

## Hospitalized Congestive Heart Failure Patients with Preserved versus Abnormal Left Ventricular Systolic Function

Manuel Martínez-Sellés, José A. García Robles, Luis Prieto<sup>a</sup>, Elisa Frades, Roberto Muñoz, Óscar Díaz Castro and Jesús Almendral

Servicio de Cardiología. Hospital Universitario Gregorio Marañón. <sup>a</sup>Departamento de Estadística. Universidad Complutense. Madrid.

**Objectives.** To compare the clinical characteristics of hospitalized patients with congestive heart failure and left ventricular dysfunction versus normal systolic function.

**Methods.** Clinical records of all admissions with a heart failure diagnostic code over a one-year period were reviewed retrospectively. Of 1,953 admissions, 595 were excluded because they did not fulfill diagnostic criteria.

**Results.** A total of 1,069 patients had 1,358 admissions with confirmed heart failure (1.27 admissions/patient). Of them, 706 patients (66%) had an echocardiographic study and 381 (54%) had ventricular dysfunction. Ventricular dysfunction was associated with previous myocardial infarction (OR = 5.8), left bundle-branch block (OR = 5.0), male sex (OR = 2.0), and smoking (OR = 1.8). Meanwhile, a negative association existed with age (OR = 0.97), previous valve surgery (OR = 0.46) and atrial fibrillation (OR = 0.49).

Patients with ventricular dysfunction had more hospitalizations in the cardiology department and received more vasodilators, aspirin, and nitrates on discharge. The prescription of angiotensin converting enzyme inhibitors prescription to patients with ventricular dysfunction increased with the severity of ventricular dysfunction and was more frequent in patients admitted to the cardiology department.

Systolic dysfunction increased hospital mortality (OR = 2.9).

**Conclusions.** Patients admitted with heart failure and systolic dysfunction had a different clinical profile than patients with a normal ejection fraction. Seven clinical variables predicted the presence of systolic dysfunction. Patients with ventricular dysfunction had more hospital mortality and were prescribed vasodilators, aspirin, and nitrates more often on discharge.

**Key words:** Heart failure. Myocardial contraction. Echocardiography.

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Correspondence: Dr. M. Martínez Sellés.  
Servicio de Cardiología.  
Hospital Universitario Gregorio Marañón.  
Dr. Esquerdo, 46, 28007 Madrid, Spain.  
E-mail: mmselles@navegalia.com

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### Características de los pacientes ingresados por insuficiencia cardíaca según el estado de su función ventricular

**Objetivos.** Comparar las características de pacientes ingresados por insuficiencia cardíaca con y sin disfunción ventricular.

**Métodos.** Se revisaron retrospectivamente las historias de todos los ingresos con diagnóstico de insuficiencia cardíaca o relacionados (1.953 ingresos) durante un año. Se excluyeron 595 por no cumplir criterios de insuficiencia cardíaca.

**Resultados.** Se analizaron los 1.358 ingresos con diagnóstico confirmado de insuficiencia cardíaca en 1.069 pacientes (1,27 ingresos/paciente). En 706 pacientes se realizó un ecocardiograma y 381 (54%) presentaban disfunción ventricular. Se asociaron con disfunción ventricular las siguientes variables en el momento del ingreso: infarto de miocardio previo (*odds ratio* [OR] = 5,8), bloqueo de rama izquierda (OR = 5,0), sexo masculino (OR = 2,0) y tabaquismo (OR = 1,8). Por el contrario, presentaron una asociación negativa la edad (OR = 0,97), cirugía valvular previa (OR = 0,46) y fibrilación auricular (OR = 0,49).

Los pacientes con disfunción ventricular ingresaban con mayor frecuencia en el Servicio de Cardiología y recibían más vasodilatadores, antiagregantes y nitratos al alta. La tasa de prescripción de inhibidores de la enzima convertidora de la angiotensina en pacientes con disfunción ventricular se incrementó con la gravedad de la disfunción y fue superior en los ingresos en el Servicio de Cardiología.

La disfunción ventricular incrementó la mortalidad intrahospitalaria (OR = 2,9).

**Conclusiones.** El perfil clínico de los pacientes ingresados con insuficiencia cardíaca por disfunción sistólica es claramente distinto del de los pacientes con fracción de eyección normal. Siete variables clínicas permiten sospechar la presencia o ausencia de disfunción sistólica. Los pacientes con disfunción sistólica tienen una mayor mortalidad intrahospitalaria y reciben más vasodilatadores, antiagregantes y nitratos al alta.

**Palabras clave:** Insuficiencia cardíaca. Contracción miocárdica. Ecocardiografía.

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## ABBREVIATIONS

HF: heart failure.  
ACEI: angiotensin II converting enzyme inhibitors.  
LVEF: left ventricular ejection fraction.  
LBBB: complete left bundle-branch block.  
AF: atrial fibrillation.

## INTRODUCTION

Heart failure (HF) is the only cardiovascular pathology whose incidence, prevalence, and overall mortality are still increasing. Depending on the studies, between 13% and 75% of the patients diagnosed as HF have a normal ejection fraction, although most authors agree that figures of 30% to 50% are probably closer to reality.<sup>1-4</sup> This percentage is even higher in persons over the age of 65 years<sup>1-3,5-7</sup> and women.<sup>1-3,6,7</sup>

In spite of this high frequency, studies comparing the clinical profile of patients hospitalized with HF due to systolic dysfunction and those with a normal left ventricular ejection fraction (LVEF) are scarce and limited by the inclusion of only men,<sup>8</sup> a small number of patients with normal LVEF,<sup>2,9-11</sup> or a different from usual cutoff point for normal LVEF.<sup>1</sup> On the other hand, although some studies indicate that patients with systolic dysfunction have a worse prognosis,<sup>3,6,8,12,13</sup> others have found no differences in survival between patients with and without ventricular dysfunction.<sup>11,14-16</sup> This discrepancy in the prognostic effect of the normal LVEF could be due to the use of different patient selection criteria, since in many cases they have been limited to subgroups of ischemic heart disease,<sup>8,12,14</sup> older people<sup>12,16</sup>, or men.<sup>5,8,16</sup>

It is important to distinguish patients with normal a LVEF from those with systolic dysfunction, not only because of the possible effect on prognosis but, above all, because treatment recommendations differ.<sup>17,18</sup> In addition, the beneficial effect of medical treatment on survival has been demonstrated only in patients with impaired LVEF. Angiotensin II-converting enzyme inhibitors (ACEI) are the first drugs that have been shown to increase survival in patients with HF and ventricular dysfunction. Confirmation of this beneficial effect has led to their unanimous recommendation by experts and societies.<sup>18-20</sup> Nevertheless, recent studies demonstrate that ACEIs are underused in patients with HF and impaired LVEF.<sup>21</sup>

The aims of the present study are: *a*) to ascertain what percentage of patients hospitalized for HF have a

normal LVEF and to compare the clinical characteristics, intrahospital mortality, and treatment at discharge of patients with ventricular dysfunction compared with patients with normal left ventricular systolic function, and *b*) to study the factors that increase or decrease ACEI prescription in patients with ventricular dysfunction.

## METHODS

The data came from the HOLA project (Heart Failure: Observation of Local Admissions). This registry covered all the medical departments of the Hospital Gregorio Marañón, a 1917-bed tertiary hospital with a healthcare area of 636 302 inhabitants (area 1 of Madrid), of which 537 666 inhabitants were over 15 years old.<sup>22</sup> The project analyzed all admissions to the Gregorio Marañón University Hospital in 1996 with the main or secondary diagnosis of HF and unspecified cardiomyopathy, according to ICD-9 codes (International Classification of Diseases 9th Revision—Clinical Modification) (Table 1). The clinical histories of 1953 patients admitted with diagnostic codes were reviewed retrospectively, and demographic and medical data were recorded.

## Inclusion criteria

The admissions of patients of 15 years old or older who met the following diagnostic criteria for HF were included:

*a*) In patients with moderate-to-severe ventricular dysfunction or cardiac valve disease, the diagnostic criteria of the European Society of Cardiology.<sup>23</sup> *b*) In patients without ventricular dysfunction or cardiac valve disease in the echocardiogram, at least one symptom (oliguria, dyspnea, or edema), one sign (edema, increased jugular venous pressure, or crepitations), and evidence of HF in the chest radiograph (cardiomegaly or lung congestion/pleural effusion). *c*) In patients for whom no echocardiogram was available, at least one symptom and one sign *or* one finding of HF in the chest radiograph.

**TABLE 1. Diagnoses of heart failure (HF) or related conditions, according to ICD-9-CM codes (International Classification of Diseases 9th Revision—Clinical Modification)**

402	Hypertensive heart disease
428.0	Heart failure
428.1	Left heart failure
428.9	Heart failure, unspecified
425.4	Other primary cardiomyopathies
425.5	Alcoholic cardiomyopathy
425.9	Secondary cardiomyopathy, unspecified

## Exclusion criteria

The patients admitted were excluded if: *a*) the presence of HF could not be confirmed using the above criteria (454 admissions; 23.3%); *b*) acute myocardial infarction was the main diagnosis (the cause of admission was myocardial infarction and HF was a complication) (69 admissions; 3.5%), or *c*) patient data was unavailable (72 admissions; 3.7%).

## Echocardiogram

The remaining 1358 admissions, corresponding to 1069 patients, were analyzed (1.27 admissions per patient). An echocardiogram was made in 706 patients (66%) and two groups were classified according to the presence (LVEF $\geq$ 50%) or absence of ventricular dysfunction (LVEF<50%). The ejection fraction was measured using the Teichholz formula and the subjective judgment of the echocardiography specialist. The criterion for performing echocardiography was the request of the responsible physician.

## Review of clinical histories

All data were collected by two cardiologists (M.M.S. and J.A.G.R.). Cases were only included if both investigators agreed that the criteria defined had been satisfied. The reproducibility of decision-making, evaluated by randomized re-evaluation of 9% of the cases, was good, with  $k=0.89$  (95% confidence interval, 0.77-0.99).

## Statistical methods

For the comparison of groups with and without systolic dysfunction, the Chi-square test or Fisher exact test, as indicated) was used for categorical variables and the Student t test for continuous variables, after confirming the assumption of a normal distribution.

In order to determine if systolic dysfunction was an independent predictor of intrahospital mortality, a multivariate analysis with logistic regression was carried out by stepwise retrograde elimination, in which the variables found to be predictive of mortality in the univariate analysis with  $P<.15$  were included.

The predictors of systolic dysfunction at admission were studied by multivariate analysis with logistic regression and retrograde stepwise elimination in which the variables recorded at admission that were predictive of systolic dysfunction in univariate analysis with  $P<.15$  were included. In order to assess the discriminatory capacity of the model, the ROC logistic regression procedure was used, based on generating the variable that predicted the probability of presenting systolic dysfunction in each subject.

The factors that determined the non-prescription of ACEI in patients with dysfunction was studied by

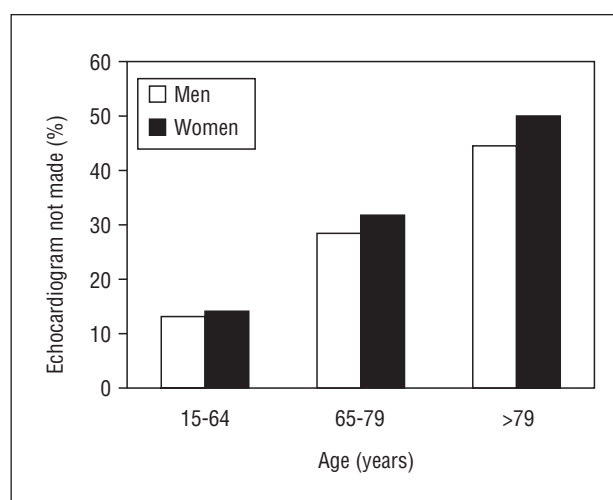
multivariate analysis (logistic regression with stepwise retrograde elimination). The variables predictive of non-prescription of ACEIs in univariate analysis with  $P<.15$  and other variables that could condition ACEI prescription were included. In order to assess the discriminatory capacity of the model, the ROC procedure for logistic regression based on generating the predicted variable was also used, which estimated the probability of each subject of not receiving ACEIs.

The odds ratios are expressed with their 95% confidence interval. The SPSS statistical program version 10.0 for Windows was used for statistical analysis (SPSS Inc., Chicago, Illinois, U.S.).

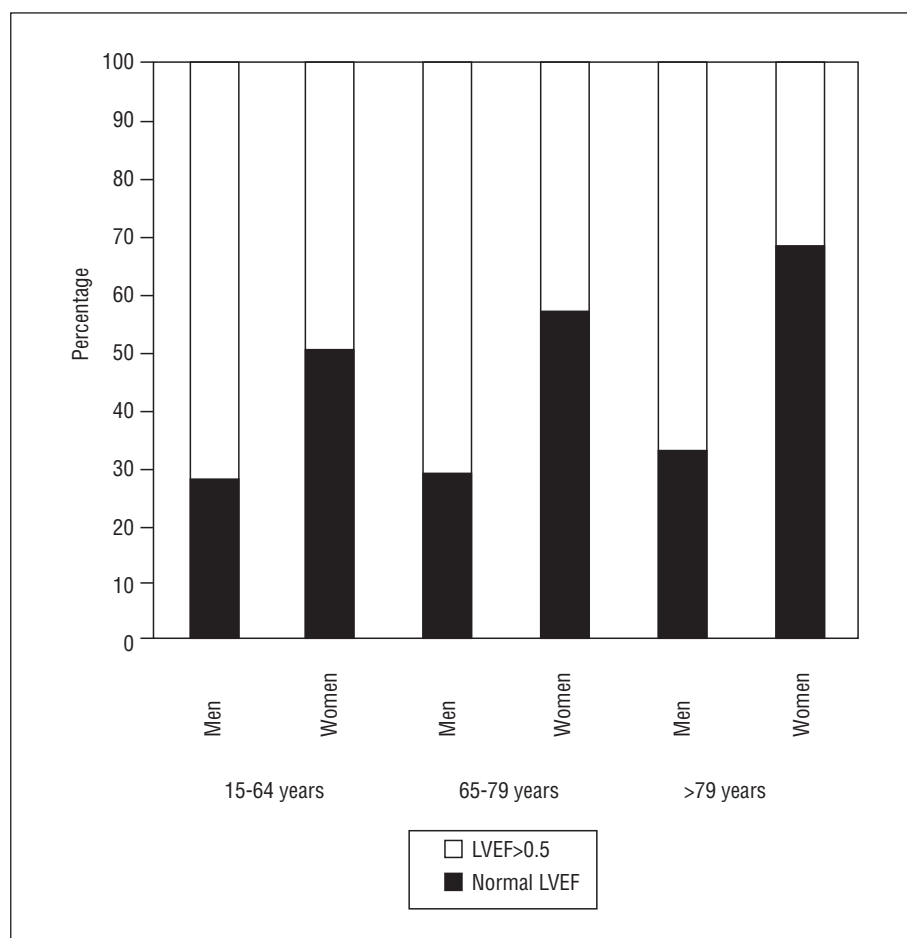
## RESULTS

### Clinical profile

From 1 January to 31 December we identified 1069 patients with 1358 admissions for confirmed HF (1.27 admissions/patient). Seven hundred and six patients (66%) with an echocardiogram were included in the present study. Echocardiograms were made less frequently in women and older persons (Figure 1). LVEF was 0.5 or less in 381 patients (54%), whereas 325 patients (46%) had a normal LVEF. The proportion of patients with a normal LVEF was greater in women (64% versus 29% in men) and older persons (55% in  $\geq 75$  versus 39% in <75 years), both being significant differences, with  $P<.001$  (Figure 2). In Table 2 is shown the univariate analysis of the comparison of the clinical profile of the two groups: the patients with normal LVEF were older, more frequently women, and presented more valvular disease. However, they had less ischemic heart disease and less comorbidity than the patients who presented systolic dysfunction.



**Fig. 1.** Percentage of patients without an echocardiogram. Distribution by age and sex.



**Fig. 2.** Distribution of the left ventricular ejection fraction (LVEF) in different groups by age and sex.

In Table 3 are listed the variables recorded at the time of admission that were independent predictors of ventricular dysfunction: presence of left bundle-branch block in the electrocardiogram, history of myocardial infarction, smoking, and male sex, all of which had a positive association. On the contrary, advanced age, previous valvular surgery, and atrial fibrillation had a negative association with ventricular dysfunction. With these 7 clinical variables at admission, the presence of LVEF=0.5 was predicted with an area under the ROC curve of 0.80 (95% confidence interval, 0.76-0.83).

### Hospital mortality

There were no significant differences in intrahospital mortality between the two groups in univariate analysis (ventricular dysfunction 7% versus normal LVEF 4%;  $P=.07$ ). However, multivariate analysis in which age and other confusion variables were controlled demonstrated that the presence of ventricular dysfunction independently increased intrahospital mortality by 2.9 times ( $P<.01$ ), with a 95% confidence interval of 1.2-7.0.

### Treatment

In the 662 patients discharged alive (94%), the treatment received at hospital discharge was analyzed. In Table 4, the pharmacological treatment of patients is compared in relation to normal or abnormal ejection fraction. The patients with ventricular dysfunction received more drugs at discharge, mainly ACEIs and other vasodilators, antiplatelet aggregants, and nitrates.

### Angiotensin I converting enzyme inhibitors

Patients with severe ventricular dysfunction (LVEF <0.3) received ACEI more frequently than those with moderate dysfunction (LVEF, 0.3-0.4), patients with moderate dysfunction more frequently than those with mild dysfunction (LVEF, 0.41-0.5), and patients with mild dysfunction more frequently than those with a normal LVEF (77%, 66%, 49% and 45%, respectively;  $P<.001$ ). In patients with LVEF=0.4, ACEI use was greater in the cardiology department than in other departments, whereas in patients with LVEF>0.4, the opposite occurred (Figure 3).

**TABLE 2. Differences in the clinical profile of patients according to the presence or absence of left ventricular ejection fraction (LVEF)>0.5**

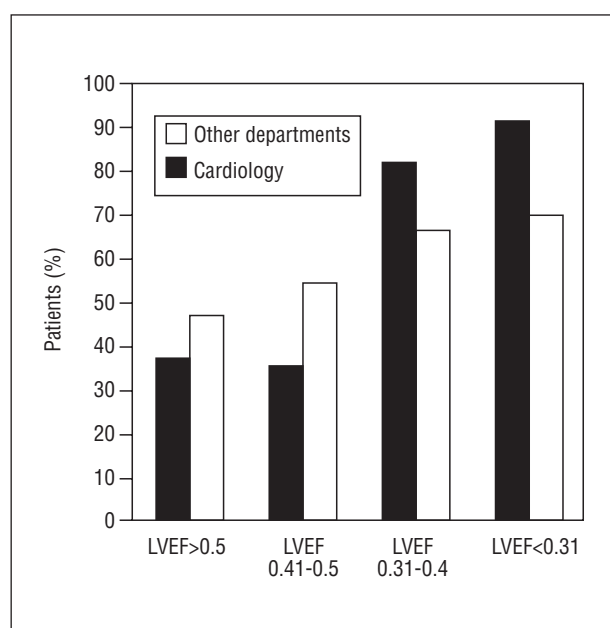
	LVEF>0.5	LVEF≤0.5	P
<i>Demographic characteristics</i>			
Age, years	74.5±11.2	70.6±11.6	<.0001
Patients >75 years	52	36	<.0001
Female sex	71	41	<.0001
<i>Comorbidity</i>			
Kidney failure	12	18	.026
Alcoholism	6	13	.001
<i>Cardiac valve disease</i>			
History of cardiac valve surgery	17	9	<.0001
Moderate or severe aortic stenosis	12	6	.007
Moderate or severe aortic insufficiency	8	4	.01
Moderate or severe mitral stenosis	16	2	<.0001
<i>Coronary artery disease and its indicators</i>			
Peripheral vascular disease	5	9	.06
Smoking	13	29	<.0001
History of myocardial infarction	6	29	<.0001
Coronary artery disease in angiography	6	16	<.0001
History of surgical revascularization	3	10	<.0001
<i>Electrocardiographic abnormalities</i>			
Atrial fibrillation	61	40	<.0001
Complete left bundle-branch block	6	18	<.0001
Lower-limb edema	69	59	.005
Admission to cardiology department	22	34	.0005

Data are expressed as percentages, except for age (in years). \*As indicated in the medical record.

In order to identify the factors that determined the non-prescription of ACEIs in patients with ventricular dysfunction, a multivariate analysis was made, the result of which is shown in Table 5. Less severe ventri-

**TABLE 3. Predictors of ventricular dysfunction at time of admission (multivariate analysis). Odds ratio for ventricular dysfunction, with 95% confidence interval**

Variable	OR	95% CI	P
Complete left bundle-branch block	5.0	2.83-9.01	<.001
History of myocardial infarction	5.8	3.39-10.02	<.001
Male sex	2.0	1.46-3.32	<.001
Smoking	1.8	1.12-2.94	.02
Age (years)	0.97	0.96-0.99	<.001
Previous cardiac valve surgery	0.5	0.33-0.67	<.001
Atrial fibrillation	0.5	0.32-0.74	.0013



**Fig. 3.** Use of angiotensin II converting enzyme inhibitors (ACEI) in relation to left ventricular ejection fraction (LVEF) and admission or non-admission to the cardiology ward. Patients with LVEF<0.4 hospitalized in cardiology wards received ACEI more often than those hospitalized in other departments. The opposite occurred in patients with LVEF=0.4. All differences were significant with  $P<.01$ .

cular dysfunction, kidney failure, and aortic stenosis was associated with less ACEI prescription.

## DISCUSSION

### Percentage of patients with normal LVEF

In our study, 46% of the patients in which an echocardiogram was made had normal ejection fraction. this figure is comparable to that obtained by other authors in population studies of HF<sup>3,4</sup> or in hospitalized patients.<sup>1,2</sup> In the substudy of Framingham made by Vasan et al,<sup>3</sup> approximately half of the patients with HF had normal a LVEF (>0.5). in the Minnesota study,<sup>4</sup> 43% had a conserved LVEF (>0.5). on the other hand, in older patients the percentage of cases of HF with conserved systolic function increased, reaching or surpassing 50% in patients over 65 years, which also seemed to occur in women.<sup>1-3,5-7</sup> It is interesting to note that in our study, as in other series, one-third of the patients were excluded from the analysis because no LVEF evaluation was available. The fact that the number of patients without an echocardiogram is higher in women and older patients (Figure 1), and that these subgroups presented more HF with normal LVEF (Figure 2), probably indicates that the figure of 46% of patients hospitalized for HF with normal LVEF is an underestimate.



**TABLE 4. Pharmacological treatment of patients in relation to ejection fraction**

Treatment at discharge	LVEF=0.5	LVEF<0.5	P
No. of drugs	3	4	<.0001
Platelet aggregation inhibitors	23	34	.0013
ACEIs	45	69	<.0001
Nitrates	43	55	.0010
Other vasodilators	3	8	.0014
Diuretics	81	82	.89
Digoxin	50	47	.42
Beta-blockers	6	6	.96
Calcium antagonists	15	12	.16
Anticoagulants	32	35	.38
Antiarrhythmic agents	3	3	.52

Data are expressed as percentages, except for the number of drugs (mean). ACEI indicates angiotensin II converting enzyme inhibitors.

**TABLE 5. Factors that determine non-prescription of angiotensin converting enzyme inhibitors (ACEIs)**

	OR (95% CI)	P
Kidney failure	3.1 (1.9-5.0)	<.00001
Aortic stenosis*	1.5 (1.2-1.9)	.0006
Ventricular dysfunction**	0.6 (0.5-0.7)	<.00001

CI indicates confidence interval.

\*Coded as «without aortic stenosis»=0, to «severe aortic stenosis»=3; \*\*coded as mild=1 to severe=3.

These factors allowed to the nonuse of ACEIs to be predicted with an area under the ROC curve of 0.77 (95% CI, 0.72-0.82).

### Profile of patients in relation to the presence or absence of ventricular dysfunction

Few studies have compared patients hospitalized for HF according to whether or not they have systolic dysfunction using a large enough number of patients to detect differences in the clinical profile of groups. In addition, previous comparisons of the clinical characteristics of patients hospitalized for HF with or without systolic dysfunction included few patients with a normal LVEF. The study by Dougherty et al<sup>10</sup> of 72 patients with HF (17 with a normal LVEF) demonstrated a greater prevalence of hypertension in patients with a normal LVEF. Echeverría et al<sup>9</sup> studied 50 patients with HF (20 with a normal LVEF) and found a greater prevalence of coronary artery disease in patients with systolic dysfunction. The V-HeFT study<sup>8</sup> compared 83 men with normal LVEF to 540 men with ventricular dysfunction. The men with normal LVEF had less coronary artery disease and more hypertension than the men with ventricular dysfunction. McDermott et al<sup>2</sup> studied 298 patients with HF, of which 92 had a normal LVEF. The patients with a normal LVEF were older, more frequently women, and more often had stroke and hypothyroidism. The patients with systolic dysfunction presented more coro-

nary artery disease and had cardiomegaly more frequently in the chest radiograph made on admission. Cohen-Solal et al<sup>1</sup> studied 739 patients (394 with LVEF>0.4) and found that these patients were older, more frequently women, had hypertension and atrial fibrillation more often, and received more calcium antagonists. On the contrary, they presented less coronary artery disease and received less ACEIs, diuretics, digoxin, nitrates, and beta-blockers than patients with LVEF<0.4. The intrahospital mortality was superior in patients with ventricular dysfunction.

In relation to previous studies, our study analyzed an unselected population and a larger number of patients, particularly patients with LVEF>0.5. This has allowed us to describe relations that were not well-known before now. Nevertheless, we found no relevant differences in the presence of cerebrovascular accidents (12% in patients with normal LVEF versus 11% in patients with ventricular dysfunction;  $P=.79$ ) or hypertension (46% in patients with normal LVEF versus 43% in patients with ventricular dysfunction;  $P=.31$ ), which suggests to us that no differences exist between patients hospitalized for HF with and without ventricular dysfunction in an unselected population.

In our population, a normal ejection fraction was more common in older people and women and less frequent in patients with ischemic heart disease/myocardial infarction. This finding coincides with the findings of studies of patients hospitalized for HF<sup>1,2</sup> or in community at large.<sup>3</sup> The relation between ventricular dysfunction and coronary artery disease is sustained by the pathophysiological substrate of impaired ventricular contraction induced by myocardial necrosis and/or ischemia.

### Prognostic value of LVEF

Our study also confirmed the less favorable intrahospital prognosis of patients with ventricular dysfunction, who had a 3-fold greater mortality. Although patients with ventricular dysfunction were found to have a shorter survival in population studies like the Framingham study,<sup>3</sup> V-HeFT,<sup>8</sup> or the study of hospitalized patients by the French Society of Cardiology,<sup>1</sup> other studies have not found a clear effect of ventricular dysfunction on prognosis.<sup>11</sup> These differences could be due to the different selection criteria of the studies, since some were limited to studying subgroups of patients with HF and ischemic heart disease, older people, or men. In addition, in most of the studies the information about ventricular function was not available for all of the patients.

### Treatment

Several clinical trials have demonstrated that ACEIs increase survival in patients with HF and ventricular

dysfunction. The first was published more than 10 years before the admissions studied here. Nevertheless, only 69% of the patients with ventricular dysfunction in our study received ACEIs at discharge. Some recent studies indicate that ACEIs are underused,<sup>24</sup> pointing to a lack of information among physicians as the cause. Another explanation is that the information obtained in clinical trials is not always applicable to unselected populations of patients with HF, which have an older mean age, more women, frequent comorbidity, and a higher incidence of HF with normal LVEF.<sup>25</sup> The fact that 31% of the patients with ventricular dysfunction in our study did not receive ACEIs could have been due, at least in part, to presence of contraindications (aortic stenosis and kidney failure), which, together with the degree of ventricular dysfunction, were the only predictors of ACEI non-prescription.

Although our rate of use of ACEIs cannot be extrapolated to other geographic areas, in a recent study that analyzed differences in the treatment of HF in different European countries, Spain occupied second place, after the United Kingdom, in the use of ACEIs at suitable doses (more than 75 mg daily of captopril or more than 20 mg daily of enalapril or lisinopril).<sup>26</sup>

Surprisingly, 45% of the patients with normal LVEF received ACEIs. This finding could be due, at least in part, to the fact that these drugs are authorized in Spain for the treatment of HF, without considering ventricular function, although all the studies of ACEIs were made in patients with LVEF<40%. An important proportion of patients with hypertension or diabetes is a possible explanation, although the fact is that cardiologists treat patients with LVEF=0.4 with ACEIs more frequently than non-cardiologists do. The opposite occurs in patients with LVEF>0.4 and suggests, as has been observed elsewhere,<sup>27-29</sup> that cardiologists follow published recommendations and the results of clinical trials.

We also found less use of platelet antiaggregants and nitrates in patients with a normal ejection fraction, which was related to the association of ventricular dysfunction with ischemic heart disease that has already been mentioned.

The low percentage of beta-blockers used is probably due to the fact that the admissions date from 1996, when the benefit of these drugs in the treatment of HF was not so well known. In addition, the present study examines treatment at discharge whereas drug administration often begins on an outpatient basis, after the acute episode concludes.

## Limitations

The exclusion of one-third of the patients because no echocardiogram was available is a limitation that may bias our sample of patients, since the subgroup of

patients in which the echocardiogram was not made were older, contained more women and, possibly, had more comorbidity. This limitation is common to all series of unselected patients hospitalized for HF, in which the percentage of patients without an echocardiogram is 23% to 46%.<sup>1,11</sup> Choosing the LVEF value (a filling-dependent measurement) as an index of left ventricular function is also questionable because the LVEF is based on two volume measurement errors that are susceptible to measurement errors and have only a moderate reproducibility.<sup>23</sup> The cutoff point of 0.5 to separate normal LVEF from ventricular dysfunction can also be criticized. We chose this value because it is the value most often used in studies to separate normal LVEF from ventricular dysfunction.<sup>3</sup> The use of only echocardiographic data and not that of the radionuclide or iodine contrast ventriculography, which were available for some patients, was an attempt to increase the homogeneity of the sample by using only data obtained with a single technique, the technique most widely used at our center. In addition, echocardiographic results were available for all the patients that had a ventriculography. Nevertheless, few studies have compared the clinical characteristics of patients hospitalized with HF and a normal LVEF versus those with ventricular dysfunction by comparing a sufficient number of patients in unselected populations. Our study contributes important information on the association between age, sex and other variables with ventricular dysfunction.

## CONCLUSIONS

1. Systolic dysfunction increases the mortality of patients hospitalized for HF.
2. The clinical profile of patients with systolic dysfunction is different from that of patients with a normal ejection fraction. The risk of systolic dysfunction increases with the presence of previous myocardial infarction, complete left bundle-branch block, smoking, and male sex, whereas it decreases with age, previous cardiac valve surgery, and the presence of atrial fibrillation.
3. Patients with ventricular dysfunction received more drugs at discharge, particularly vasodilators, platelet aggregation inhibitors, and nitrates.
4. Cardiologists treat patients with LVEF=0.4 with ACEIs more often than non-cardiologists do, and they treat patients with LVEF>0.4 less often than cardiologists do.

## REFERENCES

1. Cohen-Solal A, Desnos M, Delahaye F, Emeriau JP, Hanania A. A national survey of heart failure in French hospitals. *Eur Heart J* 2000;21:763-9.

2. McDermott MM, Feinglass J, Sy J, Gheorghiade M. Hospitalized congestive heart failure patients with preserved versus abnormal left ventricular systolic function: clinical characteristics and drug therapy. *Am J Med* 1995;99:629-35.
3. Vasan RS, Larson MG, Benjamin EJ, Evans JC, Reiss CK, Levy D. Congestive heart failure in subjects with normal versus reduced left ventricular ejection fraction. *J Am Coll Cardiol* 1999;33:1948-55.
4. Senni M, Tribouilloy CM, Rodeheffer RJ, Jacobsen SJ, Evans JM, Bailey KR, et al. Congestive heart failure in the community, trends and incidence and survival in a 10 year period. *Arch Intern Med* 1999;159:29-34.
5. Rich MW. Epidemiology, pathophysiology, and etiology of congestive heart failure in older adults. *J Am Geriatr Soc* 1997;45:968-74.
6. Aronow WS, Ahn C, Kronzon I. Normal left ventricular ejection fraction in older persons with congestive heart failure. *Chest* 1998;113:867-9.
7. Kitzman DW, Gardin JM, Gottdiener JS, Arnold A, Boineau R, Aurigemma G, et al. Importance of heart failure with preserved systolic function in patients  $\geq 65$  years of age. CHS Research Group. Cardiovascular Health Study. *Am J Cardiol* 2001;87:413-9.
8. Cohn JN, Johnson G. Heart failure with normal ejection fraction. The V-HeFT study. *Circulation* 1990;81(Suppl 3):48-55.
9. Echeverría HH, Bilsker MS, Myerburg RJ, Kessler KM. Congestive heart failure: echocardiographic insights. *Am J Med* 1983;75:750-5.
10. Dougherty AH, Naccarelli GV, Gray EL, Hicks CH, Goldstein RA. Congestive heart failure with normal systolic function. *Am J Cardiol* 1984;54:778-82.
11. McDermott MM, Feinglass J, Lee PI, Mehta S, Schmitt B, Lefevre F, et al. Systolic function, readmission rates, and survival among consecutively hospitalized patients with congestive heart failure. *Am Heart J* 1997;134:728-36.
12. Luchi RH, Snow E, Luchi JM, Nelson CL, Pircher FJ. Left ventricular function in hospitalized geriatric patients. *J Am Geriatr Soc* 1982;30:700-5.
13. Kinney EL, Wright RJ. Survival in patients with heart failure and normal basal systolic wall motion. *Angiology* 1989;40:1025-9.
14. Warnowicz MA, Parker H, Cheitlin MD. Prognosis of patients with acute pulmonary edema and normal ejection fraction after acute myocardial infarction. *Circulation* 1983;67:330-4.
15. Setaro JF, Soufer R, Remetz MS, Perlmutter RA, Zaret BL. Long-term outcome in patients with congestive heart failure and intact systolic left ventricular performance. *Am J Cardiol* 1992;69:1212-6.
16. Taffet GE, Teasdale TA, Bleyer AJ, Kutka NJ, Luchi RJ. Survival of elderly men with congestive heart failure. *Age Ageing* 1992;21:49-55.
17. Gaasch WH. Diagnosis and treatment of heart failure based on left ventricular systolic or diastolic dysfunction. *JAMA* 1994;271:1276-80.
18. Consensus recommendations for the management of chronic heart failure. *Am J Cardiol* 1999;83:1A-38A.
19. Guidelines for the evaluation and management of heart failure. Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Evaluation and Management of Heart Failure). *Circulation* 1995;92:2764-84.
20. Task Force of the Working Group on Heart Failure of the European Society of Cardiology. The treatment of heart failure. *Eur Heart J* 1997;18:736-53.
21. Cleland J. ACE inhibitors for the prevention and treatment of heart failure: why are they «under-used»? *J Hum Hypertens* 1995;9:435-42.
22. Hospital General Universitario Gregorio Marañón. Memoria 1996. Madrid: Consejería de Sanidad y Servicios Sociales. Comunidad de Madrid, 1998.
23. Task Force on Heart Failure of the European Society of Cardiology. Guidelines for the diagnosis of heart failure. *Eur Heart J* 1995;16:741-51.
24. Bart BA, Gattis WA, Diem SJ, O'Connor CM. Reasons for underuse of angiotensin-converting enzyme inhibitors in patients with heart failure and left ventricular dysfunction. *Am J Cardiol* 1997;79:1118-20.
25. McMurray J. Heart failure: we need more trials in typical patients. *Eur Heart J* 2000;21:699-700.
26. Van Veldhuisen DJ, Charlesworth A, Crijns HJ, Lie KI, Hampton JR. Differences in drug treatment of chronic heart failure between European countries. *Eur Heart J* 1999;20:666-72.
27. Reis SE, Holubkov R, Edmundowicz D, McNamara DM, Zell KA, Detre KM, et al. Treatment of patients admitted to the hospital with congestive heart failure: specialty-related disparities in practice patterns and outcomes. *J Am Coll Cardiol* 1997;30:733-8.
28. Anguita Sánchez M, Vallés Belsue F. ¿Quién debe tratar la insuficiencia cardíaca? *Rev Esp Cardiol* 2001;54:815-8.
29. Martínez-Sellés M, García Robles JA, Prieto L, Serrano JA, Muñoz R, et al. Annual prevalence and seasonal variations in congestive heart failure admissions [en prensa]. *Eur J Heart Failure* 2002.