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Predictors of 30-day mortality in patients admitted to emergency departments for acute heart failure

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ABSTRACT

Objectives: Acute heart failure (AHF) is a leading cause of admission in emergency departments (ED). It is associated with significant in-hospital mortality, suggesting that there is room for improvement of care. Our aims were to investigate clinical patterns, biological characteristics and determinants of 30-day mortality.
Methods: We conducted a single site, retrospective review of adult patients (≥18 years) admitted to ED for AHF over a 12-month period. Data collected included demographics, clinical, biological and outcomes data. Epidemiologic data were collected at baseline, and patients were followed up during a 30-day period.
Results: There were a total of 322 patients. Mean age was 83.9 ± 9.1 years, and 47% of the patients were men. Among them, 59 patients (18.3%) died within 30 days of admission to the ED. The following three characteristics were associated with increased mortality: age > 85 years (OR = 1.5[95%CI:0.8–2.7], $p = 0.01$), creatinine clearance <30 mL/min (OR = 2.6[95%CI:1.4–5], $p < 0.001$) and Nt-proBNP >5000 pg/mL (OR = 2.2[95%CI:1.2–4], $p < 0.001$). The best Nt-proBNP cut-off value to predict first-day mortality was 9000 pg/mL (area under the curve (AUC) [95%CI] of 0.790 [0.634–0.935], $p < 0.001$). For 7-day mortality, it was 7900 pg/mL (0.698 [0.578–0.819], $p < 0.001$) and for 30-day mortality, 5000 pg/mL (0.667 [0.576–0.758], $p < 0.001$).
Conclusions: Nt-proBNP level on admission, age and creatinine clearance, are predictive of 30-day mortality in adult patients admitted to ED for AHF.

1. Introduction

Acute heart failure (AHF) is a leading cause of admission in emergency departments (ED) in Western countries. Its prevalence is estimated at between 1 and 2% of the adult population and is higher than 10% in patients older than 70 years [1–3]. Recommendations for diagnosis and management of AHF were issued by the European Society of Cardiology (ESC) in 2016 [4] and by the American Heart Association (AHA) in 2013 [5] with an update in 2016 [6]. Initial diagnosis is based on clinical history, physical examination and electrocardiogram (ECG). Some abnormalities on ECG provide information on aetiology and may give indication for therapy. The plasma concentration of natriuretic peptides (B-type natriuretic peptide [BNP] and N-terminal pro-BNP [Nt-proBNP]) can be used as a complementary diagnostic test. Echocardiography provides crucial information on chamber volumes, ventricular systolic and diastolic function, valve function and pulmonary hypertension [5–7]. The information provided by the above-mentioned tests and clinical evaluation allow for initial treatment plan in most patients.

AHF is associated with significant in-hospital mortality and high rates of rehospitalization after discharge [8]. Early identification of patients at high risk of death might help emergency physicians to optimize their prompt management and thus expect an improvement in prognosis. The aim of this study was to determine the clinical and biological patterns that could successfully predict the short-term prognosis (30-day mortality) of patients with AHF at the time of admission to the ED.

2. Methods

2.1. Study design and population

We conducted a single site, retrospective study to assess risk factors associated with 30-day mortality in patients with AHF. We reviewed the clinical course of 322 patients, 18 years or older, admitted to ED with the primary diagnosis of AHF, in a large academic center, between January 1 and December 31, 2014. The outcome in this study was defined as 30-day mortality. Patients surviving and not surviving the 30-day period after discharge were matched with their clinical and biological data.

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Data were anonymized and stored electronically. The study was conducted in accordance with the principles of the Declaration of Helsinki. According to French law, institutional review board approval was not requested due to the retrospective design of the study and the use of anonymous data only.

2.2. Study protocol

Data collection was performed using patients' computerized medical records. Final diagnosis at ED discharge was used for inclusion and medical records were retrospectively reviewed to ensure that the 2012 ESC Guidelines [1] criteria were met for the diagnosis of AHF. Medical history, demographics, clinical and biological data were collected with the following software: ResUrgences® (Intuitive, Paris, France), Hopital Manager® (Softway Medical, Meyreuil, France) and CyberLab® (Clinical Biology Institute, Brussels, Belgium). All data were recorded at baseline, and patients' vital status at 30 days was ascertained by consulting hospital registries. In case of death within 30 days from ED admission, the interval (days) between admission and death was also recorded. When patients returned home before the thirtieth day, vital status was ascertained by telephone contact with the patient's general practitioner. No patient was lost during the 30-day follow up. For patients who presented to the ED more than once, only data from their first visit were included in the study. According to ESC Guidelines, patients were classified into six clinical presentations of AHF: acute pulmonary edema, cardiogenic shock, acutely decompensated chronic heart failure (CHF), hypertensive heart failure (HF), isolated right HF and acute coronary syndrome (ACS) with HF. Severe renal insufficiency was defined as a creatinine clearance according to Modification of Diet in Renal Disease (MDRD) formula lower than 30 mL/min/1.73m^2.

2.3. Statistical analysis

Data were recorded using Excel® software (Microsoft Corporation, Richmond, USA). Statistical analyses were performed using SPSS 21.0 software (IBM Corporation, Armonk, NY, USA). Comparative univariate analyses were performed using the Chi-square test and Fisher's test for percentage comparisons. Differences in continuous variables were evaluated by the Student *t*-test. The log-rank test, odd-ratios (OR) with 95% confidence intervals (CI) and receiver operating characteristic (ROC) analyses were used to determine the prognostic value of clinical and biological patterns on 30-day mortality. All tests were two-tailed and statistical significance was considered for $p \leq 0.05$.

3. Results

Overall, 322 patients with a primary diagnosis of AHF and complete data were analyzed. Their mean age was 83.9 ± 9.1 years and 47% of them were men (Table 1). Sixty percent of the patients were older than 85 years. Evidence of chronic heart failure was reported in 88.8% of cases. The most common co-morbidities were hypertension (74.5%) and atrial fibrillation (54.3%). Acutely decompensated CHF was the most frequent clinical presentation (58.1%). Acute pulmonary edema was present in 14.3%, while hypertensive HF, ACS with HF, isolated right HF and cardiogenic shock was reported respectively in 11.5, 6.2, 5.6 and 4.3% (Table 1).

A total of 59 (18.3%) patients died within 30 days of admission to the ED. Their clinical presentations were acutely decompensated CHF in 44.1% of cases, and acute pulmonary edema, cardiogenic shock and ACS with HF in 16.9, 15.2 and 11.8% of cases, respectively (Table 1). On univariate analysis, clinical pictures associated with 30-day

Table 1
SD : Standard Deviation, COPD : Chronic Obstructive Pulmonary Disease, HF : Heart Failure, MDRD : Modification of diet in renal disease.

Variables	Overall population (n = 322)	Survival patients (n = 263)	Not survival patients (n = 59)	OR	95%CI	p-Value
Demographic data						
Age (y), mean ± SD	83.9 ± 9.1					
Age > 85 y	192 (59.6%)	150 (57%)	42 (71%)	1.5	0.84–2.68	0.01
Gender (male)	150 (47%)	122 (46%)	28 (47%)	1.04	0.59–1.84	0.9
Previous medical history						
Hypertension	240 (74.5%)	200 (76%)	40 (67.6%)	0.54	0.24–1.18	0.16
Diabetes	97 (30.1%)	81 (30.8%)	16 (27%)	0.84	0.44–1.57	0.57
COPD	44 (13.6%)	38 (14.4%)	6 (10.1%)	0.67	0.27–1.67	0.38
Chronic renal failure	67 (20.8%)	51 (19.4%)	16 (27%)	1.54	0.8–2.96	0.18
Coronary heart disease	106 (32.9%)	93 (35.3%)	13 (22%)	0.51	0.26–1.005	0.05
Valvular heart disease	66 (20.4%)	50 (19%)	16 (27%)	1.57	0.82–3.04	0.13
Dyslipidemia	102 (31.7%)	89 (33.8%)	13 (22%)	0.55	0.28–1.076	0.07
Chronic heart failure (CHF)	286 (88.8%)	237 (90.1%)	49 (82.8%)	1.29	0.6–2.76	0.02
Atrial fibrillation	175 (54.3%)	151 (57.4%)	24 (40.6%)	0.51	0.29–0.90	0.02
Clinical presentation						
Acute pulmonary oedema	46 (14.3%)	36 (13.7%)	10 (16.9%)	1.29	0.6–2.76	0.21
Cardiogenic shock	14 (4.3%)	5 (1.9%)	9 (15.2%)	9.29	2.99–28.88	<0.001
Isolated right heart failure (HF)	18 (5.6%)	15 (5.7%)	3 (5.1%)	0.89	0.25–3.06	0.81
Acutely decompensated CHF	199 (61.8%)	170 (64.6%)	29 (49%)	0.53	0.3–0.93	0.02
Hypertensive HF	37 (11.5%)	33 (12.5%)	4 (6.8%)	0.51	0.17–1.5	0.21
ACS with HF	20 (6.2%)	13 (4.9%)	7 (11.8%)	2.6	0.98–6.8	0.02
Clinical patterns						
Heart rate (beats per minute)						
40–120	297 (92.2%)	244 (92.8%)	53 (89.8%)	0.69	0.26–1.80	0.52
>120	25 (7.8%)	19 (7.2%)	6 (10.2%)	1.37	0.53–3.59	0.52
Systolic blood pressure < 90 mm Hg	16 (5%)	6 (2.3%)	10 (16.9%)	13.6	3.49–53	<0.001
Biological patterns						
Nt-proBNP (pg/mL)						
5000–9999	59 (18.3%)	51 (19.4%)	8 (13.5%)	2.16	1.16–4.02	<0.001
10,000–14,999	35 (10.9%)	32 (12.2%)	3 (5.1%)	2.85	1.55–5.23	<0.001
15,000–29,999	30 (9.3%)	21 (8%)	9 (15.2%)	5.1	2.48–10.4	<0.001
>30,000	28 (8.7%)	13 (4.9%)	15 (25.3%)	10.3	3.5–30.5	<0.001
MDRD <30 mL/min/1.73m^2	61 (18.9%)	42 (16%)	19 (32.1%)	2.6	1.38–5	<0.001

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