

Clinical Investigations

Clinical Presentation, Hospital Length of Stay, and Readmission Rate in Patients with Heart Failure with Preserved and Decreased Left Ventricular Systolic Function

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Summary

Background: Congestive heart failure is the leading cause of hospital admissions for adults in the United States. To our knowledge, there are limited data comparing the clinical presentation, hospital length of stay, and readmission in patients with preserved and decreased left ventricular (LV) systolic function.

Hypothesis: The goal of the study was to determine whether there are differences in clinical presentation, hospital length of stay, and readmission in patients with preserved ($\geq 50\%$) and reduced ($< 50\%$) systolic function.

Methods: We prospectively evaluated 187 patients admitted with congestive heart failure confirmed by the presence of pulmonary vascular congestion on chest x-ray, and with recent (< 6 months) documentation of LV systolic function by two-dimensional echocardiography. History and physical examination findings, patient demographics, comorbidities, discharge medications, and length of hospital stay data were documented. Readmission rate over a 6-month follow-up period was also documented.

Results: Of the 187 patients, 130 (70%) patients had an ejection fraction (EF) $< 50\%$, and 57 (30%) patients had an EF $\geq 50\%$. Patients with EF $< 50\%$ were more likely to be men (54

vs. 37%, $p = 0.03$), African Americans (79 vs. 60%, $p = 0.007$), had a higher prevalence of previous stroke (17 vs. 5%, $p = 0.03$), and were more likely to carry no medical insurance at the time of admission (14 vs. 2%, $p = 0.01$) and to be discharged on digoxin (60 vs. 30%, $p < 0.001$). There were no significant differences in symptoms (exertional dyspnea, rest dyspnea, orthopnea, or paroxysmal nocturnal dyspnea), or in physical examination findings (S3, S4, elevated jugular venous pressure, rales, or peripheral edema). According to chest x-ray, patients with EF $< 50\%$ had more frequent cardiomegaly (88 vs. 72% $p = 0.008$), but there were no differences in the presence of pleural effusion or pulmonary vascular congestion ($p = \text{NS}$). The mean length of stay was 5.9 and 5.2 days, respectively ($p = 0.34$). During the 6-month follow-up period, the readmission rates were 33% (43 patients) and 26% (15 patients), respectively ($p = 0.36$).

Conclusion: The clinical presentation, hospital length of stay, and readmission rate for congestive heart failure are similar in patients with preserved and decreased LV systolic function.

Key words: heart failure, left ventricular systolic function, ejection fraction, follow-up

Introduction

Heart failure remains the leading cause of hospital admissions in adults in the U.S., with estimated costs exceeding 100 billion dollars annually.^{1,2} Furthermore, the rate of readmission to the hospital within 90 days of hospital discharge is reported to be as high as 45%.³⁻⁵ Previous studies suggest that 30 to 40% of patients with heart failure have preserved left ventricular (LV) systolic function.^{1,2,6,7} Therefore, targeting this patient population and understanding the differences between patients with decreased and preserved systolic function is of paramount importance in guiding therapeutic management and clinical decision making. Since the pathophysiology and thus the management are different in patients with heart failure with preserved versus depressed LV systolic function, early identification of these two subsets of patients will allow

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appropriate therapeutic strategies. To our knowledge, there are limited prospective data comparing the clinical presentation, hospital length of stay, and readmission rate of patients with heart failure with preserved and decreased systolic function.⁸ The goal of our study was to determine whether there are differences between patients with preserved ($\geq 50\%$) and reduced ($< 50\%$) systolic function.

Methods

Henry Ford Hospital, Detroit, is a 900-bed urban hospital with direct admissions from emergency rooms, suburban clinics, and transfers from several community hospitals. This study comprises the prospective evaluation of 198 consecutive patients admitted to the hospital during a 6-month time period with the admitting diagnosis of congestive heart failure. Patients were eligible for the study if they had both clinical and radiographic evidence of pulmonary vascular congestion not related to acute myocardial infarction. Only 187 patients (95%) with recent (< 6 months) documentation of LV function by echocardiography were included in the analysis. Detailed clinical data (history, physical examination, chest x-ray, electrocardiogram [ECG]) were prospectively collected by the study investigators. Data regarding patient demographics, comorbidity, discharge medications, and length of hospital stay and readmission data over a 6-month follow-up period were documented. Follow-up evaluation was performed by means of a telephone questionnaire at 2, 4, and 6 months after discharge.

Statistical Analysis

Patients with LV ejection fraction (EF) $< 50\%$ were compared with patients with EF $\geq 50\%$ using standard tests of association. The categorical variable comparisons were made using the general chi-square test. The Fisher exact test was used instead of the chi-square test if the expected number of patients within any category was < 5 . The numeric variable comparisons were made using either the Student two-sample *t*-test for equal variances or the Welch two-sample *t*-test for unequal variances. The Wilcoxon rank sum test was used rather than the *t*-test if the assumption of distributional normality was significantly violated. After further subdividing the patients into four LVEF subgroups, one-way analysis of variance (ANOVA) was used to compare the four groups regarding the logarithm-transformed hospital length of stay. Furthermore, the chi-square test was used to compare the four groups regarding the readmission status. All comparison test results were two-sided. For this descriptive study, a significance level of 0.05 was used throughout.

Results

Of the 187 patients, 130 (70%) had an EF $< 50\%$, and 57 (30%) had an EF $\geq 50\%$. The mean EF for the 130 patients with an EF $< 50\%$ was $27 \pm 10\%$ (median of 25, range 10–

48%). The mean EF for the 57 patients with an EF of at least 50% was $54 \pm 4\%$ (median of 55%, range 50–65%).

Sociodemographics

As summarized in Table I, patients with decreased systolic function (EF $< 50\%$), were more likely to be men (54 vs. 37%, $p = 0.03$), African Americans (79 vs. 60%, $p = 0.007$), had a higher prevalence of previous stroke (17 vs. 5%, $p = 0.03$), and were also more likely to carry no medical insurance at the time of admission (14 vs. 2%, $p = 0.01$). There were no statistically significant differences between the two groups with regard to age, history of hypertension, diabetes, peripheral vascular occlusive disease, smoking status, and history of myocardial infarction.

History and Physical Examination Findings

There were no significant differences in symptoms (exertional dyspnea, rest dyspnea, orthopnea, or paroxysmal nocturnal dyspnea) or in physical examination findings (S3, S4, jugular venous distention, rales, or peripheral edema). By chest x-ray, patients with low EF had more often cardiomegaly (88 vs. 72% $p = 0.008$), but there were no differences in the presence of pleural effusion or pulmonary congestion (Table II).

Discharge Medications

Patients with decreased LV systolic function were more likely to be prescribed digoxin at the time of discharge (60 vs. 30%, $p < 0.001$), whereas patients with preserved function were more likely to be discharged on a calcium-channel blocker (39 vs. 16%, $p < 0.001$). There was no significant difference between the two study groups with regard to the use of diuretics, beta blockers, or angiotensin-converting enzyme inhibitors upon discharge.

TABLE I Sociodemographics and risk factors

Variables	EF $< 50\%$ (%)	EF $\geq 50\%$ (%)	p Value
Number of patients	130	57	
Age	65 ± 13	69 ± 12	0.09
Gender (male)	54	37	0.03 ^a
Ethnicity (AA)	79	60	0.07 ^a
Hypertension	84	88	0.5
Diabetes	50	40	0.4
Previous MI	35	26	0.2
Previous CVA	17	5	0.03 ^a
Smoker	46	32	0.06
PVOD	13	7	0.5
CRI, creatinine > 2.0	24	26	0.6

^a P value < 0.05 indicates statistical significance.

Abbreviations: AA = African American, MI = myocardial infarction, CVA = cerebral vascular disease, PVOD = peripheral vascular occlusive disease, CRI = chronic renal insufficiency.

TABLE II Comparison of the clinical history, physical examination, and chest x-ray findings between patients with preserved (EF $\geq 50\%$) and decreased left ventricular systolic function (EF $< 50\%$)

Variables	EF $< 50\%$ 130 patients	EF $\geq 50\%$ 57 patients	p Value
Exertional dyspnea, %	77.7	77.2	0.9
Rest dyspnea, %	59	51	0.3
Orthopnea, %	65	51	0.45
Admission HR	98 \pm 23	94 \pm 24	0.3
Admission SBP	149 \pm 40	159 \pm 41	0.1
Admission DBP	89 \pm 23	86 \pm 29	0.9
Jugular venous pressure	6.6 \pm 2.7 cm	6.5 \pm 2.8 cm	0.6
Admission S3 gallop, %	23	16	0.3
Admission S4 gallop, %	26	25	0.8
Rales at admission, %	88	86	0.7
Cardiomegaly, %	88	72	0.008 ^a
Pleural effusion, %	44	46	0.8
Pulmonary congestion, %	98	100	0.6

^a P value < 0.05 indicates statistical significance.

Abbreviations: PND = paroxysmal nocturnal dyspnea, HR = hear rate, SBP = systolic blood pressure, DBP = diastolic blood pressure, EF = ejection fraction.

Hospital Length of Stay and Readmission Rate

The mean length of stay was 5.9 days, median of 4 days, and a range of 1 to 33 days for patients with low EF $< 50\%$. For patients with preserved systolic function (EF $\geq 50\%$), the mean length of hospital stay was 5.2 days, median of 4 days, range of 1 to 33 days. The difference between the two groups was not statistically significant ($p = 0.34$).

Of the 130 patients with an EF $< 50\%$, 43 patients (33%) were readmitted within 6 months of discharge. Of the 57 patients with an EF of $\geq 50\%$, 15 (26%) were readmitted. That difference is not statistically significant ($p = 0.36$).

Further patients stratification based on LVEF into four groups (EF $< 25\%$, EF 26–49%, EF 50–59%, EF $\geq 60\%$), showed the following results. With regard to hospital length of stay, (Fig. 1), 72 patients with an EF of $\leq 25\%$ had a mean

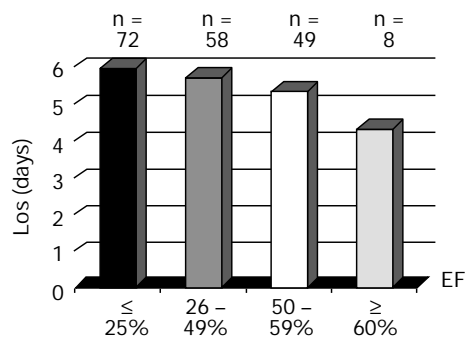


FIG. 1 Comparison of hospital length of stay (LOS) based on the ejection fraction (EF). P value > 0.05 .

length of stay of 6 days with a standard deviation (SD) of 5.8 days, a median of 4 days, and a range of 1 to 33 days; 58 patients with an EF 26–49% had a mean length of stay of 5.8 days with an SD of 5.6 days, a median of 4 days, and a range of 1 to 25 days. The 49 patients with an EF 50–59% had a mean length of stay of 5.3 days with an SD of 5.5 days, a median of 3 days, and a range of 1 to 33 days. Eight patients with an EF $\geq 60\%$ had a mean length of stay of 4.3 days with an SD of 2.3 days, a median of 4.5 days, and a range of 1 to 8 days. The difference in the length of hospital stay among these four groups was not statistically significant ($p = 0.8$). Note that the ANOVA was performed on the logarithm-transformed length of stay, thereby conforming sufficiently to the assumption of distributional normality.

The group percentages with regard to readmission rate within the 6-month follow-up period (Fig. 2) are as follows: 40% (29/72) for patients with an EF of $\leq 25\%$, 24% (14/58) for patients with an EF between 26 and 49%, 27% (13/49) for patients with an EF of at least 50 but < 60 , and 25% (2/8) for patients with an EF of at least 60%. A statistically significant difference among those percentages was not detected ($p = 0.2$). However, there was a trend for increased readmission in the very low EF group of $\leq 25\%$ compared with the other groups (40 vs. 26%).

Discussion

Heart failure is the most common discharge diagnosis among men and women aged ≥ 65 years. Readmission contributes to morbidity in these patients and is reported to occur in 20 to 50% of patients within 14 days to 6 months after discharge.^{3–5, 9, 10} Previous studies have documented patients with heart failure at risk for readmission include male gender,³ prior admission,^{3, 10} prior heart failure,¹⁰ diabetes,⁹ comorbidity,³ and low serum sodium.⁹ Acute heart failure caused by myocardial infarction or severe hypertension¹⁰ also correlated with readmission. Large observational studies of readmission with heart failure did not include EF as a correlate for hospital readmission.⁴ Chin, in a prospective evaluation of 257 patients with heart failure to determine the correlates of early hospital

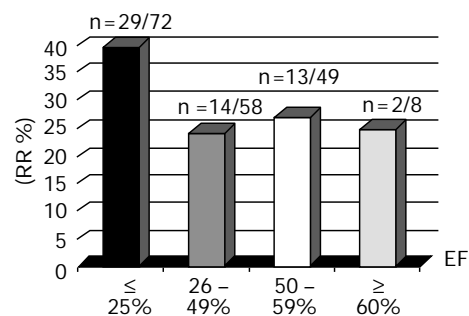


FIG. 2 Comparison of readmission rates (RR) based on the ejection fraction (EF). P value > 0.05 .

readmission found that EF did not correlate with the rate of readmission.¹¹ The results of our study suggest that the hospital length of stay and readmission rate are similar in patients with heart failure with preserved and decreased LVEF.

The clinical entity of heart failure with preserved systolic function is increasingly recognized and accounts for 30–40% of all admissions to hospital with heart failure.^{1, 2, 6–8} Understanding the differences in the clinical characteristics between these two subsets of patients with heart failure will help develop strategies targeted to decrease hospital length of stay and readmission rate.

The first question we wanted to address in this study was whether clinical data can help differentiate patients with heart failure with preserved and decreased systolic function. Previous studies have shown that in patients with coronary artery disease, the presence of cardiomegaly on chest x-ray, ECG evidence of transmural myocardial infarction, dyspnea, and rales have a predictive accuracy of 81% for identifying normal or abnormal EF. There are limited data, however, that looked specifically at the differences in the clinical findings in patients with preserved and decreased LV systolic function.¹² We found no significant differences in symptoms between the two patient populations (exertional dyspnea, rest dyspnea, orthopnea, paroxysmal nocturnal dyspnea), nor in physical examination findings (S3, S4, jugular venous distension, rales, or peripheral edema). While the physical findings were similar, it is possible that with a thorough evaluation of the point of maximal impulse and careful evaluation for the presence of S3 and S4 gallops, experienced clinicians may be able to differentiate these entities better than those reported in our analysis.

Our study analyzed the differences in hospitalized patients with congestive heart failure exacerbation. Patients with LV systolic dysfunction were more likely to be men, black, to have a history of cerebral vascular events, and to have cardiomegaly on chest x-ray. Our results show that among consecutively hospitalized patients with heart failure, hospital length of stay and readmission rates within 6 months of discharge from the study institution were not statistically different between patients with preserved and reduced systolic function.

While the focus of pharmacologic strategies has been devoted entirely to heart failure with systolic dysfunction, there is a distinct lack of clinical trials data to support therapeutic strategies in patients with preserved systolic function.^{9, 10, 13, 14}

McDermott, in his retrospective analysis of 412 patients with congestive heart failure exacerbation, reported that patients with systolic dysfunction were more likely to be readmitted within 6 months than are those with preserved systolic function.¹ The cut-off for EF was > 50% or < 40%, respectively; patients with EF 40–50% were excluded, compared with our study which included all patients with the cut-off for EF of < 50% and ≥ 50%, respectively. Harjai, in a retrospective analysis of 443 consecutive patients admitted with congestive heart failure, reported that patients with depressed LV systolic function had higher resource utilization and readmission rates following hospitalization for heart failure.⁸ The cut-off in his study was ≤ 40% for patients with depressed LV function and

> 40% for those with preserved function. Our analysis included patients with EF between 40 and 50%, and we used 50% as the cut-off for normal and abnormal systolic function, which might explain the differences in our findings compared with these studies. Also, the sample size may be a factor that explains these differences. However, our study shows that there are no differences with regard to the length of stay and readmission rate, suggesting similar resource utilization between the two groups.

Conclusion

Our study concludes that the clinical presentation in heart failure is similar in patients with preserved and decreased left ventricular systolic function and cannot be reliably differentiated by history, physical examination, and chest x-ray. The hospital length of stay and readmission rates are similar in these subsets of patients. Clinical trials are needed to identify strategies to improve outcomes among the growing subsets of patients with heart failure and preserved systolic function.

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