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Burden and Timing of Hospitalizations in Heart Failure: A Community Study

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Abstract

Objective: To study the temporal distribution and causes of hospitalizations after heart failure (HF) diagnosis.

Patients and Methods: Hospitalizations were studied in 1972 Olmsted County, Minnesota, residents with incident HF from January 1, 2000, to December 31, 2011. All hospitalizations were examined for the 2 years following incident HF, and each was categorized as due to HF, other cardiovascular causes, or noncardiovascular causes. Negative binomial regression examined associations between time periods (0-30, 31-182, 183-365, and 366-730 days after diagnosis) and hospitalizations.

Results: During the 2 years after diagnosis, 3495 hospitalizations were observed among 1336 of the 1972 patients with HF. The age- and sex-adjusted rates of hospitalizations were highest in the first 30 days after diagnosis (3.33 per person-year vs 1.33, 1.07, and 1.00 per person-year for 31-182 days, 183-365 days, and 366-730 days, respectively). The rates of hospitalizations were similar across sex, presentation of HF (inpatient or outpatient), and type of HF (preserved or reduced ejection fraction). Patients diagnosed as inpatients who had long hospital stays (>5 days) experienced more than a 30% increased risk of rehospitalization within 30 days of dismissal. Importantly, most hospitalizations (2222 of 3495 [63.6%]) were due to noncardiovascular causes, and a minority (440 of 3495 [12.6%]) were due to HF. The rates of noncardiovascular hospitalizations were higher than those for HF or other cardiovascular hospitalizations across all follow-up for all time periods after HF.

Conclusion: Patients with HF experience high rates of hospitalizations, particularly within the first 30 days, and mostly for noncardiovascular causes. To reduce hospitalizations in patients with HF, an integrated approach focusing on comorbidities is required.

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Heart failure (HF) is a major clinical and public health concern. The aging population and improved survival have led to the continued increase in HF prevalence, as well as the resulting high burden of hospitalizations and health care costs among individuals with HF.[1] Notably, the course of HF is characterized by clinical exacerbations leading to hospitalizations.[2] As such, the Hospital Readmissions Reduction Program, created under the Affordable Care Act, requires the Centers for Medicare and Medicaid Services to reduce payments to hospitals with excess 30-day readmissions for HF. Most prior studies assessing rates of hospitalization in HF have included only patients with an initial hospitalization for HF, thus pooling incident and prevalent HF and missing patients diagnosed in the outpatient setting.[3-5] There is a paucity of data describing rates of hospitalizations over the course of the HF syndrome after the initial diagnosis of HF, including patients who were diagnosed as outpatients. In addition, most studies have a short follow-up of 30 days[5] or 1 year[4,6] after the index event. Thus, there is insufficient data to determine whether the first 30 days are the most important time frame for increased risk of hospitalization after HF diagnosis.

In addition, a change in the case mix over the past decade has resulted in an increased proportion of HF with preserved ejection fraction (EF).[7] These recent community data suggest that the shift in case mix has resulted in an increase in hospitalizations for noncardiovascular causes.[7] This shift has profound

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implications for patients and clinicians, yet a full understanding of the patterns and distributions of types of hospitalizations over the course of the HF syndrome and whether these patterns are affected by EF remains largely unknown.

The goal of this study was to address the aforementioned gaps in knowledge by examining the patterns of hospitalizations over the course of the HF syndrome, identifying whether there are periods of increased vulnerability to hospitalizations, and assessing how these patterns may differ according to the case mix of HF (preserved or reduced EF) in a geographically defined community cohort of patients with HF.

PATIENTS AND METHODS

Study Population

This study was conducted in Olmsted County, Minnesota, utilizing the resources of the Rochester Epidemiology Project, a records linkage system allowing virtually complete capture of health care utilization and outcomes in county residents.[8-11] The retrieval of nearly all health care–related events occurring in Olmsted County is possible because this area is relatively isolated from other urban centers, and few health care facilities, including Mayo Clinic, Olmsted Medical Center, and their affiliated hospitals, deliver most health care to local residents. The demographic and ethnic characteristics of Olmsted County residents are representative of the state of Minnesota and the Midwest region of the United States.[9] Furthermore, broad disease trends and age- and sex-specific mortality rates in Olmsted County are similar to national data.[9] This study was approved by the Mayo Clinic and Olmsted Medical Center institutional review boards.

Identification of the Incident HF Cohort

Heart failure diagnoses among Olmsted County residents between January 1, 2000, and December 31, 2011, were identified using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) code 428 assigned during either an outpatient visit or a hospitalization.[12,13] A random sample of 50% of the HF diagnoses assigned between January 1, 2000, and December 31, 2006, was selected and reviewed; all of the HF diagnoses assigned from January 1, 2007, to December 31, 2011, were reviewed. Heart failure diagnoses were validated by trained nurse abstractors using the Framingham Heart Study diagnostic criteria,[14] and incidence status was determined after review of the entire medical record, which, on average, spanned 4 decades.[15] Patients with prevalent HF were excluded.

Clinical Data Collection

Clinical notes were reviewed to abstract height, weight, and smoking status at the time of incident HF. Body mass index was calculated as weight in kilograms divided by height in meters squared. Comorbidities were ascertained electronically by retrieving inpatient and outpatient diagnostic codes and requiring at least 2 occurrences of a code (either the same code or 2 different codes within the same code set) within the 5 years before incident HF. The code sets were based on a modification of the Charlson Comorbidy Index[16,17] and were validated against manually abstracted data in 1418 patients with incident HF (Supplemental Table, available online at http://www.mayoclinicproceedings.org). The closest serum creatinine value within 1 year of the index HF date was obtained, and the estimated glomerular filtration rate was calculated using the Modification of Diet in Renal Disease Study equation.[18] Left ventricular EF (LVEF) (%) was determined using values collected from any echocardiogram, angiogram, multigated acquisition scan, or technetium Tc 99m sestamibi scan performed within 3 months of the incident HF date. When multiple values were available, the value closest to the HF date was used; the average was used when multiple values were measured on the same day. Heart failure with preserved EF was defined as an LVEF of greater than or equal to 50%, while HF with reduced EF was defined as an LVEF of less than 50%.[19]

Outcomes Ascertainment

All hospitalizations occurring within the 2 years following incident HF were obtained from the Rochester Epidemiology Project. The principal discharge diagnosis for each hospitalization was identified, and each hospitalization was categorized as due to HF (*ICD-9-CM* code 428), other cardiovascular causes (*ICD-9-CM* codes 390-427, 429-459), or noncardiovascular causes.