Long-term outcomes and independent predictors of mortality in patients presenting to emergency departments with acute heart failure in Beijing: a multicenter cohort study with a 5-year follow-up

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Abstract

Background: Acute heart failure (AHF) is the most common disease in emergency departments (EDs). However, clinical data exploring the outcomes of patients presenting AHF in EDs are limited, especially the long-term outcomes. The purposes of this study were to describe the long-term outcomes of patients with AHF in the EDs and further analyze their prognostic factors.

Methods: This prospective, multicenter, cohort study consecutively enrolled 3335 patients with AHF who were admitted to EDs of 14 hospitals from Beijing between January 1, 2011 and September 23, 2012. Kaplan-Meier and Cox regression analysis were adopted to evaluate 5-year outcomes and associated predictors.

Results: The 5-year mortality and cardiovascular death rates were 55.4% and 49.6%, respectively. The median overall survival was 34 months. Independent predictors of 5-year mortality were patient age (hazard ratio [HR]: 1.027, 95 confidence interval [CI]: 1.023–1.030), body mass index (BMI) (HR: 0.971, 95% CI: 0.958–0.983), fatigue (HR: 1.127, 95% CI: 1.009–1.258), ascites (HR: 1.190, 95% CI: 1.057–1.340), hepatic jugular reflux (HR: 1.339, 95% CI: 1.140–1.572), New York Heart Association (NYHA) class III to IV (HR: 1.511, 95% CI: 1.291–1.769), heart rate (HR: 1.003, 95% CI: 1.001–1.005), diastolic blood pressure (DBP) (HR: 0.996, 95% CI: 0.993–0.999), blood urea nitrogen (BUN) (HR: 1.014, 95% CI: 1.008–1.020), B-type natriuretic peptide (BNP)/N-terminal pro-B-type natriuretic peptide (NT-proBNP) level in the third (HR: 1.426, 95% CI: 1.220–1.668) or fourth quartile (HR: 1.437, 95% CI: 1.223–1.690), serum sodium (HR: 0.980, 95% CI: 0.972–0.988), serum albumin (HR: 0.981, 95% CI: 0.971–0.992), ischemic heart diseases (HR: 1.195, 95% CI: 1.073–1.331), primary cardiomyopathy (HR: 1.382, 95% CI: 1.183–1.614), diabetes (HR: 1.118, 95% CI: 1.010–1.237), stroke (HR: 1.252, 95% CI: 1.121–1.397), and the use of diuretics (HR: 0.714, 95% CI: 0.626–0.814), β-blockers (HR: 0.673, 95% CI: 0.588–0.769), angiotensin-converting enzyme inhibitors (ACEIs) (HR: 0.714, 95% CI: 0.604–0.845), angiotensin-II receptor blockers (ARBs) (HR: 0.790, 95% CI: 0.646–0.965), spironolactone (HR: 0.814, 95% CI: 0.663–0.999), calcium antagonists (HR: 0.624, 95% CI: 0.531–0.733), nitrates (HR: 0.715, 95% CI: 0.631–0.811), and digoxin (HR: 0.579, 95% CI: 0.465–0.721).

Conclusions: The results of our study demonstrate poor 5-year outcomes of patients presenting to EDs with AHF. Age, BMI, fatigue, ascites, hepatic jugular reflux, NYHA class III to IV, heart rate, DBP, BUN, BNP/NT-proBNP level in the third or fourth quartile, serum sodium, serum albumin, ischemic heart diseases, primary cardiomyopathy, diabetes, stroke, and the use of diuretics, β-blockers, ACEIs, ARBs, spironolactone, calcium antagonists, nitrates, and digoxin were independently associated with 5-year all-cause mortality.

Keywords: Heart failure; Mortality; Emergency service

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Introduction

Acute heart failure (AHF) is a major public health issue with high morbidity and mortality rates,[1,2] and it is the most common cause of emergency department (ED) admission.[3] Several observational studies have investigated the short- or intermediate-term outcomes of hospitalized patients with AHF, as well as their prognostic predictors.[4-10] However, hospitalized patients are less representative because the majority of AHF patients were originally evaluated and managed in EDs, and approximately one-third of these patients discharged directly from EDs.[11,12] Therefore, evaluations of patients presenting in EDs can help us better understand the real-world profile of AHF. Unfortunately, the clinical data exploring the outcomes of patients presenting in EDs with AHF are very limited, especially for long-term outcomes.

The Beijing AHF Registry (Beijing Acute Heart Failure Registry) was a multicenter, prospective, cohort study that consecutively recruited patients with AHF from the EDs of 14 hospitals in Beijing. The primary purpose of this study was to describe the long-term outcomes of patients with AHF in the EDs and further analyze their prognostic factors.

Methods

Ethical approval

This study was approved by the Institutional Review Board of Fuwai Hospital (No. 2010-218) and was consistent with the principles of the *Declaration of Helsinki*. All the participants provided written informed consent

Study design and data collection

Data were obtained from the Beijing AHF Registry. The Beijing AHF Registry was a prospective, multicenter, cohort study aimed to clarify the profile of AHF patients in Beijing including the baseline characteristics, management strategies, mortality during ED stay, and the follow-up period, which has previously been described.[13] Briefly, a total of 3335 patients diagnosed with AHF admitted in EDs of 14 Beijing hospitals (including ten urban tertiary hospitals and four sub-urban secondary hospitals) from January 1, 2011 to September 23, 2012, were recruited consecutively. The criteria used for diagnosing heart failure (HF) were: (1) symptomatic lung congestion confirmed by chest X-ray or (2) objective findings consistent with left ventricular dysfunction. The diagnosis of AHF was made by an attending physician at each ED and confirmed by a separate panel of cardiologists, who retrospectively reviewed each patient's information. There were no exclusion criteria.

The medical histories and physical signs of patients were collected and recorded by the attending physician during ED admission. The results of laboratory tests and imaging were recorded if they were performed in the ED. Information pertaining to medical care provided during ED stay and follow-up periods was collected. HF was classified as new-onset HF and decompensation of chronic HF based on whether there was a clear previous history of HF either documented or reported by the patient. The etiology and precipitating factors of each patient with AHF were determined by the attending physicians according to the medical history, physical examination, and auxiliary examination results.

The outcomes of interest were 5-year all-cause mortality and cardiovascular (CV) deaths. CV deaths were defined as deaths that result from an acute myocardial infarction, sudden cardiac death, HF, stroke, CV procedures, CV hemorrhage, and other CV causes according to the 2017 CV and Stroke Endpoint Definitions for Clinical Trials.[14] Participants were followed by telephone or during outpatient visits by trained investigators. All outcome data were reviewed by a committee consisting of three experienced cardiologists. Death events were confirmed by checking the death certificates obtained from the residence registration system.

Statistical analysis

Categorical variables were summarized by frequencies with percentages and compared using the Chi-square test. Continuous variables were presented by means ± standard deviations or medians with interquartile ranges and compared using grouped *T*-test or Wilcoxon rank-sum test. Cumulative incidences for all-cause mortality and CV death at 5 years were described by using Kaplan-Meier estimates. A log-rank test was performed to compare outcomes among groups of patients. Univariate and multivariate Cox proportional hazards regression models with estimations of hazard ratios (HR) and 95% confidence intervals (95% CI) were used to evaluate the impact of the baseline variables on clinical outcomes. Factors with $P < 0.100$ in the univariate model were selected for the multivariate model. The final adjusted covariates included in the multivariate regression model were determined by clinical experience, previous evidence, and the results of the univariate regression analysis. Variables with missing data (including body mass index [BMI], heart rate, diastolic blood pressure [DBP], white blood cell count, serum sodium, blood urea nitrogen [BUN], B-type natriuretic peptide [BNP] or N-terminal pro-B-type natriuretic peptide [NT-proBNP] level, and left ventricular ejection fraction [LVEF]. The missing rates of these variables were 4.6%, 0.1%, 0.2%, 1.6%, 2.1%, 6.4%, 16.2%, and 37.5% respectively, and the mechanism was considered missing at random) were not imputed for univariable analysis. Before entering the multivariate models, missing values with missing rates of <20% were imputed by multiple imputation (MI) based on five replications and the Markov chain Monte Carlo method. Complete case analysis was then performed as a sensitivity analysis to evaluate the compatibility with the model obtained after the MI. A two-sided P value of <0.050 was considered statistically significant. All the analyses were performed using SPSS version 25.0 (IBM, Armonk, New York, USA).

Results

Patient characteristics

A total of 3335 patients from 14 EDs in Beijing who experienced AHF between January 1, 2011 and September

23, 2012, were enrolled in this study. The baseline characteristics of the overall cohort and those categorized by survival status at 5 years are described and compared in Supplementary Table 1, http://links.lww.com/CM9/A645. The median age was 71 years (58–79 years), and 46.8% of the patients were female. The mean BMI was 23.9 ± 3.9 kg/m^2. A total of 1669 (50.04%) patients were new-onset HF and 1666 (49.96%) patients were decompensation of chronic HF. Ischemic heart disease (43.3%), hypertensive heart disease (17.3%), and primary cardiomyopathy (16.1%) were the three most common etiologies of AHF in this study. While infection (71.0%) was the most common precipitating factor of AHF. The mean heart rate and DBP at ED admission were 98.6 ± 25.9 beats per min and 78.4 ± 17.3 mmHg, respectively. The median BNP and NT-proBNP levels were 1280 and 4920 pg/mL, respectively. LVEF data were available for 2083 (62.5%) patients, and the median LVEF was 44%. Among these patients, 910 (43.7%) had an LVEF <40%, 323 (15.5%) had an LVEF between 40% and 49%, and 850 (40.8%) had an LVEF ≥50%. A total of 2922 (87.6%) patients with a New York Heart Association (NYHA) functional classification of III to IV were admitted to ED. Approximately one-third of the patients took diuretics (31.7%), β-blockers (30.3%), and nitrates (29.3%) during the follow-up. Fewer patients took angiotensin-converting enzyme inhibitors (ACEIs, 15.1%), angiotensin-II receptor blockers (ARBs, 8.0%), aldosterone antagonists (12.4%), digoxin (11.4%), and calcium antagonists (12.6%).

Five-year outcomes and associated risk factors

A total of 396 (11.8%) patients were lost to follow-up in the fifth year, and these patients were censored at the date of last information. The 5-year mortality and CV death rates for the entire cohort were 55.4% and 49.6%, respectively [Supplementary Table 2, http://links.lww.com/CM9/A645]. The median overall survival was 34 months. 22.6% and 39.2% of the patients died within 1 month and 1 year after the onset of AHF, and the remaining 60.8% died from the second to the fifth year. Kaplan-Meier curve for the 5-year all-cause mortality and CV deaths are described in Figure 1.

The independent predictors of 5-year all-cause mortality are shown in Table 1 and Figure 2.

Age (HR: 1.027, 95 CI: 1.023–1.030, $P < 0.001$), BMI (HR: 0.971, 95% CI: 0.958–0.983, $P < 0.001$), presence of fatigue (HR: 1.127, 95% CI: 1.009–1.258, $P = 0.034$), ascites (HR: 1.190, 95% CI: 1.057–1.340, $P = 0.004$), hepatic jugular reflux (HR: 1.339, 95% CI: 1.140–1.572, $P < 0.001$), NYHA class III to IV (HR: 1.511, 95% CI: 1.291–1.769, $P < 0.001$), heart rate (HR: 1.003, 95% CI: 1.001–1.005, $P = 0.001$), DBP (HR: 0.996, 95% CI: 0.993–0.999, $P = 0.003$), BUN (HR: 1.014, 95% CI: 1.008–1.020, $P < 0.001$), BNP/NT-proBNP level at the third (HR: 1.426, 95% CI: 1.220–1.668, $P < 0.001$) or fourth quartile (HR: 1.437, 95% CI: 1.223–1.690, $P < 0.001$), serum sodium (HR: 0.980, 95% CI: 0.972–0.988, $P < 0.001$), serum albumin (HR: 0.981, 95% CI: 0.971–0.992, $P < 0.001$), AHF caused by ischemic heart diseases (HR: 1.195, 95% CI: 1.073–1.331, $P = 0.001$) or primary cardiomyopathy (HR: 1.382, 95% CI: 1.182–1.614, $P < 0.001$), comorbid with diabetes (HR: 1.118, 95% CI: 1.010–1.237, $P = 0.032$), or stroke (HR: 1.252, 95% CI: 1.121–1.397, $P < 0.001$) were the independent predictors of 5-year all-cause mortality. While the use of diuretics (HR: 0.714, 95% CI: 0.626–0.814, $P < 0.001$), β-blockers (HR: 0.673, 95% CI: 0.588–0.769, $P < 0.001$), ACEIs (HR: 0.714, 95% CI: 0.604–0.845, $P < 0.001$), ARBs (HR: 0.790, 95% CI: 0.646–0.965, $P = 0.021$), spironolactone (HR: 0.814, 95% CI: 0.663–0.999, $P = 0.048$), calcium antagonists (HR: 0.624, 95% CI: 0.531–0.733, $P < 0.001$), nitrates (HR: 0.715, 95% CI: 0.631–0.811, $P < 0.001$), and digoxin (HR: 0.579, 95% CI: 0.465–0.721, $P < 0.001$) were associated with significant improvement of 5-year survival. The independent predictors of 5-year CV deaths were similar to those of all-cause deaths, as shown in Table 2 and Figure 3. Compared with all-cause mortality, fatigue was no longer an independent risk factor. By contrast, the presence of orthopnea, comorbid with digestive system diseases, a higher white blood cell count, and a lower platelet count serve as independent risk factors for CV death. These results were generally consistent with the complete case analysis [Tables 1 and 2].

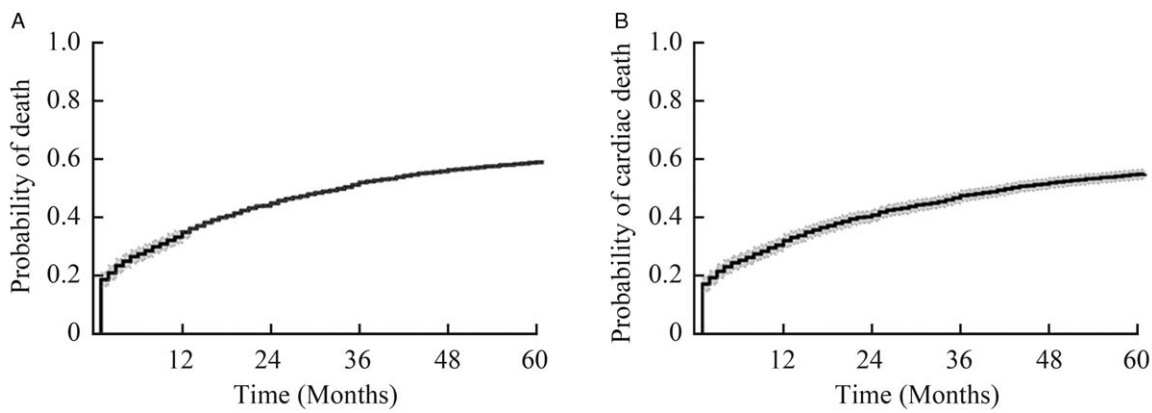

Figure 1: Kaplan-Meier curve for 5-year all-cause mortality (A) and CV deaths (B) with 95% CI of patients with AHF. AHF: Acute heart failure; CI: Confidence interval; CV: Cardiovascular.

Table 1: Independent predictors of 5-year all-cause mortality among patients with AHF using complete case and MI models.

	Complete case ($n = 2511$)			Multiple imputation ($n = 3335$)		
Variable	Hazard ratio	95% CI	*P*	Hazard ratio	95% CI	*P*
Age	1.026	1.022–1.031	<0.001	1.027	1.023–1.030	<0.001
BMI	0.973	0.959–0.987	<0.001	0.971	0.958–0.983	<0.001
Fatigue	1.094	0.965–1.240	0.161	1.127	1.009–1.258	0.034
Ascites	1.206	1.054–1.380	0.006	1.190	1.057–1.340	0.004
NYHA Class III–IV	1.374	1.151–1.641	<0.001	1.511	1.291–1.769	<0.001
Heart rates	1.004	1.002–1.006	<0.001	1.003	1.001–1.005	0.001
Diastolic blood pressure	0.995	0.991–0.998	0.003	0.996	0.993–0.999	0.003
Hepatic jugular reflux	1.368	1.143–1.637	0.001	1.339	1.140–1.572	<0.001
Diabetes	1.128	1.003–1.269	0.045	1.118	1.010–1.237	0.032
Stroke	1.327	1.168–1.506	<0.001	1.252	1.121–1.397	<0.001
Serum sodium	0.977	0.968–0.986	<0.001	0.980	0.972–0.988	<0.001
BUN	1.013	1.006–1.020	<0.001	1.014	1.008–1.020	<0.001
Serum albumin	0.982	0.971–0.994	0.002	0.981	0.971–0.992	<0.001
BNP or NT-proBNP level						
Quartile 1	Reference		Reference			
Quartile 2	1.185	1.006–1.397	0.042	1.133	0.971–1.322	0.113
Quartile 3	1.582	1.346–1.860	<0.001	1.426	1.220–1.668	<0.001
Quartile 4	1.523	1.289–1.798	<0.001	1.437	1.223–1.690	<0.001
Diastolic heart failure	0.823	0.706–0.960	0.013	0.811	0.707–0.930	0.003
Ischemic heart disease	1.197	1.054–1.358	0.005	1.195	1.073–1.331	0.001
Cardiomyopathy	1.364	1.142–1.629	0.001	1.382	1.183–1.614	<0.001
Diuretics	0.702	0.604–0.815	<0.001	0.714	0.626–0.814	<0.001
β-blockers	0.659	0.566–0.768	<0.001	0.673	0.588–0.769	<0.001
Calcium antagonists	0.596	0.494–0.718	<0.001	0.624	0.531–0.733	<0.001
ACEIs	0.737	0.613–0.887	0.001	0.714	0.604–0.845	<0.001
ARBs	0.866	0.683–1.097	0.233	0.790	0.646–0.965	0.021
Spironolactone	0.810	0.643–1.020	0.074	0.814	0.663–0.999	0.048
Nitrates	0.675	0.585–0.779	<0.001	0.715	0.631–0.811	<0.001
Digoxin	0.544	0.424–0.698	<0.001	0. 579	0.465–0.721	<0.001

ACEIs: Angiotensin-converting enzyme inhibitors; AHF: Acute heart failure; ARBs: Angiotensin II receptor blockers; BMI: Body mass index; BNP: B-type natriuretic peptide; BUN: Blood urea nitrogen; CI: Confidence interval; DBP: Diastolic blood pressure; HF: Heart failure; MI: Multiple imputation; NT-proBNP: N-terminal pro-B-type natriuretic peptide; NYHA: New York Heart Association.

Discussion

This study investigated the long-term outcomes and associated prognostic factors of patients with AHF admitted to the ED. The results showed that the 5-year all-cause mortality and CV death rates were 55.4% and 49.6%, respectively. Older age, lower BMI, presence of fatigue, ascites, hepatic jugular reflux sign, higher NYHA functional classification, higher heart rate, lower DBP, higher BUN, BNP, and NT-proBNP, lower serum sodium or albumin, AHF with an etiology of ischemic heart diseases or primary cardiomyopathy, and comorbid with diabetes or stroke were independent risk factors for 5-year all-cause mortality. The use of diuretics, β-blockers, ACEIs, ARBs, aldosterone antagonists, calcium antagonists, nitrates, and digoxin were independent protective factors.

In recent years, the large-scale registries published worldwide that focus on AHF primarily include the the Acute Decompensated Heart Failure National Registry (ADHERE) study[15-18] and the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF) study[19] from the United States, the European Society of Cardiology Heart Failure (ESC-HF) Pilot study from Europe,[20] the ADHERE- Asia Pacific (AP) study for the Asia Pacific region,[21] the EFICA study from France,[22] the Italian Network on Heart Failure (IN-HF) study from Italy,[23] and the Acute Decompensated Heart Failure Syndromes Registry (AT-TEND) study from Japan,[4] and they provide us with a real-world picture of the evaluation, management, and survival status of AHF patients. However, most of these studies selected hospitalized patients as the study population, and primarily focused on short- or intermediate-term outcomes. Few studies investigated the long-term prognosis of patients with AHF in the ED. In China, there has been no such study focusing on the Chinese population. The Beijing AHF registry first revealed the clinical profile and outcomes of Chinese patients with AHF in the ED.[13]

Compared with other registries, the 5-year all-cause mortality in our study was much lower. A registry that enrolled 6076 patients hospitalized with decompensated HF at the Mayo Clinic from 1987 to 2001 reported that the 5-year mortality rates were 65% and 68% in ejection fraction (EF) preserved and EF reduced patients, respectively.[24] Another study included 2445 patients with AHF

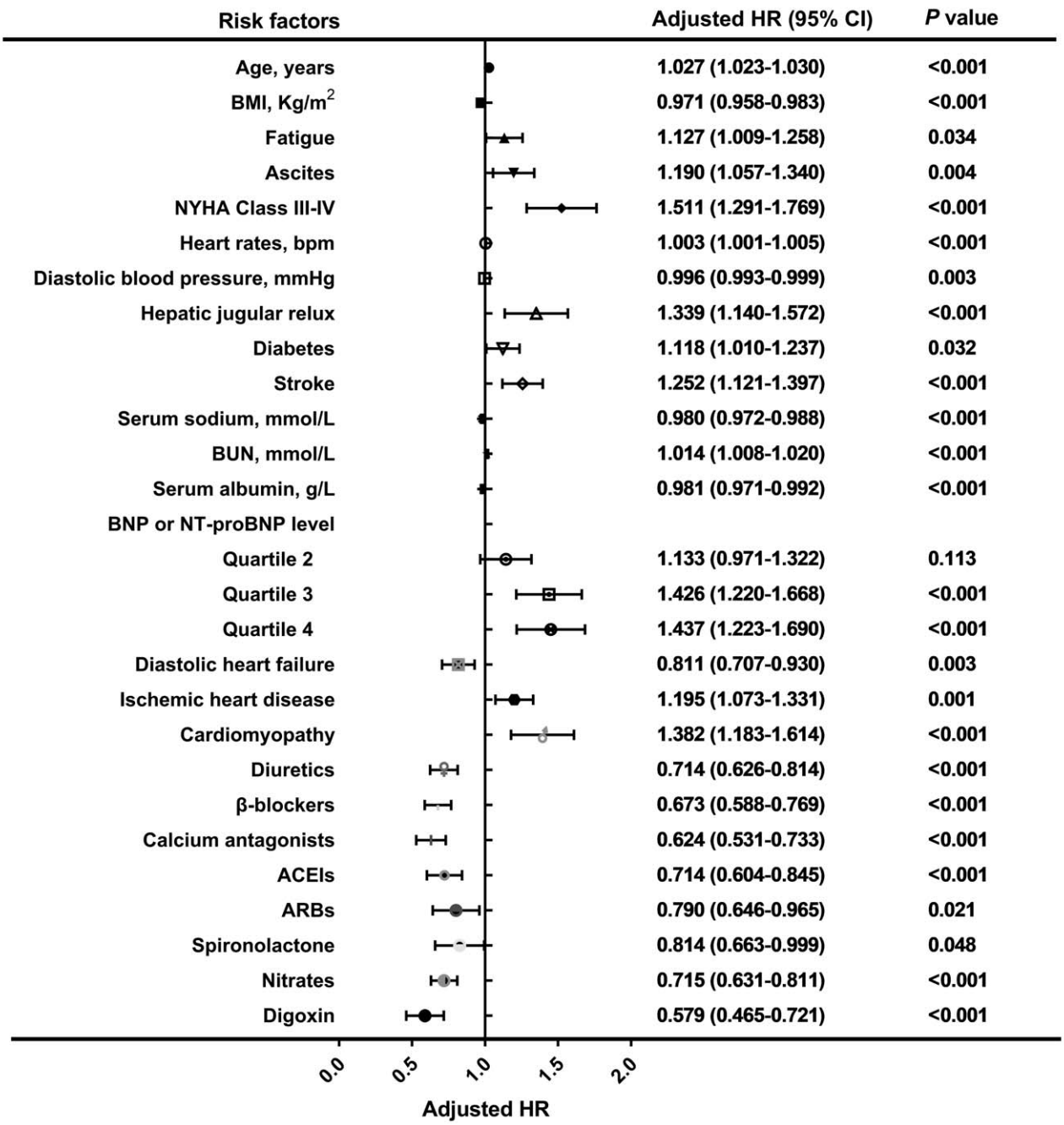

Figure 2: Independent predictors for 5-year all-cause mortality of patients with AHF by multivariable Cox regression. ACEIs: Angiotensin-converting enzyme inhibitors; AHF: Acute heart failure; ARBs: Angiotensin II receptor blockers; BMI: Body mass index; BNP: B-type natriuretic peptide; BUN: Blood urea nitrogen; CI: Confidence interval; HR: Hazard ratio; NT-proBNP: N-terminal pro-B-type natriuretic peptide; NYHA: New York Heart Association.

who were discharged from 11 greater Worcester hospitals in 2000, and it showed a 78.5% mortality rate during the 5-year follow-up.[25] Compared with the two studies, the average age of the patients in our study was lower (71 years in this study, and 76.1 years in Ref[25]), and the proportion of ischemic heart disease as the etiology of HF is lesser (43.3% in this study, and 58.6% in Ref[24]). Elderly age and comorbid with coronary heart disease were considered risk factors for poor prognosis in both of these studies. These findings might be the reason for the better outcomes of the patients in our study. In addition, a recent systematic review demonstrated a favorable survival trend after AHF episodes over the past four decades, although the overall outcomes were still poor.[26] The patients enrolled in this study were studied >10 years later than those in the two studies mentioned above. This trend may also contribute to better outcomes in our population. Recently, the 5-year outcomes of the Get With The Guidelines-Heart Failure (GWTG-HF) registry were reported, and they included a total of 39,982 patients from 254 hospitals who were admitted for HF between 2005 and 2009.[27] The 5-year mortality for the overall cohort was 75.4%. Elder age (80 years on average) is an important factor that contributes to higher mortality. However, the HR of age

Table 2: Independent predictors of 5-year cardiac death among patients with AHF using complete case and MI models.

	Complete case ($n = 2511$)			Multiple imputation ($n = 3335$)		
Variable	**Hazard ratio**	**95% CI**	***P***	**Hazard ratio**	**95% CI**	***P***
Age	1.024	1.019–1.028	<0.001	1.024	1.020–1.028	<0.001
BMI	0.971	0.957–0.986	<0.001	0.973	0.959–0.988	<0.001
Orthopnea	1.109	0.986–1.247	0.086	1.108	1.000–1.226	0.049
Ascites	1.193	1.037–1.373	0.014	1.147	1.012–1.300	0.031
NYHA Class III–IV	1.311	1.086–1.582	0.005	1.465	1.240–1.731	<0.001
Heart rates	1.004	1.002–1.006	0.001	1.003	1.001–1.005	0.002
Diastolic blood pressure	0.995	0.991–0.998	0.004	0.995	0.991–0.998	0.001
Hepatic jugular reflux	1.338	1.106–1.619	0.003	1.310	1.105–1.552	0.002
Diabetes	1.137	1.003–1.288	0.045	1.126	1.010–1.255	0.032
Stroke	1.354	1.184–1.550	<0.001	1.259	1.120–1.415	<0.001
Digestive system disease	1.685	1.262–2.249	<0.001	1.491	1.148–1.937	0.003
White blood cell count	1.011	1.000–1.023	0.056	1.015	1.005–1.025	0.004
Platelet count	0.999	0.999–1.000	0.093	0.999	0.999–1.000	0.033
Serum sodium	0.971	0.962–0.981	<0.001	0.976	0.967–0.984	<0.001
BUN	1.015	1.008–1.022	<0.001	1.016	1.010–1.022	<0.001
Serum albumin	0.987	0.975–0.999	0.034	0.986	0.975–0.997	0.013
BNP or NT-proBNP level						
Quartile 1	Reference		Reference			
Quartile 2	1.206	1.012–1.437	0.037	1.148	0.967–1.363	0.112
Quartile 3	1.719	1.449–2.040	<0.001	1.534	1.310–1.797	<0.001
Quartile 4	1.573	1.318–1.877	<0.001	1.481	1.231–1.781	<0.001
Diastolic heart failure	0.825	0.701–0.970	0.020	0.800	0.692–0.925	0.003
Ischemic heart disease	1.284	1.123–1.468	<0.001	1.252	1.117–1.404	<0.001
Cardiomyopathy	1.438	1.193–1.733	<0.001	1.433	1.214–1.691	<0.001
Diuretics	0.711	0.608–0.832	<0.001	0.731	0.637–0.839	<0.001
β-blockers	0.626	0.533–0.736	<0.001	0.650	0.564–0.749	<0.001
Calcium antagonists	0.552	0.451–0.677	<0.001	0.600	0.504–0.713	<0.001
ACEIs	0.764	0.630–0.926	0.006	0.743	0.623–0.885	0.001
ARBs	0.855	0.662–1.103	0.228	0.789	0.637–0.977	0.030
Nitrates	0.681	0.585–0.793	<0.001	0.722	0.633–0.824	<0.001
Digoxin	0.576	0.444–0.746	<0.001	0.584	0.464–0.736	<0.001

ACEIs: Angiotensin-converting enzyme inhibitors; AHF: Acute heart failure; ARBs: Angiotensin II receptor blockers; BMI: Body mass index; BNP: B-type natriuretic peptide; BUN: Blood urea nitrogen; CI: Confidence interval; DBP: Diastolic blood pressure; HF: Heart failure; MI: Multiple imputation; NT-proBNP: N-terminal pro-B-type natriuretic peptide; NYHA: New York Heart Association.

for predicting 5-year mortality both in our study and in the GWTG-HF registry was close to 1.03 per year, which indicates that the age difference among the study populations is not enough to explain the difference in mortality fully. It should be noted that although there was a significant difference in the 5-year survival rate between the two studies, the median survival was not significantly different (2.8 *vs.* 2.1 years). Previous studies have shown that the 1-year mortality in the Beijing AHF registry was 32.3%,[13] while that in the GWTG-HF registry was 24.7%,[28] suggesting that the risk of death during the early stage after HF onset was higher in our registry, but it decreased with the prolongation of survival. This difference may have occurred because the participants included in our study were selected from ED rather than from the inpatient department.

In the multivariate Cox regression models, we concluded that patient age, BMI, heart rate, serum sodium, BUN, BNP, or NT-proBNP were independent predictors for outcomes, which was consistent with previous studies.[29-35] The relationship between low systolic blood pressure (SBP) and the adverse outcomes had also been demonstrated.[9,32,34] In this study, however, we found that the DBP was more relevant to adverse outcomes than SBP. This finding suggests that we consider not only SBP but also DBP as important factors in future research regarding prognosis or predictive models of HF.

EF is considered an important index to evaluate the severity of HF. Recently, the guidelines of the European Society of Cardiology categorized patients with HF as having reduced EF (<40%), mid-range EF (40%–49%), and preserved EF (≥50%).[1] Whether the classification of HF based on EF values is related to the prognosis is controversial among different studies.[24,36-42] In our study, the EF values and the classification of HF based on EF were not associated with mortality in the univariate analysis, and they were not further evaluated in the multivariate analysis because of the high missing rate. This result suggests that the prognostic significance of HF phenotype based on EF value should be further investigated. In addition, more attention should be paid to the patients with preserved or intermediate EF.

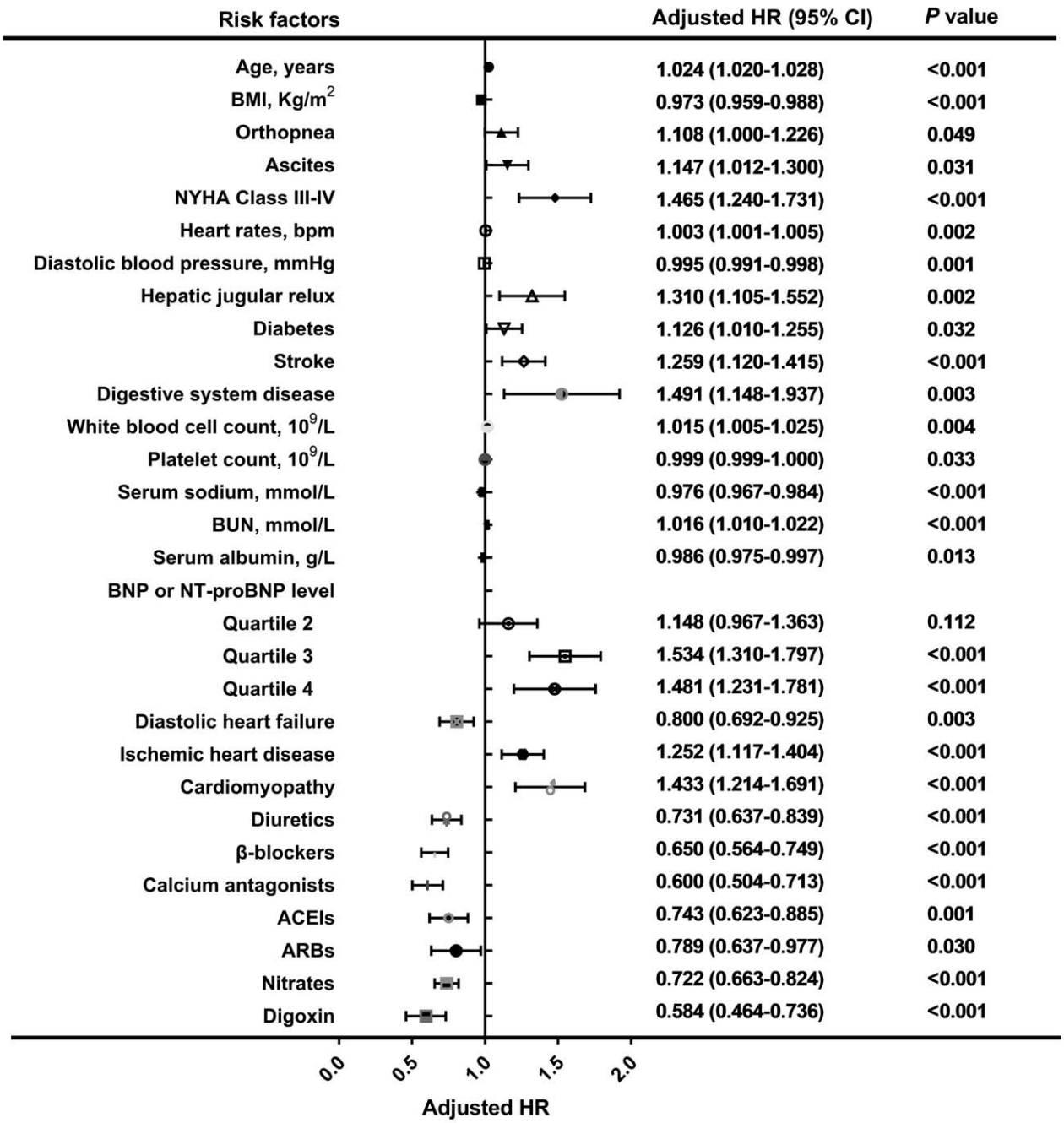

Figure 3: Independent predictors for 5-year CV deaths of patients with AHF by multivariable Cox regression. ACEIs: Angiotensin-converting enzyme inhibitors; AHF: Acute heart failure; ARBs: Angiotensin II receptor blockers; BMI: Body mass index; BNP: B-type natriuretic peptide; BUN: Blood urea nitrogen; CI: Confidence interval; CV: Cardiovascular; HR: Hazard ratio; NT-proBNP: N-terminal pro-B-type natriuretic peptide; NYHA: New York Heart Association.

The use of diuretics, β-blockers, ACEIs, ARBs, and aldosterone antagonists were proven to improve outcomes in this study, as also recommended by the guidelines.[1,43] Nevertheless, the use rate of these drugs was relatively low during the follow-up period, which may be related to the standard degree of a long-term prescription issued by emergency doctors and the compliance of patients. But it suggested that there is still room to improve the outcome of patients with HF by optimizing drug therapies.

Several limitations of this study should be mentioned. First, the relatively high lost-to-follow-up rate (11.8%) at the fifth year of follow-up may lead to inaccurate estimation of clinical outcomes and selection bias. However, 57.3% of these patients were followed-up successfully in the third year and had confirmed survival. Second, missing values are a major source of bias. Nevertheless, we used MI methods to minimize such impact. And as a consequence, the core results from the MI cohort were generally consistent with the complete case in the sensitivity analysis. Last, the laboratory examinations were conducted in different hospitals (instead of testing in a central laboratory), which may lead to the lack of standardization of laboratory examination results.

To conclude, our study, which is based on Beijing AHF registry data, demonstrates the poor long-term prognosis of AHF patients with a median survival of 34 months. The 5-year mortality and CV death rates were 55.4% and 49.6%, respectively. Less than one-third of the patients received guideline recommended drug therapies, suggesting that the outcomes of these patients could be improved by optimizing their management.

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Conflicts of interest

None.

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