CLINICAL RESEARCH STUDY

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Multimorbidity in Heart Failure: A Community Perspective

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ABSTRACT

BACKGROUND: Comorbidities are a major concern in heart failure, leading to adverse outcomes, increased health care utilization, and excess mortality. Nevertheless, the epidemiology of comorbid conditions and differences in their occurrence by type of heart failure and sex are not well documented.

METHODS: The prevalence of 16 chronic conditions defined by the US Department of Health and Human Services was obtained among 1382 patients from Olmsted County, Minn. diagnosed with first-ever heart failure between 2000 and 2010. Heat maps displayed the pairwise prevalences of the comorbidities and the observed-to-expected ratios for occurrence of morbidity pairs by type of heart failure (preserved or reduced ejection fraction) and sex.

RESULTS: Most heart failure patients had 2 or more additional chronic conditions (86%); the most prevalent were hypertension, hyperlipidemia, and arrhythmias. The co-occurrence of other cardiovascular diseases was common, with higher prevalences of co-occurring cardiovascular diseases in men compared with women. Patients with preserved ejection fraction had one additional condition compared with those with reduced ejection fraction (mean 4.5 vs 3.7). The patterns of co-occurring conditions were similar between preserved and reduced ejection fraction; however, differences in the ratios of observed-to-expected co-occurrence were apparent by type of heart failure and sex. In addition, some psychological and neurological conditions co-occurred more frequently than expected.

CONCLUSION: Multimorbidity is common in heart failure, and differences in co-occurrence of conditions exist by type of heart failure and sex, highlighting the need for a better understanding of the clinical consequences of multiple chronic conditions in heart failure patients.

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KEYWORDS: Comorbidity; Heart failure; Multimorbidity

Multimorbidity is defined as the co-occurrence of 2 or more chronic conditions.[1] As the number of conditions that a patient has increases, so do the risks of declining functional status, adverse drug effects, prescription nonadherence, duplicative tests, conflicting medical advice, unnecessary hospitalizations, and mortality.[2-7] Multimorbidity is particularly concerning in heart failure because comorbid conditions may precipitate acute decompensation, lead to greater health care utilization, and increase the risk of nonfatal complications and death.[8-11] Indeed, only a small proportion of hospitalizations in heart failure patients are due to heart failure; more than half are due to noncardiovascular

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causes.[12] Therefore, comorbidities play a prominent role in the prognosis of patients with heart failure.

However, key questions remain on the frequency and combinations of comorbidities in heart failure. The case mix of heart failure is changing over time, with an increasing proportion of heart failure with preserved ejection fraction,[13-15] who are less likely to have coronary disease than heart failure patients with reduced ejection fraction.[16] These changes highlight the need for a better understanding of the comorbidity burden in the heart failure syndrome, including the contribution of cardiovascular and noncardiovascular comorbidities according to type of heart failure (preserved vs reduced ejection fraction). Finally, differences in the comorbidity burden between men and women with preserved and reduced ejection fraction have not been described. We undertook this study to describe differences in the prevalence of individual and co-occurring comorbidities according to type of heart failure and sex in a cohort from a geographically defined community in southeastern Minnesota.

CLINICAL SIGNIFICANCE

- Heart failure (HF) patients have a high comorbidity burden, and those with preserved ejection fraction (EF) have, on average, one additional comorbidity than those with reduced EF.
- Co-occurrence of some of the psychological and neurological conditions, which are less prevalent individually, occurs at much higher-than-expected frequency.
- Multimorbidity involving noncardiovascular conditions adds complexity to the management of HF patients, underscoring the need to better understand their role in the management and outcomes in HF.

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.[17-20] The retrieval of nearly all health care events occurring in Olmsted County is possible because this area is relatively isolated from other urban centers; only a few providers—Mayo Clinic, Olmsted Medical Center, and their affiliated hospitals—deliver most health care to local residents. This study was approved by the Mayo Clinic and Olmsted Medical Center Institutional Review Boards.

Identification of the Incident Heart Failure Cohort

Heart failure diagnoses among Olmsted County residents between 2000 and 2010 were identified using International Classification of Diseases-9th Revision, Clinical Modification (ICD-9-CM) code 428 assigned during either an outpatient visit or a hospitalization.[12,21] A random sample of 50% of the heart failure diagnoses given between 2000 and 2006 were selected and reviewed; all heart failure diagnoses from 2007 to 2010 were reviewed. Heart failure diagnoses were validated using the Framingham Criteria,[22] and incidence status was determined after review of the entire medical record, which spanned, on average, 4 decades.[23] Patients who had a diagnosis of heart failure before the study period (ie, those with prevalent heart failure) were excluded.

Clinical Data Collection

Twenty chronic conditions have been identified by the US Department of Health and Human Services (US-DHHS) for studying multimorbidity.[24,25] These conditions were selected as comorbidities and were ascertained electronically by retrieving ICD-9-CM codes from inpatient and outpatient encounters at all providers indexed in the Rochester Epidemiology Project. Two occurrences of a code (either the same code or 2 different codes within the code set for a given disease) separated by more than 30 days and occurring within the 5 years before the index date were required for diagnosis. More extensive details about the definition of the 20 chronic conditions were reported elsewhere.[26] Because all patients had heart failure, this condition was not considered a comorbidity. In addition, because few individuals in our cohort had autism ($n = 0$), hepatitis ($n = 9$), and human immunodeficiency virus ($n = 0$), these conditions were also excluded, resulting in 16 of the original 20 chronic conditions.

Left ventricular ejection fraction (%) was determined using values collected from any echocardiogram, angiogram, multigated acquisition scan, or sestamibi scan performed within 3 months of the incident heart failure date. When multiple values were available, the value closest to the heart failure date was used; the average was used when multiple values were measured on the same day. Heart failure with preserved ejection fraction was defined as ejection fraction $\geq$50%, while heart failure with reduced ejection fraction was defined as ejection fraction $<$50%.[27] Patients who did not have a measure of ejection fraction in their records were excluded.

Statistical Analysis

Analyses were performed using SAS statistical software, version 9.2 (SAS Institute Inc., Cary, NC) and R, version 3.0.2 (R Foundation for Statistical Computing, Vienna, Austria). Baseline participant characteristics are presented as frequencies and mean (SD). Within men and women, differences by type of heart failure were tested using