Characteristics, Management, and Outcomes of Acute Heart Failure in the Emergency Department: A Multicenter Registry Study with 1-year Follow-up in a Chinese Cohort in Beijing

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Abstract

Background: The emergency department (ED) has a pivotal influence on the management of acute heart failure (AHF), but data concerning current ED management are scarce. This Beijing AHF Registry Study investigated the characteristics, ED management, and short- and long-term clinical outcomes of AHF.

Methods: This prospective, multicenter, observational study consecutively enrolled 3335 AHF patients who visited 14 EDs in Beijing from January 1, 2011, to September 23, 2012. Baseline data on characteristics and management were collected in the EDs. Follow-up data on death and readmissions were collected until November 31, 2013, with a response rate of 92.80%. The data were reported as median (interquartile range) for the continuous variables, or as number (percentage) for the categorical variables.

Results: The median age of the enrolled patients was 71 (58–79) years, and 46.84% were women. In patients with AHF, coronary heart disease (43.27%) was the most common etiology, and

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myocardium ischemia (30.22%) was the main precipitant. Most of the patients in the ED received intravenous treatments, including diuretics (79.28%) and vasodilators (74.90%). Fewer patients in the ED received neurohormonal antagonists, and 25.94%, 31.12%, and 33.73% of patients received angiotensin converting enzyme inhibitors/angiotensin receptor blockers, beta-blockers, and spironolactone, respectively. The proportions of patients who were admitted, discharged, left against medical advice, and died were 55.53%, 33.58%, 7.08%, and 3.81%, respectively. All-cause mortalities at 30 days and 1 year were 15.30% and 32.27%, respectively.
Conclusions: Substantial details on characteristics and ED management of AHF were investigated. The clinical outcomes of AHF patients were dismal. Thus, further investigations of ED-based therapeutic approaches for AHF are needed.

Key words: Acute Heart Failure; Clinical Characteristics; Clinical Outcomes; Current Management; Emergency Department

Introduction

Acute heart failure (AHF) is a major public health problem worldwide, and clinical outcomes for AHF patients are dismal.[1] However, the treatments for improving the outcomes of AHF patients have been largely unchanged for decades.[2] This may be due to limited information on the initial phase of AHF care.

The emergency department (ED) has a pivotal role in the initial care of patients with AHF. Equipped with comprehensive diagnostic techniques and trained health-care providers, the ED can offer open access and expeditious management for AHF patients. Signs and symptoms of AHF are most severe at the time of initial presentation. With early diagnosis and therapy in the ED, significant improvements in clinical outcomes can be achieved.[3]

However, only four published investigations have assessed the clinical approach to AHF in the ED.[4-7] Regarding the current guidelines,[2,8,9] these four studies have indicated that AHF patients receive inadequate therapy in the ED.[4-7] In addition, information on long-term outcomes of these cohorts is limited.[4-7] To improve the practice and outcomes of AHF in ED care, data on the initial characteristics, treatments, and outcomes of AHF patients are needed,[10] particularly in China where previous data have been unavailable. Herein, a patient-centered, multicenter, observational, prospective study in the Beijing Acute Heart Failure Registry investigated the current ED management and clinical outcomes of AHF patients in Beijing.

Methods

Ethical approval

The study protocol conformed to the ethical guidelines of the *Declaration of Helsinki* as reflected in a priori approval by the Institutional Review Board of Fuwai Hospital (2010, approval number: 218). Data were collected only after detailed information regarding the study was provided and a signed written informed consent has been obtained from each patient.

Study settings and population

With consideration for differences among hospitals and geographic areas, the study incorporated EDs from 10 urban tertiary hospitals and 4 suburban secondary hospitals [Table 1].

Table 1: Bed size of the clinical settings

Bed size	Level of hospital	Number of hospitals, *n* (%)
500–1000	Tertiary	4 (28.57)
	Secondary	3 (21.43)
1000–1500	Tertiary	3 (21.43)
	Secondary	1 (7.14)
1500–2000	Tertiary	2 (14.29)
	Secondary	0
2000–2500	Tertiary	1 (7.14)
	Secondary	0

The total number of enrolled hospitals is 14.

Patients diagnosed with AHF were included in this study. In accordance with the guidelines,[8] AHF was diagnosed in patients based on the signs and symptoms of AHF (e.g., dyspnea, fatigue, edema of lower extremity, or rales), a history of cardiovascular diseases or noncardiovascular diseases which increase the cardiac preload or afterload, and any of the followings: symptomatic lung congestion confirmed by chest X-ray, left ventricular ejection fraction (LVEF) <50%, brain-type natriuretic peptide (BNP) >400 pg/ml, or elevated N-terminal proBNP >1500 pg/ml.[9] There were no specific exclusion criteria.

Study protocol

Baseline characteristics and treatment data were collected from the time of each patient's presentation in the ED to disposition. Follow-up data, including daily treatments and outcomes at 30 days and 1 year after the patient presented at the ED, were also collected by telephone interview.

The study consecutively enrolled patients in whom AHF was diagnosed in the ED at participating hospitals between January 1, 2011, and September 23, 2012. Every patient who received a diagnosis of AHF in the study was identified. At the ED presentation of signs and symptoms of AHF, the attending physician examined each patient and confirmed the diagnosis. A medical history was collected by reviewing of the patient's medical documents, and the results of imaging and laboratory tests were recorded if they were ordered in the ED. Data on ED care, including pharmacological and nonpharmacological medications provided, were collected from the time of the first treatment to the ED disposition.

Follow-up data were collected until November 30, 2013. Outcome information on death and readmission of enrolled

patients were collected. In the event of the patient's death, an immediate family member reported this. We also recorded the cause of each event, including acute decompensated heart failure (HF), acute coronary syndrome, sudden cardiac death, multiple organ dysfunction syndromes, cardiovascular catheterization, or surgical procedure, heart transplantation, stroke and any other noncardiovascular diseases.

The investigators were well trained in communicating with the patients and completing case report forms. The study centers were monitored at least once per year regarding the investigators' compliance with the protocol. After review by an independent monitoring team, the data were entered into a website database designed by the Information Technology Centre of Fuwai Hospital. The Monitoring Board of Giant Med-Pharma Service Group, Beijing, China, monitored the study.

Measurements

HF was classified as new-onset HF in the absence of a history of HF, or as worsening chronic HF if a previous diagnosis or hospitalization for HF was either documented or reported by the patient. Acute myocardial infarction was diagnosed based on the presence of classical chest pain, ST segment changes on electrocardiographs, and an elevated cardiac troponin I level. Dilated cardiomyopathy was diagnosed based on an echocardiographic-derived enlarged left ventricular diastolic diameter and reduced LVEF without any detectable primary causes. Atrial fibrillation on admission was identified based on the "f" wave on electrocardiographs. Upper respiratory infections were diagnosed based on histories of respiratory symptomatology and otherwise unexplained white blood cell counts >10 × 10^9/L for bacterial etiology.

The endpoints of this study were the 30-day and 1-year all-cause mortalities and readmissions. Death events were confirmed by checking the death certificates obtained from the residence registration system. Readmission was defined as either re-hospitalization or re-presentation to ED.

Statistical analysis

The data were reported as median (interquartile range) for the continuous variables, or as number (percentage) for the categorical variables. Missing values of baseline variables were supplemented when the missing rate was <20%. The missing value was supplemented with the median for continuous variables or the largest proportion category for categorical variables. There were no missing data on variables of treatments for the AHF patients. We estimated the 30-day and 1-year all-cause mortality rates and 95% confidence intervals (*CI*s) using the Kaplan–Meier method. The Division of Medical Research and Biometrics of Fuwai Hospital performed all statistical analyses independently. SAS software version 9.3 (SAS Institute, Cary, NC, USA) was used.

Results

The study consecutively enrolled 3335 patients, and the follow-up data were available in 92.80% of the entire cohort. The median short- and long-term follow-up periods were 31 (30–34) days and 372 (366–433) days, respectively [Figure 1].

Demographic characteristics and clinical profiles

Of the entire cohort, the median age was 71 (58–79) years, and female patients accounted for 46.84% [Table 2]. The main etiology of AHF was ischemic heart disease (43.27%), and the primary participant was myocardial ischemia (30.22%).

On admission, there were 36.10% patients presented with orthopnea, and 63.06% presented with New York Heart Association functional Class IV in the entire cohort. The median systolic blood pressure (SBP) was 130 (111-150) mmHg (1 mmHg = 0.133 kPa). The median LVEF was 44% (32-57%), and 40.81% patients presented with an LVEF ≥50%. Of 2795 patients with available BNP values, 86.40% had a BNP ≥400 pg/ml or N-terminal proBNP ≥1500 pg/ml.

Emergency department treatments and dispositions

Treatments and dispositions for AHF patients in the ED are shown in Table 3. Intravenous diuretics, vasodilators, and inotropes/vasopressors were frequently used in the EDs. Loop diuretic agents (78.77%) were the most commonly prescribed. Nitrates (57.72%) were the primary vasodilator agents prescribed in the EDs. Digitalis (17.18%) was the most frequently used inotropic agent administered to the patients with AHF. Oral drugs were given less to AHF patients in the EDs, and diuretics (41.23%) remained the most commonly prescribed oral drugs. For evidence-based medications, only 25.94% of the entire cohort received angiotensin converting enzyme inhibitors (ACEIs)/angiotensin receptor blockers (ARBs), 31.12% received beta-blockers, and 33.73% received spironolactone. Subsequent clinical decisions were also made in the ED. About half of the patients with AHF were admitted into the wards, and one-third were directly discharged home.

Clinical outcomes at 30 days and 1 year

Clinical outcomes of patients with AHF in either short- or long-term were poor [Table 4]. All-cause mortality rate at

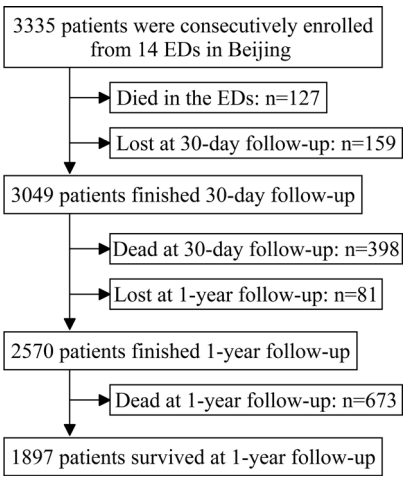

Figure 1: The flowchart of the study. ED: Emergency department.

Table 2: Demographics and clinical characteristics of AHF patients in the ED

Items	Overall cohort (n = 3335)
Demographics	
Age (years)	71 (58–79)
Female	1562 (46.84)
BMI (kg/m^2)	23.7 (21.5–26.0)
Number of patients with BMI >25 kg/m^2	1090 (32.68)
Natives	2362 (70.82)
New-onset heart failure	1669 (50.04)
Tertiary hospital	2956 (88.64)
Etiologies	
Ischemic heart disease	1443 (43.27)
Acute myocardial infarction	395 (11.84)
Prior myocardial infarction	726 (21.77)
Cardiomyopathy	536 (16.07)
Dilated cardiomyopathy	335 (10.04)
Hypertensive heart disease	578 (17.33)
Valvular heart diseases	345 (10.34)
Comorbidities	
Stroke/TIA	662 (19.85)
Diabetes mellitus	1003 (30.07)
COPD/asthma	504 (15.11)
Hypertension	1405 (42.13)
Chronic renal dysfunction	558 (16.73)
Atrial fibrillation on admission	928 (27.83)
Current smoker	727 (21.80)
Current alcoholic	495 (14.84)
Precipitating factors	
Myocardial ischemia	1008 (30.22)
Upper respiratory infection	871 (26.12)
Arrhythmia	633 (18.98)
Symptoms and signs	
Paroxysmal nocturnal dyspnea	586 (17.57)
Orthopnea	1204 (36.10)
Edema of lower extremity	1905 (57.12)
Jugular venous congestion	577 (17.30)
NYHA	
Class II	79 (2.37)
Class III	1153 (34.57)
Class IV	2103 (63.06)
Heart rate (beats/min)	96 (80–112)
SBP (mmHg)	130 (111–150)
<90	148 (4.44)
90–139	1756 (52.65)
≥140	1431 (42.91)
DBP (mmHg)	80 (70–90)
Imaging/laboratory	
LVEF (%)*	44 (32–57)
≥50*	850 (40.81)
Lung congestion on X-ray	2843 (85.25)
Hemoglobin (g/L)	126 (109–142)
White blood cell count (×10^9/L)	8 (6.2–10.6)
Albumin (g/L)†	36.3 (32.8–40)
Serum sodium (mmol/L)	138 (135–141)
Scr (μmol/L)	92 (71–126)
Scr (mg/L)	10.4 (08.1–14.3)
BUN (mmol/L)	8 (6–11.3)
BUN (mg/L)	212.5 (159.5–301.3)
BNP (pg/ml)‡	1280 (613–3170)
NT-proBNP (pg/ml)§	4920 (2426–10,324)
BNP >400 pg/ml or NT-proBNP >1500 pg/ml‖	2415 (86.40)
Arterial oxygen pressure (mmHg)	79 (69–108)

Data are reported as median (interquartile range) for the continuous variables, or as n (%) for the categorical variables. *Data were available in 2083 patients in the overall cohort; †Data were available in 2173 patients in the overall cohort; ‡Data were available in 777 patients in the overall cohort; §Data were available in 2038 patients in the overall cohort; ‖Data were available in 2795 patients in the overall cohort. AHF: Acute heart failure; BMI: Body mass index; BNP: Brain natriuretic peptide; BUN: Blood urea nitrogen; DBP: Diastolic blood pressure; COPD: Chronic obstructive pulmonary disease; ED: Emergency department; LVEF: Left ventricular ejection fraction; NT-proBNP: N-terminal pro-brain natriuretic peptide; NYHA: New York Heart Association; SBP: Systolic blood pressure; Scr: Serum creatinine; TIA: Transient ischemic attack; SD: Standard deviation.

30 days was 15.30%, and the all-cause mortality rate had doubled to 32.27% at 1 year. The outcome of all-cause mortality or readmission rates at 1 year was 59.49%.

Oral medications during the follow-up periods

Data on daily oral drugs of the AHF patients were also collected during the follow-up periods [Table 5]. Less than half of the AHF patients were given oral diuretics after surviving from the indexed AHF. For evidence based medications, only 28.67%, 39.91%, and 32.63% of the patients were treated with ACEIs/ARBs, beta-blockers, and spironolactone during the follow-up periods.

Discussion

Comparison of clinical characteristics

In this study, we first revealed the clinical profiles and outcomes of Chinese patients with AHF in the ED. Compared with the Chinese patients hospitalized with HF and those enrolled in the China Heart Failure Registry Study,[11] AHF patients in the ED were comorbid with less atrial fibrillation and renal dysfunction, presented with higher mean values of heart rate, SBP and serum creatinine, medicated with more intravenous agents and fewer oral drugs. Compared with other Asian patients, such as those enrolled in the Acute Decompensated Heart Failure Syndromes or Korean Acute Heart Failure Registry Studies,[12,13] AHF patients in our study presented with less hypertension. Compared with Western cohorts, such as those enrolled in the Acute Decompensated Heart Failure National Registry Study or EuroHeart Failure Survey II study,[14,15] the cohort in the Beijing AHF Registry was relatively younger, with a lower mean body mass index (BMI), and less frequently comorbid with hypertension, diabetes mellitus, or renal dysfunction.

Table 3: Medications for patients with AHF in the ED

Items	Overall cohort (n = 3335)
Pharmacological therapies	
Intravenous diuretics	2644 (79.28)
Loop diuretics	2627 (78.77)
Intravenous vasodilators	2498 (74.90)
Nitrates	1925 (57.72)
Isosorbide dinitrate	1714 (51.39)
Nitroglycerin	211 (6.33)
Sodium nitroprusside	396 (11.87)
Urapidil	67 (2.01)
Other intravenous vasodilator agents	110 (3.30)
Intravenous inotropes/vasopressors	1111 (33.31)
Digitalis	573 (17.18)
Dopamine	463 (13.88)
Dobutamine	6 (0.18)
Milrinone/amrinone	62 (1.86)
Levosimendan	4 (0.12)
Epinephrine/isoproterenol	3 (0.09)
Oral diuretics	1375 (41.23)
Oral ACEIs/ARBs	865 (25.94)
Oral beta-blockers	1038 (31.12)
Oral spironolactone	1125 (33.73)
Oral digoxin	819 (24.56)
Oral nitrates	860 (25.78)
Oral aspirin	1182 (35.44)
Oral statin	618 (18.53)
Oral calcium antagonists	324 (9.72)
Anticoagulant	749 (22.46)
Low molecular heparin	438 (13.13)
Warfarin	165 (4.95)
Bronchodilators	1319 (39.55)
Antibiotics	1357 (40.69)
Antiarrhythmic	248 (7.44)
Sedatives	211 (6.33)
Nonpharmacological therapies	
Nasal oxygen catheter	2825 (84.71)
Mask oxygen inhalation	288 (8.64)
CPAP/BiPAP noninvasive ventilation	58 (1.74)
Tracheal intubation	61 (1.83)
Hemodialysis	29 (0.87)
Ultrafiltration	5 (0.15)
Peritoneal dialysis	5 (0.15)
IABP	9 (0.27)
CAG + PCI	3 (0.09)
CAG	1 (0.03)
Carotid artery intervention	1 (0.03)
Temporary pacemaker	1 (0.03)
Chest drainage	3 (0.09)
Pericardiocentesis	1 (0.03)
Pulmonary embolectomy	1 (0.03)
Cardiac valve surgery	9 (0.27)
CABG	1 (0.03)
Other therapy	6 (0.18)
ED dispositions	
Inpatient admission	1852 (55.53)
Discharge	1120 (33.58)
Left against medical advice	236 (7.08)
Died in the ED	127 (3.81)
Length of stay (h)	38 (12-95)

Data are reported as median (interquartile range) for the continuous variables, or as n (%) for the categorical variables. ACEI: Angiotensin convert enzyme inhibitor; AHF: Acute heart failure; ARB: Angiotensin receptor blocker; Bi-PAP: Bi-level positive airway pressure; CABG: Coronary artery bypass graft; CAG: Cardio angiography; CPAP: Continuous positive airway pressure; ED: Emergency department; IABP: Intra-aortic balloon pump; PCI: Percutaneous coronary intervention; SD: Standard deviation.

Early initial treatments in the emergency department

Consistent with previous registry studies,[12-15] intravenous diuretic agents are the primary therapy to relieve the congestion of AHF. Per the class I recommendation in guidelines,[8,9,16-18] diuretics are consistently used for AHF patients in the clinical practices, but evidence regarding the survival benefits of diuretics is still limited. There are two studies reporting positive results,[3,19] In Ularitide Global Evaluation in Acute Decompensated Heart Failure Dyspnea study, early treatments in the ED setting of AHF patients were associated with substantial lessening of dyspnea.[3] Furthermore, an analysis of registry database found that delayed administration of intravenous diuretic was independently associated with a modest increased risk of in-hospital mortality.[19] These results suggest that administration of intravenous diuretic for AHF patients should be promptly initiated in the ED.

In addition to diuretics as a mainstay therapy, in the present study, we found that intravenous vasodilators were also frequently used, and these agents were more likely to be used in our cohort (74.90%) than in other registry cohorts (14.3–51.3%).[12-15] The most common intravenous vasodilator agents were nitrates, which were more likely to be administered to patients with coronary artery disease. In low-dose medications, intravenous nitrates contribute to dilating coronary artery and decreasing preload of the heart;[20] thus, symptoms of AHF could be alleviated. The median dosage of nitrates administered to our cohort was 50 (25–50) μg/min, which has mild influence on SBP. In addition, previous studies have reported that the early initiation of intravenous vasodilators in the ED may be associated with better clinical outcomes.[21-23] The latest recommendations on prehospital and early hospital management of AHF suggest that intravenous vasodilator therapy may be administered for symptomatic relief as an initial therapy in AHF patients with SBP ≥110 mmHg.[17] The latest recommendations from the European Society of Cardiology suggest that intravenous vasodilators could be used cautiously in AHF patients without SBP <90 mmHg or symptomatic hypotension.[16] Considering that only 4.44% of the patients in our study presented an SBP <90 mmHg, in the emergent phase of AHF, it appears that the

recommended therapy has been substantially implemented in this cohort.

Intravenous inotropic/vasopressor agents were also frequently administered to the patients in our study. There were 4.44% patients with AHF in the total cohort with SBP <90 mmHg. These patients needed inotropic/vasopressor agents to maintain a stable hemodynamic status. However, different types and doses of the agents execute various functions. The primary inotropic agents in our study were digitalis and dopamine. The updated recommendations from the Editorial Board of Chinese Cardiology suggest that intravenous digitalis could be used in AHF patients to reduce the recurrence of decompensation, and decrease in the heart rate of patients comorbid with atrial fibrillation.[9] In addition, dopamine was also recommended in the guidelines.[9] However, the mean dosage of intravenous dopamine administered in the patients in our study was relatively less than the recommended dosage (mean 103 ± 36 μg/min in our cohort compared with 250–500 μg/min in the guidelines). Low-dose dopamine was associated with increased renal blood flow and urine volume.[24] In fact, only a small proportion of the inotropic/vasopressor agents were used for their inotropic effects in our observation.

Notably, in contrast to the prevalent use of intravenous vasodilators in AHF patients, neurohormonal antagonists were underused in our cohort. These include beta-blockers (31.12%), ACEIs/ARBs (25.94%), and spironolactone (33.73%), although they have been proved independently to decrease the long-term mortality rate in HF patients and are recommended by the guidelines.[18] Fewer prescriptions by Chinese physicians in practice may be because of lack of awareness of these guidelines, caution to implement, or reluctance to adopt the medications. The AHF patients in our study were in relatively more severe condition, since 88.64% of the total participants were recruited from tertiary hospitals. Underutilization of neurohormonal antagonists in our study may be related to concerns over the risk of hypotension, renal dysfunction, hyperkalemia, or arrhythmias. Furthermore, in a crowded ED, physicians focus more attention on alleviating the more urgent symptoms and signs of AHF patients than improving long-term clinical outcomes.

Compared to medications administered in the ED, the proportion of patients given daily neurohormonal antagonists only slightly increased during the follow-up periods [Table 5]. After intensive intravenous therapy in the ED, AHF patients achieve hemodynamic stabilization. We hypothesized that these patients may have daily continued the oral medications they obtained in the ED, and not sought outpatient consultation for therapeutic adjustment after discharge. Indeed, ED care has a pivotal role in the compliance to guidelines that recommend daily therapy after discharge.

However, there are controversies about administration of neurohormonal antagonists to patients with AHF in the ED. Activation of the renin-angiotensin aldosterone system and sympathetic nervous system has been considered the compensating mechanism of AHF. Utilization of these neurohormonal antagonists may contribute to worsening cardiac function and subsequent poor outcomes. While some small-sample randomized controlled trials have shown little difference in outcomes between the AHF cohorts medicated with and without beta-blockers.[25,26] The AHF patients who used beta-blockers in the ED used beta-blockers more frequently after discharge,[25,26] while some observational studies have found that continuation or initiation of beta-blockers in AHF patients contributed to better survival.[27-30] Similar benefits from the early initiation of ACEIs/ARBs or spironolactone in patients with AHF have also been reported.[28,31,32] Thus, to improve the clinical outcomes of patients with AHF, neurohormonal antagonists may be initiated or continued among patients without contraindications in the ED. More solid evidence is needed.

Table 4: Incidence of short- and long-term clinical outcomes of patients with AHF

Outcomes	Incidence (95% *CI*)	
	30-day (%)	1-year (%)
All-cause mortality	15.30 (14.10–16.59)	32.27 (30.66–33.94)
All-cause readmission	15.64 (14.40–16.97)	46.89 (45.02–48.79)
All-cause mortality or readmission	28.14 (26.61–29.74)	59.49 (57.77–61.22)
Cardiovascular mortality	13.59 (12.45–14.82)	28.08 (26.53–29.71)
Cardiovascular readmission	10.54 (9.51–11.68)	37.38 (35.58–39.24)
Cardiovascular mortality or readmission	22.18 (20.77–23.66)	50.84 (49.07–52.62)

CI: Confidence interval; AHF: Acute heart failure.

Table 5: Oral medications for AHF patients during the follow-up periods

Medications	Patients with 30-day follow-up information (n = 3049)
Oral diuretics	1493 (48.97)
Oral ACEIs/ARBs	874 (28.67)
Oral beta-blockers	1217 (39.91)
Oral spironolactone	995 (32.63)
Oral digoxin	769 (25.22)
Oral nitrates	1102 (36.14)
Oral aspirin	1147 (37.62)
Oral statin	715 (23.45)
Oral calcium antagonists	448 (14.69)
Warfarin	283 (9.28)

Data are reported as n (%) for the categorical variables.
ACEIs: Angiotensin convert enzyme inhibitors; AHF: Acute heart failure; ARBs: Angiotensin receptor blockers.

Differences in emergency department dispositions

Another interesting point is the differences in ward admission rates of AHF patients visiting the ED. In North America and Europe, the majority (80–90%) of AHF patients in EDs are admitted into the hospitals.[2,4] In Beijing, only

55.53% of patients with AHF in the ED were admitted, and up to one-third of the overall cohort were directly discharged. It may be reasonable to consider that in Beijing the ED partially takes the role of hospitalization of AHF patients. On the one hand, we reckon that 88.64% of patients with AHF in the present registry were recruited from 10 tertiary hospitals, which had limited medical beds in the intensive care units. On the other hand, AHF patients in Beijing require urgent medical care and may prefer expeditious symptom relief to costly inpatient hospitalization. Moreover, the former could be achieved by a visit to the ED, where usually staffed by cardiologists and equipped with echocardiographic machines.[33] In addition, the relatively longer time the AHF patients spent in the ED could confirm these facts.

Underlying reasons for poor outcomes

The all-cause mortality for AHF patients in our cohort in the ED was 3.81%, which increased to 15.30% in 30 days, and doubled to 32.27% in 1 year. The mortality of AHF patients in our registry was higher than those reported in the Atherosclerosis Risk in Communities Study (29.5%)[34] and other registries (17.4–20.5%).[15,35-37]

The observed variations in mortality among the different studies may be due to differences in patient ethnic backgrounds, the severity of the patients' clinical conditions, and the quality of healthcare provided (e.g., prescription of evidenced drugs and admission rates). In contrast to previous registries regarding AHF, patients in our study showed a significantly lower median BMI (23.7 kg/m^2) than did other cohorts (26.8–29 kg/m^2).[15,34-37] Since low BMI has been related to poor clinical outcome in AHF patients,[38] the lower BMI of our patients may partly explain their poor outcomes in our study. AHF patients enrolled from the ED may be in more severe condition than hospitalized AHF patients.[36,37] In addition, the status of AHF patients in our cohort may be more severe because they were largely enrolled from tertiary hospitals. Apart from the severity of AHF in the patients enrolled in our cohort, the relatively low rate of inpatient admission may mean insufficient treatment of these patients. Thus, many sick patients may have been discharged before fully stabilized. What is more important, as noted above, is that the underutilization of neurohormonal antagonists in the EDs and during the follow-up periods may account for poor clinical outcomes in our cohort. Although it has not been fully evidenced, the utilization of digoxin may contribute to the poor outcomes in patients with HF.[16] To decrease the mortality and readmission rates of patients with AHF, patients should be offered sufficient medical resources, and neurohormonal antagonists should be used in the ED and during stable periods. We found that both clinical characteristics and management may contribute to the dismal outcomes of AHF patients in our study.

Study limitations

This study had limitations that merit comments. First, not all of the eligible patients were enrolled in the study, but we endeavored to recruit consecutively every patient who presented with features suggesting AHF, and signed informed consent form was obtained from each patient or immediate family member if the patient was severely ill. Second, participants enrolled from tertiary hospitals, which are more likely to admit severely ill patients, accounted for 88.64% of the overall cohort. Further studies should consider enrolling a range of clinical settings and samples. Finally, this study was performed in Beijing, and the patients and level of medical care may not be representative of China nationally.

In summary, our study provides substantial information regarding the characteristics and current clinical practices in ED care of AHF patients. One-year clinical outcomes were observed. To improve the poor survival of the patients, the early initiation of recommended treatments for AHF care should be promoted in the ED. Furthermore, investigations of the associations between ED therapeutic approaches and outcomes of AHF patients are urgently needed.

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Conflicts of interest

There are no conflicts of interest.

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