Impact of COPD on the Mortality and Treatment of Patients Hospitalized With Acute Decompensated Heart Failure

The Worcester Heart Failure Study

Kimberly A. Fisher, MD; Mihaela S. Stefan, MD; Chad Darling, MD; Darleen Lessard, MS; and Robert J. Goldberg, PhD

BACKGROUND: COPD is a common comorbidity in patients with heart failure, yet little is known about the impact of this condition in patients with acute decompensated heart failure (ADHF), especially from a more generalizable, community-based perspective. The primary objective of this study was to describe the in-hospital and postdischarge mortality and treatment of patients hospitalized with ADHF according to COPD status.

METHODS: The study population consisted of patients hospitalized with ADHF at all 11 medical centers in central Massachusetts during four study years: 1995, 2000, 2002, and 2004. Patients were followed through 2010 for determination of their vital status.

RESULTS: Of the 9,748 patients hospitalized with ADHF during the years under study, 35.9% had a history of COPD. The average age of this population was 76.1 years, 43.9% were men, and 93.3% were white. At the time of hospital discharge, patients with COPD were less likely to have received evidence-based heart failure medications, including β -blockers and angiotensin-converting enzyme inhibitors/angiotensin receptor blockers, than patients without COPD. Multivariable, adjusted in-hospital death rates were similar for patients with and without COPD. However, among patients who survived to hospital discharge, patients with COPD had a significantly higher risk of dying at 1 year (adjusted relative risk [RR], 1.10; 95% CI, 1.06-1.14) and 5 years (adjusted RR, 1.40; 95% CI, 1.28-1.52) after hospital discharge than patients who were not previously diagnosed with COPD.

CONCLUSIONS: COPD is a common comorbidity in patients hospitalized with ADHF and is associated with a worse long-term prognosis. Further research is required to understand the complex interactions of these diseases and ensure that patients with ADHF and COPD receive optimal treatment modalities.

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ABBREVIATIONS: ACE-I = angiotensin-converting enzyme inhibitor; ADHF = acute decompensated heart failure; ARB = angiotensin receptor blocker; CABG = coronary artery bypass graft; EF = ejection fraction; HF = heart failure; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; LOS = length of hospital stay; RR = relative risk

AFFILIATIONS: From the Department of Medicine (Dr Fisher), Department of Emergency Medicine (Dr Darling), and Department of Quantitative Health Sciences (Ms Lessard and Dr Goldberg), University of Massachusetts Medical School, Worcester; and the Department of Medicine (Dr Stefan), Baystate Medical Center, Springfield, MA.

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CORRESPONDENCE TO: Robert J. Goldberg, PhD, Division of Epidemiology of Chronic Diseases and Vulnerable Populations, Department of Quantitative Health Sciences, University of Massachusetts Medical School, 368 Plantation St, Worcester, MA 01605; e-mail: Robert.Goldberg@umassmed.edu

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Heart failure (HF) and COPD are leading causes of morbidity and mortality worldwide.¹⁻³ The two diseases often coexist,^{4,5} owing to shared key predisposing factors, including the smoking of tobacco and advanced age. COPD is one of the most common comorbidities in patients with HF, with a prevalence of 20% to 30%.⁶⁻¹⁰

There is increasing recognition of the prognostic and therapeutic importance of the comorbid conditions associated with HF.¹⁰ The presence of COPD in patients with HF has been associated with poor clinical outcomes,^{7,11} and the management of HF is complicated by the presence of COPD. The cornerstones of therapy for HF and COPD, β -blockers and β -agonists, have opposing pharmacologic actions, raising concerns that the treatment of one condition may worsen the other. Despite a growing evidence base demonstrating the safety of cardioselective β -blockade in patients with COPD,^{12,13} patients with COPD and HF are less likely to receive

several guideline-recommended therapies for HF.^{7,8,11,14} Data are extremely limited that describe the clinical epidemiology of patients with HF and coexistent COPD from the more generalizable perspective of a population-based investigation.^{8,11}

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The primary objective of this large observational study was to describe, from a community-wide perspective, the impact of COPD on the in-hospital and long-term mortality and on the treatment of patients hospitalized with acute decompensated HF (ADHF). A secondary aim was to examine decade-long trends (1995-2004) in the survival and treatment patterns of patients with ADHF according to COPD status. Data from the population-based Worcester Heart Failure Study were used for purposes of this study.^{15,16}

Materials and Methods

Study Population

The Worcester Heart Failure Study is a population-based investigation that includes residents of the Worcester, Massachusetts, metropolitan area (2000 census estimate, 478,000) hospitalized with ADHF at all 11 medical centers in Central Massachusetts during the four study years of 1995, 2000, 2002, and 2004.¹⁴⁻¹⁹ These years were selected due to the availability of grant funding and for purposes of describing decade-long trends in the descriptive epidemiology of ADHF. Details of this study have been previously provided.¹⁵⁻²⁰ This study was approved by the institutional review board at the University of Massachusetts Medical School (approval No. 10398 1).

To identify cases of possible ADHF, the medical records of patients discharged with a primary or secondary *International Classification of Diseases, Ninth Revision* code consistent with HF were reviewed by trained study physicians and nurses. The presence of HF as the primary cause of hospitalization was confirmed using preestablished Framingham criteria,^{21,22} and determination was made whether the index hospitalization during the years studied was the first (incident) episode of HF or otherwise. Medical records of patients with discharge diagnoses of hypertensive heart and renal disease, acute cor pulmonale, cardiomyopathy, pulmonary congestion, acute lung edema, and respiratory abnormalities were also reviewed to identify patients who may also have had new-onset ADHF.¹⁵ Patients who developed HF during hospitalization for another acute illness (eg, acute myocardial infarction) or after an interventional procedure (eg, coronary artery bypass surgery [CABG]) were not included in this study. COPD was considered to be present if a patient was described in his or her medical record as having clinical or radiographic evidence of COPD. Pulmonary function testing results were not available to confirm the diagnosis or to assess the severity of COPD.

Data Collection

For each case of ADHF identified, abstracted data from hospital medical records included patient demographics (eg, age, sex, race); medical history (eg, coronary heart disease, diabetes, renal failure, stroke); clinical characteristics (eg, presenting symptoms, physiologic findings); and

laboratory measurements, including echocardiography results, length of hospital stay (LOS), and hospital discharge status. Use of cardiac medications (eg, angiotensin-converting enzyme inhibitors (ACE-Is), angiotensin receptor blockers (ARBs), β -blockers, and diuretics) at the time of hospital discharge, LOS, and vital status were determined through chart review. Long-term survival status through 2010 was assessed through the review of hospital medical records for subsequent health-care encounters at all participating greater Worcester medical centers, as well as through the review of the Social Security Death Index and death certificates at the Massachusetts State Health Department; further follow-up information was obtained for >99% of discharged patients.

Data Analysis

Differences in the demographic and clinical characteristics, as well as in the receipt of various hospital treatment practices, among patients with ADHF with and without a history of COPD were examined using χ^2 tests for discrete variables and Student *t* test for continuous variables.

A life-table approach was used to include patients with varying duration of follow-up after being discharged from all metropolitan Worcester hospitals during the years under study. We calculated crude and multivariable adjusted relative risk (RR) estimates to examine the independent association between COPD status and in-hospital and postdischarge mortality at selected time points (30 days, 1 year, and 5 years) using Poisson regression with robust error variance. Multivariable logistic regression analyses were used to examine decade-long trends in death rates at similar time points. We adjusted all regression models for a number of factors of prognostic importance that differed between our respective comparison groups, including age, sex, race, LOS, previously diagnosed HF, prior vascular disease (history of stroke, peripheral vascular disease, angina, or CABG surgery), prior comorbidities (diabetes, hypertension, renal disease, anemia, and atrial fibrillation), smoking status, and laboratory and physiologic variables at the time of hospital presentation (BP and sodium and creatinine levels). Variables with high rates of missing data, which occurred for ejection fraction (EF) findings and BMI, were not included in our regression models. All analyses were performed using SAS 9.2 (SAS Institute Inc).

Results

Study Population Characteristics

A total of 9,748 patients were hospitalized with ADHF at all metropolitan Worcester medical centers during the years under study, of whom 3,500 (35.9%) had a history of COPD. Overall, the mean age of the study population was 76.1 years, 43.9% were men, and 93.3% were white. There were no significant changes in the prevalence of previously diagnosed COPD among patients with ADHF during the years studied (1995 = 35.5%; 2000 = 34.3%; 2002 = 37.9%; 2004 = 35.7%; $P = 0.37$).

Compared with patients without COPD, patients with COPD were slightly younger and more likely to be obese and to currently smoke. Patients with COPD had a significantly higher burden of comorbidities, including a history of previously diagnosed renal disease, peripheral vascular disease, anemia, angina, and atrial fibrillation (Table 1). On the other hand, these patients were less likely to have a history of cerebrovascular disease or to have previously undergone CABG. Patients with COPD were less likely to have presented with a first episode of ADHF and were more likely to have a preserved EF among those in whom echocardiographic findings were available. A history of COPD was associated with a slightly longer LOS (Table 1).

Hospital Discharge Treatment Practices

Patients with COPD were less likely to have been treated with most classes of HF-specific medications at the time of hospital discharge than patients without COPD (Table 2). These included ACE-Is and ARBs (ACE-Is/ARBs) and β -blockers. Patients with COPD were slightly more likely to have been treated with diuretics on discharge than patients without COPD. There were no significant differences in the use of nitrates and hydralazine between patients with and without COPD; however, very few patients ($\leq 1\%$) in either group were treated with this combination of medications (Table 2).

After restricting our sample to the subset of patients with ADHF and a documented EF $< 40\%$, patients with COPD remained significantly less likely to have been prescribed β -blockers at the time of hospital discharge than patients without COPD (45.4% vs 59.0%; $P < .001$). Among patients with documented EF values $< 40\%$, there were no differences in the use of ACE-Is/ARBs (71.2% vs 73.5%; $P = .42$) or diuretics (84.7% vs 83.2%; $P = .54$) at the time of hospital discharge between patients with and without COPD.

Use of β -blockers increased between 1995 and 2004 at a relatively similar rate in patients with and without COPD. At the time of hospital discharge, β -blockers were prescribed to 13.1% of patients with COPD as compared with 27.8% of patients without COPD in 1995; these percentages increased to 57.5% and 72.9%, respectively, in 2004. ACE-Is/ARBs and diuretic use remained fairly constant during the years studied in each of our primary comparison groups (Fig 1).

In-Hospital Death Rates

Patients with previously diagnosed COPD had higher in-hospital death rates compared with patients without COPD (7.9% vs 6.8%; $P = .05$). After adjusting for differences in several baseline demographic and clinical characteristics, differences in hospital death rates were no longer statistically significant (RR, 0.99; 95% CI, 0.98-1.00) (Table 3). In multivariable, adjusted logistic regression models examining decade-long trends in in-hospital survival, we observed a significant improvement in short-term survival among patients without COPD between 1995 and 2004 (OR 1.70; 95% CI, 1.23-2.36), but not in patients with COPD (OR, 1.34; 95% CI, 0.92-1.97) (Fig 2).

Postdischarge Death Rates

Among patients who survived to hospital discharge, patients with COPD were more likely to have died over the course of our extended follow-up (Fig 3). Although there were no differences in our multivariable adjusted death rates at 30 days after hospital discharge (RR, 1.01; 95% CI, 1.00-1.03), patients with COPD were significantly more likely to have died at 1 year (adjusted RR, 1.10; 95% CI, 1.06-1.14) and 5 years (adjusted RR, 1.40; 95% CI, 1.28-1.52) following hospital discharge for ADHF (Table 3). These findings did not materially change when the use of HF medications (ACE-Is/ARBs and β -blockers) at the time of hospital discharge were included in the regression model (data not shown).

When we examined decade-long trends in postdischarge survival between 1995 and 2004, we observed an improvement in survival at 30 days postdischarge among patients with COPD (OR, 1.67; 95% CI, 1.13-2.49) but not in patients without COPD (OR, 1.23; 95% CI, 0.89-1.70). Overall, long-term survival improved significantly between 1995 and 2004 among all patients hospitalized for ADHF. However, patients without COPD had a more marked improvement than patients with COPD in 1-year (OR, 1.69 [95% CI, 1.41-2.02] vs OR, 1.42 [95% CI, 1.13-1.80]) and 5-year

TABLE 1] Characteristics of Patients Hospitalized With Acute Decompensated Heart Failure According to History of COPD

Patient Characteristic	With COPD (n = 3,500)	Without COPD (n = 6,248)	P Value
Demographics			
Age, mean, y	75.6	76.5	< .001
Age, y			< .001
< 65	548 (15.7)	976 (15.6)	
65-74	910 (26.0)	1,187 (19.0)	
75-84	1,317 (37.6)	2,298 (36.8)	
≥ 85	724 (20.7)	1,783 (28.6)	
Male sex	1,562 (44.6)	2,722 (43.6)	.31
White race	3,319 (94.8)	5,772 (92.4)	< .001
Current smoker	514 (14.7)	429 (6.9)	< .001
Former smoker	2,025 (57.9)	2,360 (37.8)	< .001
BMI, ^a mean, kg/m ²	28.2	27.5	< .001
BMI, ^a kg/m ²			< .001
< 25	1,177 (41.2)	2,091 (41.9)	
25-30	712 (25.0)	1,537 (30.8)	
≥ 30	965 (33.8)	1,358 (27.2)	
Medical history			
Diabetes	1,370 (39.1)	2,437 (39.0)	.89
Hypertension	2,371 (67.7)	4,322 (69.2)	.14
Stroke	412 (11.8)	886 (14.2)	< .001
Renal disease	959 (27.4)	1,571 (25.1)	.015
Peripheral vascular disease	729 (20.8)	1,188 (19.0)	.032
Angina	643 (18.4)	1,018 (16.3)	.009
Coronary artery bypass grafting	661 (18.9)	1,403 (22.5)	< .001
Anemia	904 (25.8)	1,495 (23.9)	.037
Atrial fibrillation	1,408 (40.2)	2,337 (37.4)	.006
Incident heart failure	773 (22.1)	2,061 (33.0)	< .001
Vital signs on presentation, mean			
Systolic BP, mm Hg	140.6	143.8	< .001
Diastolic BP, mm Hg	73.0	75.7	< .001
Pulse rate, beats/min	91.5	87.8	< .001
Respiratory rate, breaths/min	24.8	23.1	< .001
Laboratory findings on admission, mean			
Creatinine, mg/dL	1.58	1.68	< .001
eGFR, mL/min/1.73 m ²	52.1	50.2	< .001
B-type natriuretic peptide, ^b ng/L	988	1,078	.15
Serum sodium, mmol/L	137.6	137.3	.002
Baseline ejection fraction, ^c mean, %	47.2	44.6	< .001
Baseline ejection fraction ^c			< .001
> 50	555 (51.5)	1,058 (44.9)	

(Continued)

TABLE 1] (continued)

Patient Characteristic	With COPD (n = 3,500)	Without COPD (n = 6,248)	P Value
41-50	160 (14.8)	335 (14.2)	
≤40	363 (33.7)	963 (40.9)	
Length of stay, mean, d	6.5	6.0	.007

Data given as No. (%) unless otherwise indicated. eGFR = estimated glomerular filtration rate.

*BMI data available on 7,840 patients.

*B-type natriuretic peptide data available on 1,502 patients, of whom 96.9% were in the 2004 cohort.

*Echocardiographic data available on 3,434 patients.

(OR, 2.08 [95% CI, 1.70-2.56] vs OR, 1.65 [95% CI, 1.23-2.23]) multivariable, adjusted, postdischarge survival rates between 1995 and 2004 (Fig 2).

Discussion

In this large, community-based study of residents of central Massachusetts hospitalized with ADHF, we found COPD to be a common comorbidity, affecting approximately one in every three patients with ADHF. We observed significant differences between patients with and without COPD with regard to comorbidity burden, presenting clinical characteristics, medications prescribed at hospital discharge, and all-cause mortality. COPD was associated with an increased risk of dying over the long-term in the setting of ADHF. While long-term survival following hospital discharge improved in patients with and without a history of COPD during the decade studied (1995-2004), patients with ADHF and coexistent COPD continued to fare worse than those without COPD. We found a marked increase in the use of β -blockers at the time of discharge in all patients during the years under study; however, a gap in the use of these medications persisted between patients with and without prior COPD, independent of HF classification based on echocardiographic findings.

TABLE 2] Heart Failure-Specific Discharge Medications in Patients Hospitalized With Acute Decompensated Heart Failure According to History of COPD

Medication	With COPD (n = 3,223)	Without COPD (n = 5,821)	P Value
ACE-I/ARB	1,596 (49.5)	3,157 (54.2)	<.001
β -Blockers	1,271 (39.4)	3,251 (55.9)	<.001
Diuretics	2,701 (83.8)	4,676 (80.3)	<.001
Nitrates and hydralazine	36 (1.1)	48 (0.82)	.17

Data given as No. (%) unless otherwise indicated. ACE-I = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker.

Prevalence of COPD in ADHF and Clinical Characteristics

Approximately one-third of patients hospitalized for ADHF in our study had a prior history of COPD. This proportion is slightly higher than the findings from other observational studies, which found prevalence estimates to have ranged from 10% to upwards of 25%.^{6-8,10,11,23,24} In one of the only other community-based studies of COPD in patients with HF, 20% of 799 patients hospitalized with HF at any of the 11 health-care establishments responsible for managing patients with HF in the Somme region of France during 2000 had coexisting COPD. This study was, however, limited to patients with a first episode of HF, which likely accounted for the lower observed prevalence of COPD than was observed in our study.⁸ Although the prevalence of COPD in patients with HF has been noted to be higher in other studies,²³ we were encouraged that the prevalence of COPD in residents of central Massachusetts hospitalized at all metropolitan Worcester medical centers remained stable during the decade studied.

Patients with COPD had a higher burden of vascular comorbidities, likely related to increased rates of smoking, which is a common risk factor for these conditions; COPD may also be an independent risk factor for cardiovascular morbidity.²⁵ In contrast to prior studies,^{7,8} patients with COPD in the present investigation were slightly more likely to have heart failure with preserved EF (HFpEF). Interpretation of this finding is limited, however, by the substantial rate of missing echocardiographic data in our study population. However, emphysema and airflow obstruction have been shown to impair left ventricular filling without association with EF, suggesting a potential mechanism by which COPD may predispose patients to HFpEF.²⁶ The present results confirm that COPD is a common comorbidity in patients hospitalized with ADHF. Since the two diseases present with relatively similar symptoms, further

Figure 1 – Changes in discharge medical therapy by study year according to history of COPD. A, β -blockers. B, Angiotensin-converting enzyme inhibitor or angiotensin receptor blocker. C, Diuretic therapy.

research is needed to accurately identify and optimally manage these frequently overlapping conditions.

Hospital Treatment Practices

Given long-standing concerns about the safety of β -blocker use in patients with obstructive lung disease, it was not surprising that patients with COPD were significantly less likely to have been prescribed β -blockers at the time of hospital discharge than patients without COPD. Reflecting the results of clinical trials demonstrating benefits on survival through the use of β -blockers in patients with HF, β -blocker use increased in both groups over time. However, even during the most recent year under study (2004), almost one-half of patients with ADHF and COPD were not prescribed a β -blocker on discharge, as compared with only 25% of patients without COPD.

It is possible that the observed differences in β -blocker use at the time of hospital discharge were related to patients with COPD being less likely to have HF with reduced EF (HFrEF) (EF < 40%) and, therefore, not having a definite indication for treatment with β -blockers. However, the observed differences in β -blocker use persisted even after restricting our analysis to patients with documented HFrEF, suggesting that even among the subset of patients proven to benefit from β -blocker treatment, patients with COPD were less likely to have received this evidence-based therapy. Because echocardiographic data were only available on a subset of patients and the use of echocardiography differed according to COPD status, this subgroup analysis should be interpreted with appropriate caution. Nonetheless, in light of data demonstrating the safety of cardioselective β -blockers in patients with COPD,^{12,13} sustained educational efforts of health-care professionals are needed to ensure that potential gaps in treatment are eliminated.

We also observed a significant difference in hospital prescribing practices in the use of ACE-I/ARB medications between patients with and without COPD. This finding may be accounted for by the increased prevalence of renal disease among patients with COPD, lower presenting BP, or more frequently preserved EF. Our finding that ACE-I/ARB treatment did not differ between patients with and without COPD when restricted to those with HFrEF supports the notion that differences in HF classification (HFpEF vs HFrEF) account at least in part for the observed differences in use of this class of medications between patients with and without COPD.

Consistent with the findings from several other studies, we found a slightly higher rate of use of diuretics in patients with ADHF and concomitant COPD.^{6-8,11,26} This may reflect increased volume overload in these patients related to concomitant steroid use, or the presence of pulmonary hypertension and right-sided HF. The present results suggest that the use of HF-specific medications differs between patients with and without COPD. These differences may reflect the complex physiologic interactions between COPD and ADHF,²⁷ resulting in differing requirements for, and responses to, HF-specific medications.

In-Hospital and Postdischarge Death Rates

We found that patients with a history of COPD had similar short-term mortality as patients without COPD. However, COPD was associated with a substantially worse long-term prognosis. This is in keeping with the

TABLE 3] In-Hospital and Postdischarge Death Rates of Patients Hospitalized With Acute Decompensated Heart Failure According to History of COPD

Mortality	With COPD	Without COPD	Unadjusted RR ^a (95% CI)	Multivariable adjusted RR (95% CI)
In-hospital	277 (7.9)	427 (6.8)	0.99 (0.98-1.00)	0.99 (0.98-1.00)
30-d postdischarge	309 (9.6)	443 (7.6)	1.02 (1.01-1.04)	1.01 (1.00-1.03)
1-y postdischarge	1,348 (41.8)	2,031 (34.9)	1.12 (1.08-1.16)	1.10 (1.06-1.14)
5-y postdischarge	2,626 (81.5)	4,190 (72.0)	1.51 (1.39-1.64)	1.40 (1.28-1.52)

Data given as No. (%) unless otherwise indicated. RR = relative risk.

^aRelative risk of selected end points in patients with COPD, as compared with those without. Patients without COPD made up the referent group.

results from other observational studies that have found increased death rates in patients hospitalized with HF and concomitant COPD.^{7,8,10,24} Because we did not have spirometric data available to confirm the diagnosis of COPD, our findings are subject to potential misclassification bias; however, this is expected to reduce the magnitude of the association between COPD and the observed increased risk of dying over the long-term period of follow-up. Thus, it is possible that COPD confers an even greater risk of dying following hospitalization for ADHF than we have observed. In addition, measures of the severity of COPD (FEV₁ and GOLD [Global Initiative for Chronic Obstructive Lung Disease] stage) have been shown to be independent predictors of mortality and event-free survival, respectively, in patients with COPD and concomitant HF.^{9,28} Therefore, the degree of increased mortality associated with COPD in ADHF is dependent on the severity of COPD. Our study is limited in not being able to quantify the severity of COPD; however, the community-based nature of this investigation is expected to have included individuals with varying degrees of COPD severity and, therefore, may provide a more reliable estimate of the short- and long-

term impact of COPD on prognosis in patients with HF than studies with more highly selected patient populations.

The impact of COPD on mortality in patients with ADHF appears to have been more pronounced over the long term. For example, while there were no differences in short-term death rates during the first 30 days after hospital discharge, there was a 10% increased risk of dying at 1 year and 40% at 5 years postdischarge in patients with COPD compared with those without. This finding is consistent with the results from other observational studies. In the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) registry of patients hospitalized with ADHF at > 200 medical centers across the United States between 2003 and 2004, there were no differences in the risk-adjusted, all-cause, in-hospital or 60-day mortality rates between patients with and without COPD.⁶ Similarly, in a community-wide study of patients hospitalized with newly diagnosed HF in the Somme region of France in 2000, there was no significant impact of COPD on short-term survival. Consistent with our findings, this study

Figure 2 – Trends in multivariable adjusted odds of survival among patients hospitalized with acute decompensated heart failure according to history of COPD. A, In-hospital. B, 30-d postdischarge. C, 1-y postdischarge. D, 5-y postdischarge. Adjusted for age, sex, white race, incident heart failure, length of hospital stay, prior vascular disease (history of stroke, peripheral vascular disease, angina, or coronary artery bypass surgery), prior other comorbidities (diabetes, hypertension, renal disease, anemia, and atrial fibrillation), smoking status, and laboratory and physiologic variables on presentation (BP, sodium, creatinine).

Figure 3 – Survival following hospital discharge for acute decompensated heart failure according to history of COPD.

demonstrated a significant association between COPD and long-term mortality, with an approximately 50% lower 5-year survival rate observed among patients with previously diagnosed COPD compared with those without.⁸

Prior studies have suggested that the severity of ADHF at the time of hospital presentation is strongly associated with early mortality.¹⁵ Thus, one possible explanation for these findings is that short-term mortality is predominantly influenced by ADHF presenting characteristics, whereas comorbidities such as COPD may be stronger determinants of long-term outcomes. Although our study did not assess the cause of death, this supposition is supported by the findings from other studies in which the excess mortality associated with COPD in patients with ADHF was mainly non-cardiac in etiology.²⁹ Further studies are needed to determine and address the factors leading to increased long-term mortality in patients with COPD and ADHF.

The present study is unique in examining changing trends in a variety of descriptive patient characteristics, treatment practices, and outcomes over a decade. We observed improvements in survival over time in all patients with ADHF, but there was a larger improvement in survival among patients without COPD compared with those with COPD. Although our study was not designed to explain which factors influenced the observed decreases in mortality, these results suggest that the overall quality of care of patients with ADHF may be either more consistently applied to, or more effective in, patients without COPD. For example, patients with COPD were less likely to have received evidence-based HF medications on discharge. In addition, these patients were more likely to have a preserved EF, and there have been fewer advances in the treatment of patients with preserved EF during this time period than for those with reduced EF findings.^{30,31}

Study Strengths and Limitations

The primary strength of this study was the large sample of patients with independently validated hospitalizations for ADHF from the perspective of a large community-based investigation, with collection of detailed clinical characteristics and excellent rates of long-term follow up. Limitations include the lack of spirometric data to confirm the diagnosis of COPD. However, numerous prior studies of COPD and HF have defined COPD similarly.^{6-8,11} We did not collect data on the specific causes of mortality and, therefore, were unable to determine if the increased mortality observed in patients with COPD was cardiac or noncardiac in etiology. We did not include patients who developed HF during hospitalization for another illness and, therefore, are unable to comment on how COPD status might differentially impact patients who develop HF in this context. Because our most recent hospitalized cohort included patients admitted to all central Massachusetts medical centers with ADHF in 2004, our results may not reflect more recent advances in the care of patients with ADHF, COPD, or both. It is unknown whether these advances have differentially affected patients based on their COPD status. In addition, our predominantly white population limits the generalizability of our findings to other racial and ethnic groups. Finally, we did not have information on medication use following hospital discharge; however, prior studies have demonstrated that prescription of cardiac medications at hospital discharge significantly increases the likelihood of long-term use.³²

Conclusions

In summary, COPD is a common comorbidity in patients hospitalized for ADHF. Patients with COPD are less likely to receive HF-guideline recommended medications, including β -blockers and ACE-Is/ARBs, than patients without COPD. Use of β -blockers increased during the period of study in all hospitalized patients, but the gap in the use of β -blockers between patients with and without COPD persisted during each of the years examined. COPD was associated with significantly increased long-term death rates in patients with ADHF. Long-term survival improved for all patients with ADHF discharged from central Massachusetts hospitals between 1995 and 2004; however, these improvements were greater for patients without COPD than for those with coexistent COPD. Further studies are needed to better understand how to optimize the long-term outpatient treatment of patients with COPD and ADHF and address the causes of increased mortality in these patients.

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