IQRO JURNALI / 2023
GUVOHNOMA № 060680
E-ISSN : 2181-4341
https://wordlyknowledge.uz
IMPACT FACTOR(SJIF) : 3,934
VOLUME 4, ISSUE 2, 2023

ONE OF THE MOST COMMON CURRENT, DANGEROUS DISEASES IS THE CAUSES, TREATMENT AND PREVENTION OF HEART FAILURE

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Annotation
Although the incidence of heart failure has remained stable in recent decades, the likelihood of survival after a diagnosis of heart failure has increased, suggesting that the profile of heart failure may be changing. Such changes may be due to shifts in population demographics, changes in the prevalence of risk factors for heart failure, and the evolution of therapeutic strategies for heart failure.[3] The overall profile of heart failure may also be influenced by changes in the prevalence of heart failure with preserved ejection fraction.

Key words
Heart , heart failure , coronary artery.

We performed a study to define secular trends in the prevalence of heart failure with preserved ejection fraction among patients admitted for decompensated heart failure at a single institution over a 15-year period. We hypothesized that the prevalence of heart failure with preserved ejection fraction has increased over time. We also investigated whether patterns of the prevalence of heart failure were associated with changes in the types of cardiovascular disease among patients with heart failure. Finally, we examined whether changes in survival rate over the 15-year period differed between patients with preserved ejection fraction and those with reduced ejection fraction.

The Mayo Clinic hospitals are located in Olmsted County, Minnesota, and serve patients from the community and those referred from other sites. The institution maintains an integrated medical-record system of all encounters that identifies each patient with a unique number.[4] This system served as the basis for our retrospective analysis of data on patients hospitalized for heart failure. Study funding was provided by the Miami Heart Research Institute and the National Institutes of Health. The study was approved by the institutional review board of the Mayo Foundation; because the study involved only the review of records obtained as a part of routine medical care, no patient consent was required.

The Mayo Integrated Computer System identified all consecutive patients admitted to Mayo Clinic hospitals in Rochester, Minnesota, between January 1, 1987, and December 31, 2001, who were discharged with a code 428 diagnosis according to the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM).[2] The list of patients with this diagnosis was matched with the list of patients discharged with a diagnosis-related-group (DRG) code 127 diagnosis. Only patients discharged with both ICD code 428 and DRG code 127 were considered for inclusion in the study. If a patient was admitted more than once for heart failure during the study period, only the data from the first admission were analyzed. We validated the frequency with which such patients met the modified Framingham criteria for heart failure[5] or the clinical criterion (diagnosis of heart

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failure recorded on the chart by the attending physician) during the index hospitalization by manually abstracting data from the charts of a random sample of 135 patients.

All data were extracted electronically. Data were collected on the age, date of birth, sex, home address, admission date, body weight, and height of the patients. During the study, the proportion of patients for whom data on height and weight were electronically available increased from 9 percent in the first five years to 31 percent in the second five years to 83 percent in the last five years. Data on coexisting cardiovascular conditions in each patient were also extracted with the use of all relevant ICD codes. Data on serum creatinine and blood hemoglobin levels were extracted from the Mayo Laboratory Information System. Data on ejection fraction and the presence of valve disease that was more than moderate (aortic or mitral stenosis or regurgitation) were extracted from the Mayo echocardiographic database.[6] The final study cohort consisted of patients meeting the above criteria who had undergone echocardiography within 30 days before or after hospitalization.

Patients with an ejection fraction of 50 percent or higher were classified as having heart failure with preserved ejection fraction, whereas those with an ejection fraction of less than 50 percent were classified as having heart failure with reduced ejection fraction.[7-9] Obesity was defined by a body-mass index (the weight in kilograms divided by the square of the height in meters) of 30 or more. The patients were classified as community patients (residents of Olmsted County) or referral patients on the basis of their ZIP Code of residence.

Survival status was initially determined from the Mayo Clinic registration database, as previously described.[2] For patients with no record of death in the registration database, information on vital status and mortality was queried with the use of ACCURINT, an institutionally approved Web-based resource and location service.

To identify changes over time, we constructed simple linear regression models with the year of admission as the independent variable. We report Pearson's correlation coefficients and P values. Differences between groups were tested by the two-sample t-test for continuous variables and the chi-square test for categorical variables. We used a regression model to adjust for the effect of age on the differences in baseline characteristics between patients with preserved ejection fraction and those with reduced ejection fraction. We estimated the overall survival by the Kaplan–Meier method and tested for differences in survival between groups or times by the log-rank test. Cox proportional-hazards regression was used to adjust for the effect of differences in baseline characteristics on survival. We did not adjust for body-mass index in this analysis because complete data on this variable were not available.

A total of 6076 patients with ICD code 428 and DRG code 127 were discharged from 1987 through 2001. Echocardiographic assessment of ejection fraction within 30 days was available for 4596 patients (76 percent), who constituted the study population. The proportion of patients undergoing echocardiography did not change significantly over time (P=0.10). Ninety-five percent of the charts sampled for validation of the diagnosis of heart failure met the Framingham criteria, and 99 percent met either the clinical or the Framingham criteria. More than 97 percent of the patients were white.

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PATIENT CHARACTERISTICS AND EJECTION FRACTION

Table1.

Table 1. Characteristics of Patients with Heart Failure and Preserved or Reduced Ejection Fraction.*

Characteristic	Reduced Ejection Fraction (N=2429)	Preserved Ejection Fraction (N=2167)	P Value	Adjusted P Value†
Age (yr)	71.7±12.1	74.4±14.4	<0.001	NA
Male sex (% of patients)	65.4	44.3	<0.001	<0.001
Body-mass index‡	28.6±7.0	29.7±7.8	0.002	0.17
Obesity (% of patients)‡§	35.5	41.4	0.007	0.002
Serum creatinine on admission (mg/dl)	1.6±1.0	1.6±1.1	0.31	0.30
Hemoglobin on admission (g/dl)	12.5±2.0	11.8±2.1	<0.001	<0.001
Hypertension (% of patients)	48.0	62.7	<0.001	<0.001
Coronary artery disease (% of patients)	63.7	52.9	<0.001	<0.001
Atrial fibrillation (% of patients)	28.5	41.3	<0.001	<0.001
Diabetes (% of patients)	34.3	33.1	0.42	0.61
Substantial valve disease (% of patients)	6.5	2.6	<0.001	0.05
Ejection fraction (%)	29±10	61±7	<0.001	NA

* Continuous variables are expressed as means ±SD. To convert values for creatinine to micromoles per liter, multiply by 88.4.
† The P values are adjusted for age. NA denotes not applicable.
‡ Data on height and weight were not consistently accessible by electronic means over the course of the study; during the three consecutive five-year periods of the study, the data were available for 9 percent, 31 percent, and 83 percent of the study population, respectively. The body-mass index is the weight in kilograms divided by the square of the height in meters.
§ Obesity was defined by a body-mass index of 30 or more.

Characteristics of Patients with Heart Failure and Preserved or Reduced Ejection Fraction.
Patients with preserved ejection fraction were older, were more likely to be female, had a higher mean body-mass index, were more likely to be obese, and had lower hemoglobin than those with reduced ejection fraction (Table 1). Overall, the prevalence of preserved ejection fraction among all patients with a discharge diagnosis of heart failure was 49 percent among patients 65 years of age or older and 40 percent among those under 65 years of age (P=0.004).

The prevalence rates of hypertension and atrial fibrillation were higher and the prevalence rates of coronary artery disease and valve disease were lower among patients with preserved ejection fraction than among those with reduced ejection fraction. These differences remained significant after adjustment for the age difference between the two groups (Table 1). The serum creatinine level on admission and the prevalence of diabetes were similar in the two groups of patients.

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KNOWLEDGE