Clinical Predictors of Preserved Left Ventricular Ejection Fraction in Decompensated Heart Failure

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Abstract

Background: Identification and clinical impact of preserved left ventricular ejection fraction (LVEF) on in-hospital outcomes in patients with acute decompensated heart failure (HF) remain poorly defined.

Objective: To describe clinical predictors and in-hospital outcomes of acute decompensated HF patients and preserved LVEF, and to develop a clinically-based predictive rule based on data acquired on admission.

Methods: Consecutive admissions for HF (n=721) at a tertiary care hospital were followed up to discharge or death. More than 80 clinical variables were evaluated to identify predictors of preserved LVEF upon admission.

Results: Preserved LVEF (≥50%) was identified in 224 (31%) hospitalizations. Clinical predictors of preserved LVEF were age > 70 years old (p=0.04), female gender (p<0.001), non-ischemic etiology (p<0.001), atrial fibrillation or flutter (p=0.001), anemia (p=0.001), pulse pressure > 45 mmHg (p<0.01) and absence of EKG conduction abnormalities (p<0.001). A clinical score based on these variables was accurate to predict preserved LVEF upon hospital admission (area under ROC curve of 0.76). No significant differences were observed on in-hospital mortality or clinical complications according to quintiles of LVEF.

Conclusions: Preserved LVEF is a prevalent and morbid condition among hospitalized HF patients. Simple clinical data obtained on admission might be useful for predicting preserved LVEF. (Arq Bras Cardiol 2010; 94(3):364-371)

Key words: Acute decompensated heart failure, preserved ejection fraction and in-hospital mortality.

Introduction

Heart failure (HF) remains a major health care problem in Brazil and worldwide[1-4]. Heart failure (HF) with preserved systolic function has been recognized for more than 30 years, but it was only in the last decade that a broader understanding of its epidemiology, clinical presentation and prognosis has emerged[5-8]. It is now well recognized that a significant number of patients presenting HF symptoms have a normal or only mildly reduced left ventricular ejection fraction (LVEF). Prevalence of preserved LVEF in HF cohorts, however, may vary greatly, depending on diagnostic criteria, study setting and design. It is estimated that approximately 30-50% of hospital admissions attributed to decompensated HF occur in patients without systolic dysfunction[9-12]. Furthermore, hospitalizations for HF with preserved LVEF have become increasingly more frequent in the last two decades[13].

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Diagnostic criteria for HF associated with normal LVEF are not universally accepted and may be confusing and unpractical for clinicians evaluating patients with decompensated HF[14]. In the emergency department, rapid identification of HF patients with preserved LFEF is particularly important, as treatment strategies may change dramatically according to different classes of left ventricular function[15]. Diagnostic and prognostic data derived from post-hoc analysis of clinical trials that enrolled HF outpatients with preserved LVEF may not be applicable to this specific clinical scenario[16-19]. Furthermore, prospective data evaluating the impact of left ventricular function on in-hospital outcomes are scarce and conflicting[5,20,21].

The purpose of this prospective cross-sectional study was to

I) describe the prevailing and independent clinical predictors of preserved LVEF in patients admitted for decompensated HF at a tertiary teaching hospital;

II) develop a simple clinically-based predictive rule of HF with preserved LVEF based on a set of clinical features acquired within the first hours from hospital admission; and

III) compare clinically relevant in-hospital outcomes of patients with preserved LVEF to those with left ventricular systolic dysfunction.

Methods

Study setting and identification of cases

The study protocol was conducted at Hospital de Clínicas de Porto Alegre, a tertiary care teaching hospital located in the South Region of Brazil, with 749 beds. Consecutive patients admitted to our institution with suspected acute decompensated HF between August 2000 and January 2004 were eligible for enrollment, irrespective of their subsequent in-hospital destination (whether clinical wards, intensive care units or discharged directly from the emergency department). The protocol of this registry has been previously reported[22]. In brief, a study investigator or a trained research assistant from the HF team inquired members of medical teams about potentially eligible patients on a daily basis. HF diagnosis and inclusion of individuals were based on the Boston criteria[23]. Boston criteria are based on clinical history findings (maximum of 4 points: dyspnea at rest [4 points], orthopnea [4 points], paroxysmal nocturnal dyspnea [3 points], dyspnea while walking on level area [2 points] or dyspnea while climbing [3 points]), physical examination (maximum 4 points: heart rate abnormality [1-2 points], high jugular venous pressure [2-3 points], lung crackles [1-2 points], wheezing [3 points] or third heart sound [3 points] and *chest radiography* (maximum 4 points: alveolar pulmonary edema [4 points], interstitial pulmonary edema [3 points], bilateral pleural effusion [3 points], cardiothoracic ratio greater than 0.50 [3 points], or upper zone flow redistribution [2 points]). Patients admitted with a Boston score equal or greater than 8 points (definite HF) were considered for inclusion if there was no evidence of an alternative medical diagnosis to which the clinical picture presented could be attributed. Most relevant exclusion conditions were chronic obstructive pulmonary disease, primary pulmonary hypertension, pericardial disease, obesity, physical deconditioning, anxiety, active respiratory infections or pulmonary emboli. In addition, exclusion criteria included history of an acute cardiac event (acute coronary syndrome, myocardial revascularization or cardiac surgery) within a 3-month period from index HF admission and inability to give written informed consent. The research protocol was reviewed and approved by the Human Research Committee from our institution and written informed consent was obtained from all patients prior to enrollment. This investigation conforms to the principles outlined in the Declaration of Helsinki. Registry entries from the current analysis reflect that individual admissions and multiple hospitalizations of the same patients may be entered into the registry as separated records. The complete registry includes 779 consecutive admissions for decompensated HF, but only 721 had a recent evaluation of left ventricular function by echocardiography and constituted the study population.

Data collection

After inclusion, patients were followed throughout hospital stay until discharge or death. A complete medical history was obtained from all patients. Trained investigators inquired the patients on admission and daily during hospitalization in order to collect data including demographics, past medical history, initial presentation (clinical, physical examination and laboratory data), functional capacity, hospital management and hospital outcomes. After death or discharge, missing data were reviewed directly from electronic charts.

Standard M-mode, two-dimensional, and Doppler transthoracic echocardiography were performed at the discretion of the patients' physicians and were interpreted by experienced staff cardiologists. The non-invasive cardiac laboratory of our institution follows the current recommendations of the American Society of Echocardiography for LVEF estimations[24]. Echocardiographic data analyzed in the present study were obtained directly from electronic reports, in order to reproduce data typically available in routine clinical practice. Preserved systolic function was defined as LVEF equal or above 50% in the absence of significant valvular or pericardial disease. Devereaux formula was used to estimate left ventricular mass, while diastolic dysfunction was defined by standardized echocardiographic criteria[25]. Most patients had an assessment of left ventricular function performed during index admission; for those who did not, the most recent assessment was recorded from the hospital chart.

Statistical analysis

Continuous variables with normal distribution were expressed as mean standard-deviation, while those with non-normal distribution were described as median and interquartile ranges. Categorical data were described as number and percentages. Clinical characteristics and outcomes were compared among different quintiles of LVEF. More than 80 clinical variables based on medical history, physical examination, laboratory and echocardiographic data were evaluated to determine independent predictors of preserved LVEF. Pearson chi-squared test (or Fisher's exact test when appropriate) was used for categorical data analysis. Comparisons among continuous variables were performed using unpaired Student's t-test and Mann-Whitney U-test, as appropriate. To examine the significance of overall comparisons of groups regarding LVEF quintiles, ANOVA test for linearity and Mantzel-Haenzel test were used for quantitative and qualitative variables, respectively. Logistic regression analysis was performed to identify independent predictors of preserved LVEF among the clinical characteristics presented. Only variables with less than 5% missing data and with a p value < 0.10 in the univariate analysis were accepted for multivariate model (age > 70 years, female gender, non-ischemic etiology, pulse pressure > 45 mm Hg, absence of left bundle branch block or non-specific intratraventricular conduction delay, hemoglobin < 11.5 mg/dl, non-sinus rhythm on EKG, sodium, blood urea nitrogen (BUN) and third heart sound). Variables considered to represent potential colinearity were excluded from the model. Cut-off points from continuous variables associated with preserved LVEF in univariate analysis were determined by looking for the best discriminatory value in individual receiver operator characteristic (ROC) curves. After multivariate analysis, a clinical score was created using the regression coefficient estimates for those independent predictors of preserved LVEF identified by logistic regression selected model. Its diagnostic properties (sensitivity, specificity and predictive values) were then calculated for different score

ranges using Pearson chi-squared test. Finally, score global accuracy was estimated by the area under the ROC curve. A two-sided p value smaller than 0.05 was considered to indicate statistical significance. All statistical analyses were performed using SPSS 12.0 software program for Windows (SPSS Inc., Chicago IL).

Results

Overall population

In the present analysis, 721 consecutive admissions for decompensated HF were studied (mean age of 66 ± 13 years old). LVEF was normally distributed as depicted in Figure 1, with mean LVEF of 42 ± 17% (median = 39%). Overall, 50% of patients were male and the predominant etiologies were ischemic and hypertensive (Table 1). A substantial proportion of the study population (approximately 23%) had a history of more than 3 previous HF hospitalizations. Also, as expected, more than 90% of them were in NYHA functional classes III and IV at admission. At hospital admission, 67% of patients were taking ACEIs (Angiotensin-converting enzyme inhibitors), but only 21% were on beta-blockers. In-hospital deaths occurred in 71 patients (10%), mostly due to progression of HF and cardiogenic shock (41[58%]). The majority of the remaining deaths were due to sepsis, acute cerebral and coronary events. During hospitalization, most patients were treated in the regular clinical ward, with intermittent or continuous use of intravenous loop diuretics and incremental doses of vasodilators. Inotropic support was used in less than 5% of admitted patients.

Preserved LVEF

In this cohort of acute decompensated HF, preserved LVEF was observed in 223 (31%) admissions. Table 1 demonstrates demographic and clinical characteristics among different LVEF quintiles. Patients with higher LVEF were older and predominantly female ($p<0.001$). The prevalence of diabetes and chronic obstructive pulmonary disease, as well as the Charlson comorbidity index, did not differ across LVEF quintiles. Patients with higher LVEF were more likely to have hypertension as HF etiology, atrial fibrillation and higher baseline systolic and pulse pressure. Among traditional clinical signs and symptoms of HF, only the presence of third heart sound was significantly different among LVEF categories ($p<0.001$).

Echocardiographic evidence of diastolic dysfunction was more frequently reported in patients with preserved LVEF, but electrocardiographic conduction abnormalities (left-bundle branch block and intraventricular conduction delay) were far more common in those with LV systolic dysfunction (55[36%] versus 11[8%] comparing the lowest and highest quintiles of LVEF, $p<0.001$). Serum hemoglobin and sodium levels were also significantly different according to LVEF quintiles, whereas renal function was similar in patients with or without systolic dysfunction. The proportion of patients treated with diuretics and beta-blockers before HF admission was similar in different LVEF categories, but ACEIs and digoxin use increased as LVEF decreased ($p<0.01$).

Clinical predictors of preserved LVEF

In multivariate analysis, 7 independent predictors remained significantly associated with a LVEF greater or equal to 50%, as described in Table 2. Older age, female gender, non-ischemic etiology, non-sinus rhythm, lower hemoglobin levels, higher pulse pressure levels and the absence of electrocardiographic conduction abnormalities were significantly and independently associated with preserved LVEF. A clinical score (ranging from 0 – 6 points) based on logistic regression coefficients of the multivariate model was built. Diagnostic properties of the clinical score rule for prediction of preserved LVEF are displayed in Table

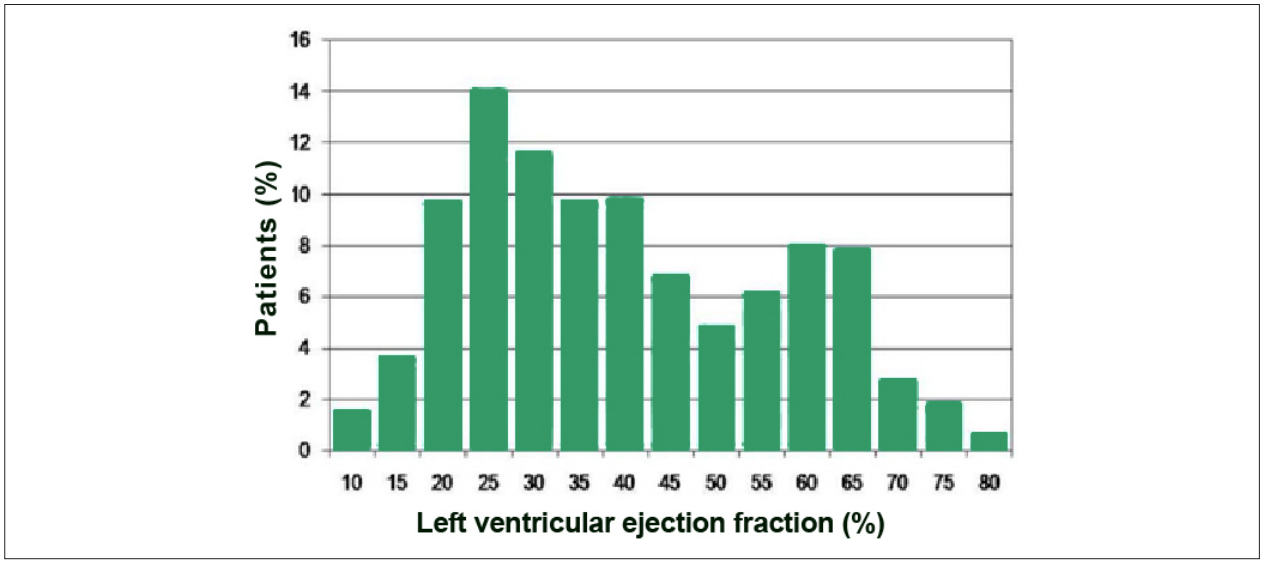

Figure 1 - Left ventricular ejection fraction (LVEF) distribution in the study population

3. Scores equal or lower than 1 point showed a negative predictive value of 100% for the presence of preserved LVEF, while scores higher than 5 points determined a specificity of at least 97%. Each 1-point increment in the score increased 2.5 times the chance of identifying an HF patient with preserved LVEF (95% CI 2.1 – 2.9; p < 0.001). Overall accuracy of the score for the prediction of preserved LVEF was 76% (95% CI 72% - 79%; p < 0.0001) (Figure 2).

Table 1- Demographic and clinical characteristics upon admission

		Quintis de FEVE, %					p*
	All admissions	10-26	27-34	35-44	45-60	61-86	
n (%)	721	152 (21)	141 (19)	140 (19)	150 (21)	138 (19)	
Demographics							
Age, years	66 ± 13	62 ± 12	67 ± 15	67 ± 13	69 ± 12	68 ± 14	<.0001
Gender, male	359 (50)	109 (71)	72 (51)	75 (53)	61 (40)	42 (30)	<.0001
HF history							
Boston clinical score	10.1 ± 2.2	10.5 ± 2.3	10.3 ± 2.1	10.1 ± 2.2	9.8 ± 2.1	10.1 ± 2.3	0.04
Previous HF admissions >3	166 (23)	48 (31)	35 (25)	27 (19)	37 (24)	19 (14)	0.001
Etiology, ischemic	266 (37)	73 (48)	56 (40)	62 (44)	53 (36)	22 (16)	<.0001
Etiology, hypertensive	243 (34)	33 (22)	43 (31)	43 (31)	64 (43)	60 (44)	<.0001
Medical history							
AF	253 (35)	32 (21)	51 (36)	49 (35)	66 (44)	55 (40)	<.0001
Charlson index	2 (1-3)	2 (1-3)	1 (0-3)	2 (1-4)	2 (1-4)	1 (0-3)	0.5
Laboratory data							
Hemoglobin, g/dL	12.1 ± 2.1	12.6 ± 1.8	12.4 ± 2.0	12.0 ± 2.0	11.8 ± 2.2	11.7 ± 2.3	<.0001
Creatinine, mg/dL	1.2 (0.9-1.6)	1.2 (1.0-1.5)	1.2 (0.9-1.6)	1.2 (0.9-1.7)	1.1 (0.9-1.6)	1.1 (0.8-1.5)	0.6
Sodium, mEq/L	138 (134-140)	136 (133-140)	137 (135-141)	137 (134-140)	138 (135-140)	138 (135-141)	0.003
BUN, mg/dL	30 (21-43)	28 (21-43)	33 (22-45)	29 (22-43)	29 (22-42)	26 (18-41)	0.06
Physical examination							
SBP, mmHg	131 ± 30	120 ± 25	129 ± 27	133 ± 28	138 ± 33	138 ± 34	<.0001
PP, mmHg	50 (40-60)	40 (30-50)	40 (40-60)	50 (40-60)	50 (40-60)	50 (40-60)	<.0001
Third heart sound	144 (20)	53 (35)	26 (18.5)	28 (20)	17 (11.5)	20 (14.5)	<.0001
EKG and echocardiographic data							
LVEDD, mm	58 (52-65)	67 (62-73)	61 (56-67)	59 (55-64)	54 (50-59)	49 (43-54)	<.0001
EKG QRS, ms	115 ± 33	128 ± 34	122 ± 33	110 ± 31	109 ± 29	101 ± 31	<.0001
Diastolic dysfunction	170 (24)	33 (22)	24 (18)	32 (23)	34 (23)	47 (35)	0.008
LV mass, g	312	353	325	303	288	244	<.0001
	(236-378)	(268-442)	(247-385)	(232-366)	(236-365)	(195-333)	
LBBB or IVCD	159 (22)	55 (36)	48 (34)	25 (18)	20 (13)	11 (8)	<.0001
Medications							
ACEIs	459 (67)	103 (72)	96 (72)	90 (67)	89 (63)	81 (60)	0.007
ß-blockers	148 (21)	31 (22)	34 (25)	31 (23)	22 (15)	30 (22)	0.9
Diuretics	537 (74)	117 (77)	111 (78)	100 (71)	110 (73)	99 (73)	0.1
Digoxin	374 (54)	93 (64)	87 (65)	70 (52)	68 (47)	56 (41)	<.0001

HF - heart failure; NYHA- New York Heart Association; AF - atrial fibrillation; BUN - blood urea nitrogen; SBP – systolic blood pressure; PP - pulse pressure; EKG - electrocardiography; LVEDD - left ventricular end-diastolic diameter; LV - left ventricular; LBBB - left-bundle branch block; IVCD - intraventricular conduction delay; ACEIs - angiotensin-converting enzyme inhibitors; *p for trend

In-hospital outcomes

In-hospital mortality and in-hospital complications was similar across different LVEF quintiles (Table 4). These findings did not change substantially after adjustment for age and gender. Both in-hospital mortality and complications rates were statistically similar when LVEF equal or above 40% (11.5% for LVEF ≥ 40% versus 8% for LVEF < 40%, p= 0.1 for in-hospital mortality; and 45.5% for LVEF ≥ 40% versus 38.5% for LVEF < 40%, p= 0.06 for complications) or 50% (10.5% for LVEF ≥ 50% versus 9.5% for LVEF < 50%, p= 0.7; and 44% for LVEF ≥ 50% versus 41% for LVEF < 50%, p= 0.4, respectively) were considered as cut-off values for preserved systolic function. Hospital length-of-stay among patients discharged alive was also similar among LVEF categories (median 11 days; interquartile range: 6-19 days). Cardiac arrhythmias and fever or evidence of infection during hospital-stay was more often observed in patients with higher LVEF values, but GI bleeding or renal function impairment did not differ according to LVEF.

Discussion

In this study, we have demonstrated that preserved LVEF is a prevalent and morbid condition among hospitalized HF patients in a Brazilian teaching hospital. Patients with acute decompensated HF and preserved LVEF presenting distinctive clinical characteristics: older age, female gender, non-ischemic etiology, chronic atrial fibrillation, anemia, a large pulse pressure and narrow QRS complexes. A simple clinical score based on these findings was properly performed to rapidly identify subgroups of patients with a higher and lower likelihood of having preserved ejection fraction when presenting acute decompensated HF. Finally, patients with preserved LVEF demonstrated similar in-hospital mortality rates and in-hospital morbidity compared to those with LV systolic dysfunction.

Several reports demonstrated that HF with preserved LVEF is a prevalent condition both in community-based and hospital cohorts and that these patients present similar clinical features, although not always as severe, when compared with the typical HF patients with systolic dysfunction[4,5,7,14]. The overall prognosis of these patients, although probably better than that of those with HF and systolic dysfunction, is, nonetheless, far worse when compared to normal individuals[10]. Furthermore, although mortality for HF with systolic dysfunction has decreased over the last 15 years, fatal outcome rates for HF with preserved LVEF have remained stable[13].

Among patients hospitalized due to acute decompensated HF, data on clinical course and outcomes of patients with preserved LVEF is limited. Previous reports demonstrated conflicting findings about the clinical impact on long-term outcomes, and scarce data are available on in-hospital event rates[10,11]. A Canadian cohort of hospitalized HF patients did not observe significant differences for both in-hospital and 1-year mortality rates between patients with systolic dysfunction and those with preserved ejection fraction (4.9% and 3.8%, respectively, for in-hospital death)[26]. However, recent analysis from the ADHERE Registry, including over 100,000 HF admissions, demonstrated that in-hospital death rates were significantly lower for patients with preserved LVEF (2.8% vs. 3.9%; p = 0.005), although duration of intensive care unit stay and total hospital length-of-stay were similar[27]. Considering these latter findings, it is conceivable to assume that differences in some clinical outcomes may in fact be present in patients with different degrees of LV systolic function, but the magnitude of these differences may not be as great as previously considered. Nonetheless, our data support the concept that patients with preserved LVEF hospitalized with acute decompensated HF have a considerably morbid condition, associated with substantial in-hospital mortality and high clinical event rates during hospital stay. In-hospital death rates in our sample were significantly higher, irrespective of LVEF strata, when compared to data previously published in other countries, particularly in North American reports[28,29]. Our data derive from a cohort of consecutive HF patients diagnosed by clinical criteria, representing the typical ''real-world'' patient that seeks hospital care. Although widely accepted to diagnose HF in the outpatient setting, neither

Table 2- Independent predictors of preserved LVEF in patients with acute decompensated HF

Clinical correlates	Odds ratio	95% CI	p value	Clinical Score *
History & Physical Exam				
Age > 70 years	1.48	1.00-2.17	0.04	+0.5
Female gender	2.30	1.57-3.36	<0.0001	+1.0
Non-ischemic etiology	2.29	1.54-3.41	<0.0001	+1.0
Pulse pressure > 45 mmHg	1.80	1.17-2.77	0.006	+1.0
EKG				
Non-sinus rhythm on EKG	1.81	1.25-2.62	0.001	+0.5
Absence of LBBB or IVCD	5.00	2.77-9.01	<0.0001	+1.5
Laboratory				
Hemoglobin < 11.5 mg/dL	1.81	1.25-2.63	0.001	+0.5

** Based on the regression coefficient derived from the multivariate analysis; CI - confidence interval; EKG - electrocardiography; LBBB - left bundle branch block; IVCD - intraventricular conduction delay; LVEF - left ventricular ejection fraction*

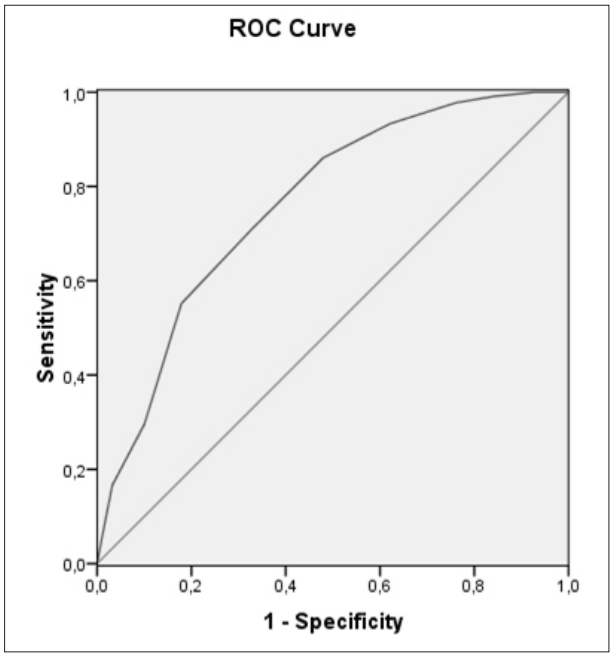

Figure 2 - Accuracy (ROC curve) of the clinical score rule for preserved LVEF prediction upon hospital admission in the study cohort.

the Framingham nor the Boston criteria can differentiate patients with systolic dysfunction from those with preserved LVEF[14]. In addition, B-type natriuretic peptide levels, which have been extensively validated as a diagnostic and prognostic tool in acute decompensated HF, are high in patients with a congestive state regardless of LVEF status[30]. All current diagnostic criteria proposed to identify HF with preserved systolic function incorporate imaging modalities to objectively define diastolic dysfunction, a rather limiting step in the acute setting[14]. In this scenario, simple clinical characteristics that may suggest the presence of LV dysfunction may be instrumental to physicians facing the clinical dilemma of treating patients with HF symptoms in the emergency department.

Several studies tried to identify clinical variables that could be associated with preserved LVEF, and therefore help in its identification before imaging assessment of systolic and diastolic parameters[11,19-21,27]. Some of these characteristics have been systematically reported in cohorts of hospitalized HF patients, such as older age, female gender and lower prevalence of previous history of myocardial infarction or coronary artery disease among subjects with preserved LVEF[11,20,21,29]. More recently, anemia[31] and atrial fibrillation[27] have also been demonstrated to be more common in admitted HF patients without systolic dysfunction. On the contrary, left bundle branch blocks are significantly more frequent in the presence of LV dysfunction[21,31]. Furthermore, high pulse pressure values, as identified in the present study, have been associated to higher LVEF both in outpatients and in acute decompensated HF patients[32,33]. In this study, we proposed a simple predictive rule to identify LV function based on easily obtained clinical characteristics at presentation. The overall diagnostic performance of this clinical score was adequate with an area under ROC curve of 0.76. For instance, patients with a score ≤ 2 points represent a subgroup with a very high probability of having LV dysfunction (LVEF < 50%). Our data corroborate the clinical characteristics that define this profile in a cohort of acute decompensated HF patients outside North America. The therapeutic implications of these findings cannot be underscored. Collins et al[34], in a recent report, elegantly suggested several specific goals to be kept in mind when treating patients with acute decompensated HF[34]. For instance, use of inotropic negative drugs to manage blood pressure and control ventricular rate is an everyday clinical dilemma in the management of acute decompensated HF that might be greatly influenced by left ventricular function.

Limitations

Some potential limitations of our study deserve consideration. Our population was "highly selected" in order to avoid incorrectly including other diagnoses that could simulate HF symptoms, based on relatively high cut-off for Boston criteria (≥8). Such inclusion strategy was defined a priori and was chosen to avoid "contamination" of the studied sample. We acknowledge that this may be a potential limitation and that our results are applicable only to a selected group of acute decompensated HF patients. We cannot exclude the possibility that the selection criteria used in the present protocol (high Boston score) could have disproportionately exclude some HF patients with preserved ejection fraction, that might have less severe HF burden and therefore lower complication rates. The proposed score

Table 3- Diagnostic properties of clinical score rule for preserved LVEF prediction

Score range	n (%)	Preserved LVEF n	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
≤ 1.0	36 (5)	-	0	92.5	0	67.5
> 1.0	658 (95)	223	100	7	32	100
> 2.0	597 (83)	218	98	24	36.5	96
> 3.0	431 (60)	192	86	52	44.5	89.5
> 4.0	212 (29.5)	123	55	82	58	80.5
> 5.0	53 (7.5)	37	16.5	97	70	72
= 6.0	17 (2.5)	12	5.5	99	70.5	70

Table 4- **Incidence of in-hospital outcomes according to LVEF quintiles**

LVEF, % (Quintiles)	All admissions n = 721	In-hospital mortality n= 71 (10%)	In-hospital complications n = 302 (42%)	Hospital length-of-stay, days*
10-26	152 (21)	17 (11)	57 (37)	11 (6-18)
27-34	141 (19)	7 (5)	49 (35)	10 (6-18)
35-44	140 (19)	16 (11)	69 (49)	10 (6-19)
45-60	150 (21)	13 (8)	63 (42)	13 (7-22)
61-86	138 (19)	18 (13)	64 (46)	12 (7-19)
p value †		0,4	0,05	0,06
			In-hospital complications	
	Fever or infection n = 169 (23%)	GI bleeding n = 15 (2%)	Arrhythmias n = 45 (6%)	Worsening renal function n = 177 (25%)
10-26	27 (18)	2 (1)	7 (4)	37 (24)
27-34	25 (17)	1 (0,5)	4 (3)	33 (23)
35-44	39 (28)	4 (3)	11 (8)	39 (28)
45-60	40 (26)	5 (3)	11 (7)	36 (24)
61-86	38 (27)	3 (2)	12 (9)	32 (23)
p value †	0,01	0,2	0,04	0,9

**n = 698 (only patients discharged alive included in hospital length-of-stay analysis); †p for trend; Abbreviations: LVEF, left ventricular ejection fraction; GI, gastrointestinal.*

derived from a cohort of consecutive HF patients representing typical "real world" patients seeking hospital care. We have previously shown that several clinical characteristics are similar between HF patients admitted to our institution and those admitted to a tertiary-care university hospital in the US[28]. We acknowledge that external prospective validation is warranted to assure that the proposed score also performs adequately in different HF cohorts; this aspect represents a major limitation of our findings.

Conclusions

In patients hospitalized for decompensated HF, preserved LVEF is a common finding associated with substantial short-term mortality and high rates of clinically relevant in-hospital morbid events. At clinical presentation, simple clinical characteristics were helpful in identifying distinctive patient profiles that predicted LV function strata with a reasonable accuracy. This predictive rule, however, needs further prospective validation in different cohorts of HF patients.

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