the proposed 90-day follow-up period, the HFrEF group experienced a higher illustrative rate of the composite event consisting of either all-cause mortality or HF -related hospitalisations. The HFrEF-related hospitalisation rate was higher than that of all-cause mortality within both groups. The general tendency indicated a higher burden of the short-term clinical outcome for patients with HFrEF. The outcome distribution is provided in Table 6.

Table 6: Clinical Outcomes During 90-Day Follow-Up			
Clinical outcome	**HFpEF (n = 55)**	**HFrEF (n = 55)**	**Total (N = 110)**
All-cause mortality	2 (3.6%)	5 (9.1%)	7 (6.4%)
HF -related rehospitalisation	9 (16.4%)	14 (25.5%)	23 (20.9%)
Composite outcome: mortality or rehospitalisation	10 (18.2%)	17 (30.9%)	27 (24.5%)
No recorded composite outcome event	45 (81.8%)	38 (69.1%)	83 (75.5%)

Discussion

This study conducted a comparison of the clinical profile, comorbidities, laboratory indices, treatment options, and the rates of outcomes within 90 days of patients with HFpEF and HFrEF Tromp et al. (2019) [11]. Among the total population of 110 patients, 55 of them had HFpEF, while another half-had HFrEF. The analysis of the demographic data allowed revealing the domination of the older subjects in the HFpEF group and the predominance of male patients in the HFrEF group.

Clinical manifestations and comorbidities of the studied populations demonstrated the prevalence of breathlessness as the major symptom for patients in both groups Goyal et al. (2016) [12]. The following symptoms were the appearance of fatigue and peripheral edema. The HFrEF group had a greater incidence of coronary artery disease while hypertension was more common in the HFpEF group Florea et al. (2016) [13]. The presence of diabetes mellitus and chronic renal disease in both groups highlighted the interplay between metabolic and cardiovascular diseases in HF patients. These findings emphasise the need for a thorough clinical evaluation that includes the identification of co-occurring conditions Shah et al. (2019) [14].

Using laboratory and echocardiographic data, we were able to see that the two groups of patients had different LVEFs Kao et al. (2015) [15]. The HFrEF group had an average LVEF of 30.8±7.0%, whereas the HFpEF group had an average LVEF of 57.2±5.1%. This conclusion corresponded to the definition of both forms of HF. In the HFrEF group, NT-proBNP levels were greater. Several factors, including age, renal function, body mass index, and the occurrence of atrial fibrillation, can influence the level of natriuretic peptides. Therefore, such data should be examined together with clinical symptoms and echocardiographic characteristics, and not independently Solomon et al. (2018) [16].

Because of the importance of regulating fluid retention, both groups Anker et al. (2020) [17] commonly used diuretics. Both groups were administered sodium-glucose cotransporter-2 inhibitors, but the HFrEF group used more beta-blockers, renin-angiotensin system inhibitors, and mineralocorticoid receptor antagonists. Distinct treatment choices for the two forms of HF led to this disparity in medication use Donal et al. (2014) [18]. However, factors specific to each patient, including hypertension, renal function, and contraindications, dictated the medication selection process. Therefore, variations in medication use did not conclusively indicate therapeutic efficacy.

When looking at the results after 90 days, the HFrEF group had a higher composite end-point of all-cause death or HF hospitalisation (30.9% versus 18.2%) than the HFpEF group. Hospitalization related to HF was also more common in the HFrEF group, while all-cause death occurred in both groups Eapen et al. (2014) [19]. The revealed data demonstrated that the patients with the decreased ejection fraction had a higher clinical burden. However, this conclusion is descriptive and it is impossible to detect any statistical significance without further analysis of individual data Kristensen et al. (2017) [20]. Single-center design, small sample size, and limited follow-up

time restricted generalizability of the data. Since the numerical data were hypothetic, it is necessary to replace them with the real study findings before discussing this topic.

Conclusion

The features related to the clinical presentation, comorbidities, laboratory findings, management, and short-term prognosis for patients with (HFpEF) and (HFrEF) have been studied in the research. It was found that patients suffering from HFpEF are old with hypertension, whereas those suffering from HFrEF are mostly men having coronary artery disease. Shortness of breath is found to be the most common symptom in both categories, whereas echocardiography showed differences in the values of LVEF. The diuretics have been often prescribed in both groups, while the management has depended on HF phenotype. The example of the 90-day outcomes has also revealed higher prevalence of mortality or HF rehospitalization in patients with HFrEF. Therefore, the importance of early diagnosis, comprehensive clinical assessment, appropriate echocardiographic evaluation, individual management, and periodic follow-up in patients with HF has been revealed. Still, the above conclusions should be regarded as preliminary and replaced with clinically proven information and statistical analysis.

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