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Hospitalization for Heart Failure in the Presence of a Normal Left Ventricular Ejection Fraction

Results of the New York Heart Failure Registry

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OBJECTIVES We conducted a prospective multicenter registry in a large metropolitan area to define the clinical characteristics, hospital course, treatment, and factors precipitating decompensation in patients hospitalized for heart failure with a normal ejection fraction (HFNEF).

BACKGROUND The clinical profile of patients hospitalized for HFNEF has been characterized by retrospective analyses of hospital records and state data banks, with few prospective single-center studies.

METHODS Patients hospitalized for heart failure (HF) at 24 medical centers in the New York metropolitan area and found to have a left ventricular (LV) ejection fraction of ≥50% within seven days of admission were included in this registry. Patient demographics, signs and symptoms of HF, coexisting and exacerbating cardiovascular and medical conditions, treatment, laboratory tests, procedures, and hospital outcomes data were collected. Analysis by gender and race was prespecified.

RESULTS Of 619 patients, 73% were women, who were on average four years older than men (72.8 ± 14.1 years vs. 68.6 ± 13.8 years, $p < 0.001$). Black non-Hispanic patients comprised 30% of the study population. They were eight years younger than other patients (66.0 ± 14.2 years vs. 74 ± 13.5 years $p < 0.001$). Co-morbid conditions and their prevalence were: hypertension, 78%; increased LV mass, 82%; diabetes, 46%; and obesity, 46%. Before clinical decompensation that precipitated hospitalization, 86% of patients had chronic symptoms compatible with New York Heart Association functional classes II to IV. Factors precipitating clinical decompensation were identified in 53% of patients. In-hospital mortality was 4.2%.

CONCLUSIONS Patients hospitalized for HFNEF are most often chronically incapacitated elderly women with a history of hypertension and increased LV mass. Reasons for clinical decompensation are identified in only one-half of patients. (J Am Coll Cardiol 2004;43:1432–8) © 2004 by the American College of Cardiology Foundation

An increasing number of patients hospitalized for heart failure (HF) are found to have a normal left ventricular (LV) ejection fraction (EF) (1–5). The cause of HF in these patients is thought to be related to LV diastolic dysfunction. The clinical profile of these patients has been characterized by retrospective analyses of hospital records and state data banks (6–10). Few single-center studies have prospectively evaluated patients hospitalized for heart failure with normal ejection fraction (HFNEF) (11). Therapeutic guidelines are available for the treatment of patients with low-EF HF, but no evidence-based guidelines have been developed for the management of patients with HFNEF (12). Knowledge of current therapeutic trends in patients with HFNEF would be useful in assessing the feasibility of randomized placebo-controlled trials aimed at assessing pharmacologic interventions for these patients.

Accordingly, the New York Heart Failure Consortium completed a prospective multicenter registry to characterize the clinical profile, hospital course, and treatment of patients hospitalized for congestive HF and found to have a normal LVEF.

METHODS

The New York Heart Failure consortium is composed of 24 academic and community medical centers (Appendix). Sev-

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Abbreviations and Acronyms

B-NH = black non-Hispanic
BP = blood pressure
EF = ejection fraction
GFR = glomerular filtration rate
HF = heart failure
HFNEF = heart failure with normal ejection fraction
LV = left ventricle/ventricular

enteen centers actively enrolled patients. The demographics of the 7 centers that did not contribute to the registry were similar to those of the 17 centers that participated. Enrollment began January 1, 1999, and ended June 30, 2001.

Study population. Patients hospitalized with a primary diagnosis of HF and found to have a normal LVEF (≥50%) within seven days of admission were eligible. Both clinical and radiographic evidence were required to establish the diagnosis of HF. Clinical evidence included pulmonary rales and peripheral edema. Radiographic evidence of pulmonary congestion was documented at each institution by an attending radiologist before patient enrollment. Patients hospitalized primarily for acute myocardial infarction or acute coronary syndrome or with a secondary diagnosis of HF were excluded from the registry. However, we retained those patients in whom an acute coronary syndrome was not clinically recognized upon presentation but diagnosed subsequently on the basis of positive cardiac enzymes or new electrocardiographic changes. Patients satisfying eligibility criteria were consecutively enrolled at each medical center. Data logs within each institution and across all institutions were repeatedly screened to ensure that patients were entered into the database only once. Institutional review board approval was obtained at all sites.

Registry design and data collection. The registry database consisted of 153 variables that captured data on demographics, signs and symptoms of HF, presence of coexisting cardiovascular and medical conditions, medications at presentation and at discharge, laboratory tests, procedures, and hospital course. Clinical history and duration of conditions, such as hypertension and diabetes, were based on patient and physician reporting and review of the medical record. Patients were characterized as having coronary artery disease if they had a history of chronic angina, a stress test positive for ischemia, a prior myocardial infarction, coronary stenoses ≥50% by cardiac catheterization, or prior coronary angioplasty or coronary bypass surgery. Cardiovascular or medical conditions that could precipitate hospitalization were prospectively defined. These included: severe hypertension upon presentation (systolic blood pressure [BP] >200 mm Hg); severe valvular disease (regurgitation ≥3+ or stenosis ≤1.0 cm^2); uncontrolled supraventricular arrhythmia (atrial fibrillation, atrial flutter, or other supraventricular tachycardia of <1 week duration or associated with a heart rate ≥130 beats/min); acute coronary syndrome secondarily diagnosed by positive cardiac enzymes or new electrocardiographic changes; restrictive, constrictive, or obstructive cardiomyopathies; stroke; severe chronic obstructive pulmonary disease or asthma; pneumonia; sepsis; or serum creatinine >3.0 mg/dl. Severe chronic obstructive pulmonary disease was determined by pulmonary function tests or by the need for systemic steroid therapy.

Data collection and management were carried out on a secure web-based system called the Advanced Data Entry and Protocol Tracking (New England Research Institutes, Watertown, Massachusetts). This system has multiple tools to immediately assess the validity and completeness of data being entered and to provide real-time feedback to individual sites on incomplete, missing, or incorrect data.

Determination of LVEF. The LVEF was obtained by two-dimensional echocardiography or gated radionuclide ventriculography. Only patients with a normal (≥50%) LVEF were eligible. Echocardiograms or nuclear scans were interpreted by experienced observers without knowledge of a patient's inclusion into the registry. The EF by two-dimensional echocardiography was determined by a visual estimate based on an assessment of LV contractile function in multiple echocardiographic views. The accuracy and reproducibility of visual estimates of LVEF have been previously established (13). The EF by gated radionuclide ventriculography was calculated from the LV time-activity curve (14).

Echocardiographic analysis. The LV internal dimensions and wall thicknesses were measured according to the recommendations of the American Society of Echocardiography (15). Wall motion was assessed in the parasternal long- and short-axis views and apical two-, three-, and four-chamber views. Presence and severity of mitral and aortic regurgitation were assessed with color Doppler imaging and image-guided pulsed Doppler studies with semiquantitative grading (16). Aortic valve area was calculated from the continuity equation and mitral valve area from pressure half-time analysis. Right ventricular systolic pressure was calculated from the measurement of tricuspid regurgitation blood flow velocity using the modified Bernoulli equation and an assumed right atrial pressure of 10 mm Hg. Cardiac mass was calculated using the Penn convention (17). Mass was indexed by $height^{2.7}$ (m), with partition values of 46.7 $g/m^{2.7}$ in women and 49.2 $g/m^{2.7}$ in men to define increased LV mass (18).

Renal function. Glomerular filtration rate (GFR) (ml/min) was calculated using a modified Cockgroft-Gault formula: GFR = (140 − age/creatinine) × (calculated weight/72) × (0.85 for female), where calculated weight (kg) = ideal weight (kg) + 0.4 × (actual weight − ideal weight) and ideal weight = 51.65 + (1.85 × [height (inches)] − 60]) for men and 48.67 + (1.65 × [height (inches) − 60]) for women (19).

Body mass index. Body mass index was calculated as weight (kg)/$height^2$ (m). Obesity was defined by a body mass index >30 (20).

Table 1. Clinical Characteristics and Co-Morbid Conditions

	Total 619 (100%)	Women 449 (72.5%)	Men 170 (27.5%)
Age (yrs)*	71.7 ± 14.1	72.8 ± 14.1	68.6 ± 13.8
History of hypertension	78.2%	78.8%	76.3%
Systolic BP (mm Hg, on presentation)	159.7 ± 35.5	158.8 ± 34.3	162.2 ± 38.5
Diastolic BP (mm Hg, on presentation)	83.9 ± 20.4	82.9 ± 19.7	86.3 ± 22.1
Diabetes mellitus	45.9%	44.9%	48.5%
Coronary artery disease	43.1%	42.3%	45.1%
History of COPD or asthma	24.5%	25.1%	22.9%
Atrial fibrillation	23.4%	22.7%	25.3%
Atrial flutter	2.1%	1.3%	4.1%
Supraventricular tachycardia	0.8%	0.5%	1.8%
Hypothyroidism	9.7%	11.3%	5.1%
Hemoglobin (mg/dl)	11.8 ± 2.2	11.7 ± 2.0	12.2 ± 2.4
Glomerular filtration rate† (ml/min)	50.8 ± 28.5	50.1 ± 22.7‡	52.7 ± 22.8‡
Dialysis	4.5%	3.6%	7.1%
Body mass index (n = 509)	30.6 ± 8.8	30.8 ± 8.9	30.2 ± 8.3
Body mass index >30 (n = 509)	46.2%	46.9%	44.4%

Quantitative values are mean ± SD. *Age was the only statistically significant difference between women and men ($p < 0.001$). To avoid type 1 error only p values ≤0.01 are significant (see Methods). †Excluding patients on dialysis, n = 483. ‡See Methods for glomerular filtration rate calculation; p value adjusted for age.
BP = blood pressure; COPD = chronic obstructive pulmonary disease.

Statistical methods. Summary statistics are presented as mean ± standard deviation for continuous data or median and interquartile range where indicated and percentages for categorical data. For comparisons by gender and race, Student's *t* test was used to compare the distributions of normally distributed variables and the Wilcoxon rank sum test was used to compare the distributions of non-normally distributed variables determined by the examination of Q-Q plots and the Shapiro-Wilk test for normality p value. The Fisher exact test was used to compare group proportions. Differences between presentation and discharge medical regimen were assessed using McNemar's test for agreement. The signed rank test was used to assess the difference between presentation and discharge systolic and diastolic BPs. Linear regression was used to examine differences in hemodynamic and cardiac measures by race and gender adjusted for covariates that differed by race and gender. The skewed outcome measure GFR was log-transformed before linear regression analysis. Least-squares means are reported to express covariate-adjusted mean values by race and gender. Logistic regression analysis was used to examine differences by race and gender in the use of medications adjusted for covariates such as blood pressure and age.

Only p values of ≤0.01 were considered statistically significant. Analyses were conducted with the Statistical Analysis System Version 8.1 (SAS Institute, Cary, North Carolina) and S-Plus 2000 (S-Plus, Insightful Corp., Seattle, Washington) software.

RESULTS

Clinical characteristics and co-morbid conditions. A total of 619 patients (mean age 71.7 ± 14.1 years, range 22 to 106 years) were enrolled. Four hundred forty-nine patients (72.5%) were women and 170 (27.5%) were men. Women were on average four years older than men: 72.8 ± 14.1 years versus 68.6 ± 13.8 years ($p < 0.001$). Before hospitalization, 75% of patients had chronic symptoms compatible with New York Heart Association functional class II or III, 14% of patients had chronic symptoms compatible with functional class I, and 11% had chronic symptoms with functional class IV.

The LVEF was measured by echocardiography in 96% of patients and by nuclear imaging in 4% of patients. Measurement of LVEF was obtained within three days of admission in 83% of patients and within seven days in all patients. Women and men had identical mean LVEF: 59.9 ± 7.2% and 59.7 ± 7.4%, respectively.

Patients had multiple co-morbid conditions (Table 1). Hypertension was the most common with a mean duration of 14 years (median 10.5 years; interquartile range 7 to 20 years). The BP upon presentation and prevalence of hypertension were similar in women and men. The second most common co-morbid conditions were diabetes and obesity, with a similar prevalence in the total population (46%) and between women and men. Eighty-eight percent of diabetics were treated with oral hypoglycemic agents and/or insulin and 10% were treated with diet alone. Their mean hemoglobin A1C was 8.2 ± 2.4%. Forty-three percent of patients had coronary artery disease. Atrial fibrillation was present in nearly one-quarter of patients.

Two-dimensional echocardiographic Doppler findings. Echocardiographic and Doppler parameters are summarized in Table 2. Chamber dimensions were normal in women and men. Eighty-three percent of women and 81% of men had increased LV mass with a similar median LV mass index: 66.9 versus 65.7 $g/m^{2.7}$ ($p = 0.92$). Moderate pulmonary hypertension, as evidenced by a mean right ventricular systolic BP of 47 ± 17 mm Hg, was observed in 272 patients whose clinical characteristics, including the presence of pulmonary disease, were similar to those of the entire cohort.

Table 2. Two-Dimensional and Doppler Echocardiographic Parameters

	Total (n = 619)	Women* (n = 449)	Men* (n = 170)	Black-NH† (n = 184)	Other Race† (n = 430)
LV systolic diameter (cm)	3.21 ± 0.73	3.18 ± 0.72‡	3.34 ± 0.74‡	3.22 ± 0.72‡	3.24 ± 0.72‡
LV diastolic diameter (cm)	4.70 ± 0.76	4.67 ± 0.70‡	4.90 ± 0.72‡	4.67 ± 0.71‡	4.75 ± 0.70‡
RVSP (mm Hg) (n = 272)	46.5 ± 17.1	46.1 ± 17.2	47.7 ± 16.9	47.3 ± 16.9	46.0 ± 17.2
Median LVMI ($g/m^{2.7}$) (Q1,Q3) (n = 360)	66.5 (53.4, 84.8)	66.9 (53.4, 84.7)	65.7 (52.5, 85.4)	68.5 (53.3, 89.2)	66.0 (53.4, 84.5)
Mitral regurgitation ≥1+§	62.9%	64.3%	59.2%	66.7%	61.3%
Mitral regurgitation ≥3+§	9.9%	11.6%	5.4%	11.7%	9.3%
Aortic regurgitation ≥1+§	27.8%	28.4%	26.0%	25.7%	28.5%
Aortic regurgitation ≥3+§	2.3%	2.5%	1.8%	3.9%	1.6%
Mitral stenosis	3.6%	4.2%	1.8%	2.2%	4.2%
Mitral stenosis with MVA < 1.0 cm^2	0.8%	0.9%	0.6%	0.0%	1.2%
Aortic stenosis	8.4%	8.0%	9.5%	4.9%	10.0%
Aortic stenosis with AVA < 1.0 cm^2	2.8%	3.2%	1.8%	1.1%	3.5%

Quantitative values are mean ± SD. *The only statistically significant difference between women and men was LV diastolic diameter (p = 0.005). To avoid type 1 error, only p values ≤0.01 are significant (see Methods). †There were no significant differences by race after adjustment for age. To avoid type 1, error only p values ≤0.01 are significant (see Methods). ‡p Values adjusted for body surface area. §Semiquantitative scale 1+ to 4+.

AVA = aortic valve area; LV = left ventricle; LVMI = left ventricular mass index; MVA = mitral valve area; RVSP = right ventricular systolic pressure; Q1 = first quartile (25th percentile); Q3 = third quartile (75th percentile).

Factors precipitating hospitalization. Symptomatic deterioration precipitating hospitalization was related to exacerbation or poor control of coexisting conditions in 51% of patients and to new events in 2%. Except for severe valvular heart disease (combined prevalence of severe regurgitation and stenosis, 13.9%), severe hypertension (prevalence 13%), and acknowledged noncompliance to medication (prevalence 12.8%), the prevalence of all other precipitating factors was below 10% (Fig. 1). Two or more precipitating factors were present in 19.3% of patients.

Diagnostic procedures and hospital course. Sixty-three patients (10%) underwent cardiac stress testing, which was positive for ischemia in 28 patients. Fifty-six patients (9%) underwent coronary angiography that revealed one or more stenoses ≥70% in 34 patients. Thirty-one patients (5%) underwent right heart catheterization.

Mean BPs at discharge were within normal values for both women and men: 131/71 and 134/73 mm Hg, respectively. Mean and median lengths of stay were 8.8 and 6.0 days, respectively. In-hospital mortality was 4.2%. Patients who died were significantly older than patients who survived: 78.9 ± 14.3 years versus 71.3 ± 14.1 years (p = 0.01). Gender, the presence of co-morbid conditions, or precipitating factors for hospitalization did not affect length of stay or mortality.

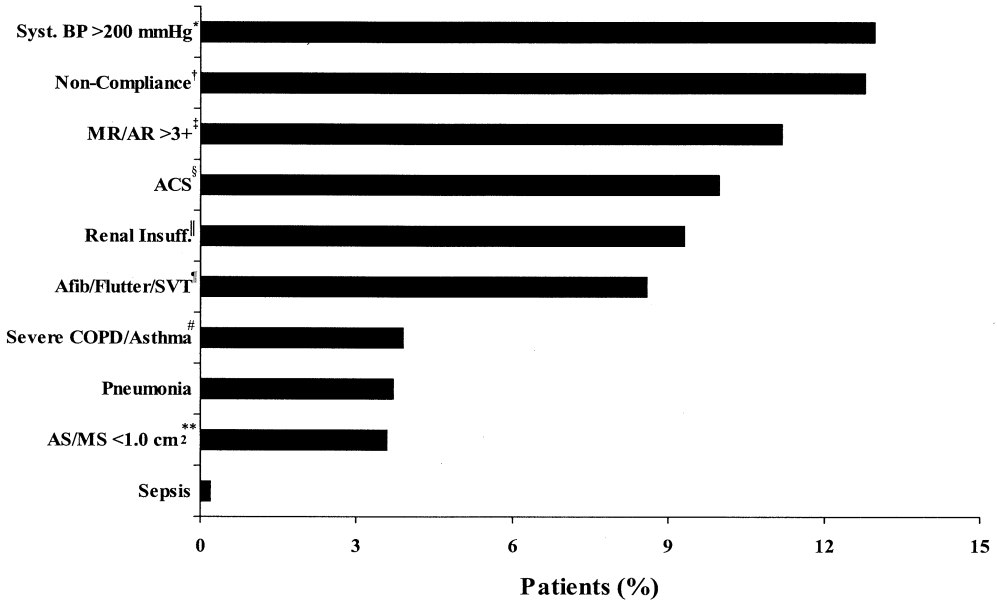

Figure 1. Cardiovascular or medical conditions and new events precipitating hospitalization. Ranked by prevalence. *Syst. BP = systolic blood pressure upon presentation (emergency department); †non-compliance = non-compliance with medication; ‡MR/AR = mitral regurgitation/aortic regurgitation (severity scale from 1+ to 4+); §ACS = acute coronary syndrome; ‖baseline dialysis or creatinine >3 mg/dl; ¶Afib/Flutter/SVT= atrial fibrillation or atrial flutter/supraventricular tachycardia—<1 week duration or heart rate ≥130 beats/min; #COPD = chronic obstructive pulmonary disease—severe was defined by pulmonary function tests or by the need for systemic steroid therapy; **AS/MS = aortic stenosis/mitral stenosis.

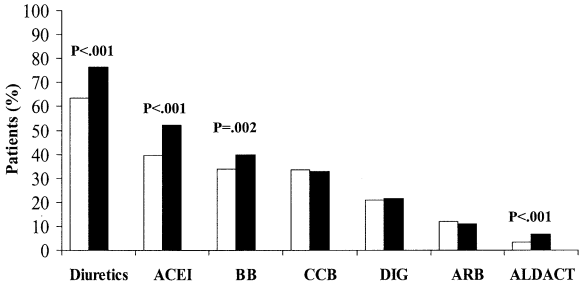

Figure 2. Percentage of patients at presentation **(open bars)**, and at discharge **(solid bars)** receiving diuretics, angiotensin-converting enzyme inhibitors (ACEI), beta-blockers (BB), calcium channel blockers (CCB), digoxin (DIG), angiotensin II receptor blockers (ARB), and aldactone (ALDACT).

Medications. Medications at presentation and at discharge are shown in Figure 2. Therapeutic adjustments during hospitalization included an absolute increase in the percentage of patients receiving diuretics by 12.8% ($p < 0.001$), angiotensin-converting enzyme inhibitors by 12.6% ($p < 0.001$), aldactone by 3.5% ($p < 0.001$), and beta-adrenergic blockers by 6.1% ($p = 0.002$). The percentage of patients receiving digoxin, calcium channel blockers, and angiotensin receptor blockers remained unchanged.

Patient profile by race. One hundred eighty-four patients (30%) were black non-Hispanic (B-NH). As observed in the entire cohort, 72% of the B-NH patients were women. The B-NH patients were on average eight years younger than patients of other racial background: 67.1 ± 14.3 versus years 75.1 ± 13.4 years for women ($p < 0.001$), and 62.9 ± 13.5 years versus 71.1 ± 13.3 years for men ($p < 0.001$). Both LVEF and the percentage of patients with New York Heart Association functional class II to IV were similar in B-NH patients and in others: 59.0 ± 7.7% versus 60.3 ± 7.0% ($p = 0.04$) and 80% versus 88% ($p = 0.03$), respectively. A greater percentage of B-NH patients had a history of hypertension: 86% versus 74% ($p < 0.001$). Mean systolic and diastolic BPs upon presentation and at discharge were significantly greater in B-NH patients than in others (Fig. 3). However, the percentage of patients with increased LV mass was comparable: 84% versus 82% ($p = 0.65$). Obesity (body mass index >30) was more prevalent in B-NH women than in other women: 59% versus 41% ($p = 0.002$).

Age-corrected GFR, after excluding patients on dialysis, was significantly lower in B-NH patients than in others: 47.7 ± 23.3 ml/min versus 52.3 ± 22.9 ml/min ($p = 0.008$). The use of long-term hemodialysis was 7.1% in B-NH patients and 3.3% in others ($p = 0.05$). After adjusting for higher BPs in B-NH patients, the use of angiotensin-converting enzyme inhibitors did not differ significantly in B-NH patients compared with others: 48% versus 35.8% upon presentation (unadjusted $p = 0.006$, BP adjusted $p = 0.045$) and 61.2% versus 48.7% at discharge (unadjusted $p = 0.005$, BP adjusted $p = 0.110$). Racial background did not affect in-hospital mortality or length of stay.

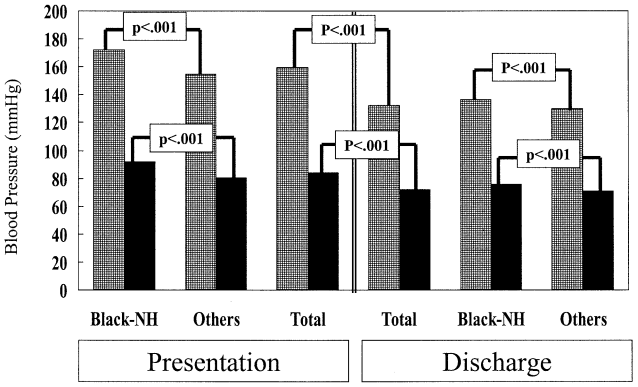

Figure 3. Mean systolic **(hatched bars)** and diastolic **(solid bars)** blood pressures upon presentation (emergency department) and at discharge in the entire cohort of patients (Total) and according to racial background (Black non-Hispanic [B-NH] and Others). Blood pressure (mm Hg) upon presentation: B-NH 172 of 92, Other 155 of 81, Total 160 of 84. Blood pressure (mm Hg) on discharge: B-NH 137 of 75, Other 130 of 71, Total 132 of 72.

DISCUSSION

Our registry provides a comprehensive description of the clinical characteristics, hospital course, and treatment of patients hospitalized for HFNEF. It highlights the severity of symptoms before decompensation, the high prevalence of a substantially increased LV mass, and clinical differences according to racial background. Lastly, factors that precipitate hospitalization are identifiable in only one-half of patients hospitalized for HFNEF.

Diagnosis of diastolic HF. When LVEF is normal, HF is attributed to diastolic dysfunction and labeled diastolic HF. However, because it is difficult to noninvasively assess LV diastolic function, the criteria required to diagnose diastolic HF remain uncertain (21–23). Vasan and Levy (24) sought to strengthen the diagnosis of diastolic HF by requiring a shorter interval between the HF event and documentation of a normal LVEF. Accordingly, the diagnosis of diastolic HF was probable in 84% of our patients. Previous studies dealt with only possible diastolic HF as the interval between presentation and measurement of LV function was either not recorded or could be as long as one year (6–10,25,26). The criteria required to diagnose HF in the present registry were also more stringent than the criteria in prior reports dealing with hospitalized patients, as we required both clinical and radiographic findings to document the diagnosis of HF (6–11,25,26).

The presence of diastolic abnormalities in patients with presumed diastolic HF has recently been questioned (27). In particular, the contribution of arterial stiffening and renal dysfunction, common to the elderly, is increasingly entertained as a mechanism that might help precipitate HFNEF (28,29).

Clinical characteristics. Nearly three-quarters of patients hospitalized for HFNEF in the New York metropolitan area are elderly women with increased LV mass and a history of hypertension. Between the ages of 65 and 74

years, women represent 56% of the population in New York State (30). The modest predominance of women in the elderly population cannot account for the high prevalence of women in the present registry. The mechanisms responsible for the prevalence of HFNEF in women are unclear. Gender affects cardiac remodeling. When confronted with pressure overload, the LV hypertrophies more and dilates less in women than men (31). A reduced rate of myocyte loss in women and transcriptional regulation by estrogens of genes implicated in cardiac hypertrophy may contribute to persistent gender related differences in cardiac remodeling (11,24,31–33).

The prevalence of coronary artery disease in our patients was similar to that of previous reports (7,11,25). In contrast, the prevalence of diabetes in our patients (46%) was greater than the range previously reported in this patient population (23% to 33%) (8,9,11,25,34). The greater prevalence of diabetes is concordant with the high prevalence of obesity noted in our patients, an observation that was also made in the Strong Heart Study (10). The association of diabetes, hypertension, and obesity in 24% of our patients suggests the possibility of a high prevalence of the metabolic syndrome in our population. (10,34–36).

Chronicity of symptoms. Eighty-five percent of our patients had chronic overt symptoms of HF that antedated their hospitalization. Functional intolerance and moderate pulmonary hypertension most likely result from chronic elevation of LV filling pressures (37). The marginal status of our patients at baseline renders the identification of precipitating factors for hospitalization difficult, as these factors are likely to be modest in nature. The present experience is similar to that in patients with HF due to LV systolic dysfunction, where precipitating factors are often not identified but generally thought to be related to medical and dietary non-compliance (38).

Therapy. Despite conflicting views regarding the use of angiotensin-converting enzyme inhibitors in patients with diastolic HF, they were, after diuretics, the medications most often prescribed to our patients (8,39). Angiotensin II receptor blockade with losartan has been shown to substantially reduce LV hypertrophy in hypertensive patients with increased LV mass (40). Definite evidence supporting modulation of the renin-angiotensin system in patients with HF and preserved systolic function (EF >40%) awaits the results of ongoing double-blind, randomized placebo-controlled trials (41,42).

Racial differences. Racial profiling in medical research needs to be interpreted with caution. Despite their significantly younger age, B-NH patients presented with more severe hypertension and worse renal function than others. Our data are consistent with the higher prevalence of end organ damage in B-NH hypertensive patients. Obesity was also particularly prevalent in B-NH women compared with other women. Despite their reported reduced efficacy in African Americans, angiotensin-converting enzyme inhibitors tended to be prescribed at least as often in B-NH patients as in others (43).

Study limitations. The present study has several limitations. There was no echocardiographic core laboratory to ensure uniform quality control of all imaging studies. To address the issue of validity of echocardiographic measurements, we performed a "by center analysis" of LV mass index that incorporates measures of wall thickness and chamber dimensions and is corrected for height. There were some differences in mean height-corrected LV mass by site ($p = 0.04$), but when examined as a threshold measure (defined as elevated LV mass >46.7 $g/m^{2.7}$ in women and >49.2 $g/m^{2.7}$ in men), the prevalence of this condition was found to be similar among all sites ($p = 0.38$). The measurement of B-type natriuretic peptide was not commercially available when the registry was initiated. Standard load-dependent echocardiographic parameters of LV diastolic dysfunction were not collected and the technical ability to collect load-independent (tissue Doppler) parameters was not available at all sites. Last, we did not mandate that all patients undergo cardiac stress testing to unmask occult coronary disease or require serum in all patients for hemoglobin A1C determinations; we relied on physician clinical judgment. Thus, the prevalence of coronary artery disease or diabetes mellitus may have been underestimated. We also recognize that when defined according to recent guidelines, the duration and prevalence of hypertension and diabetes in our patient population may be underestimated as the physiologic thresholds for establishing these diagnoses continue to be lowered.

In summary, patients hospitalized in the New York metropolitan area for HFNEF are preponderantly elderly women with a history of hypertension and increased LV mass. The chronic disability of these patients and the frequent inability to identify a factor precipitating hospitalization points to an absence of functional reserve and the need to develop aggressive treatment strategies.

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APPENDIX

For a list of the New York Heart Failure Consortium Medical Centers, please see the April 21, 2004, issue of *JACC* at http://www.cardiosource.com/jacc.html.