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Ana Catarina Pinho Gomes

Characterisation of Acute Heart Failure Hospitalisations in a Portuguese Cardiology Department

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CHARACTERISATION OF ACUTE HEART FAILURE HOSPITALISATIONS IN A PORTUGUESE CARDIOLOGY DEPARTMENT

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Abstract

Aims: We describe the clinical characteristics, management and outcomes of patients hospitalised with acute heart failure (AHF) in a south western European Cardiology Department. We sought to identify the determinants of length of stay (LOS) and heart failure (HF) rehospitalisation or death during a 12-months follow-up period.

Methods and Results: This was a retrospective cohort study including all patients admitted during 2010 with either a primary or secondary diagnosis of AHF. Death and readmission were followed through 2011.

Amongst the 924 patients admitted, 201 (21%) had AHF, 107 (53%) of which with new-onset AHF. The main precipitating factors were acute coronary syndrome (ACS) (63%) and arrhythmia (14%). The most frequent clinical presentations were heart failure (HF) after ACS (63%), chronic decompensate HF (47%) and acute pulmonary oedema (21%). On admission 73% had left ventricular ejection fraction (LVEF) < 0.50. Median LOS was 11 days and in-hospital mortality was 5.5%. Rehospitalisation rate was 21% and 24% at six and 12 months respectively. All-cause mortality was 16% at 12 months. The independent predictors of re-hospitalisation or death were HF hospitalisation during previous year (Hazard Ratio – HR – 3.177), serum sodium < 135 mmol/L on admission (HR 1.995), atrial fibrillation (HR 1.791) and reduced LVEF (HR 0.518).

Conclusions: Our patients more often presented new-onset AHF, due to an ACS, causing reduced LVEF. Several predictive factors of death or rehospitalisation were identified that may help to select high risk patients to be followed in a HF management programme after discharge.

Key words

Acute heart failure; acute coronary syndrome; management; prognosis; length of stay; re-hospitalisation, mortality.

Introduction

Acute heart failure (AHF) is a major public health concern because of its increasing prevalence and associated high morbidity, mortality and costs (1-5). Despite being one of the most frequent reasons for hospitalisation in western countries, it has received much less attention than chronic heart failure (CHF) and, thus, large scale studies specifically addressing AHF are relatively scarce (6, 7).

AHF is associated with a high rate of rehospitalisation but little is known regarding the most relevant predictive factors. Thus, it is important to develop appropriate predictive models that might help us to adequately stratify AHF patients and improve their management and follow-up (8).

Moreover, in spite of several studies conducted in Europe and the USA on the clinical characteristics, treatment and outcome of AHF patients, very limited information is available on this subject in Portugal (9).

In the present study we describe the clinical characteristics, hospital management and outcomes of AHF patients admitted to a Portuguese Cardiology Department, and present a predictive model for readmission or death at 12-months in this population.

Methods

Study description

This is an observational hospital-based retrospective cohort study, conducted at the Cardiology Department of Hospital de S. João, Porto, Portugal. Demographic, clinical and follow-up data collection was done between the February 1st, 2011 and the December 31st, 2011, ensuring a minimum follow-up of one year for all patients.

Inclusion criteria

All patients admitted to the Cardiology Department between January 1st and December 31st 2010, were screened. Paper and computer-based clinical records from the 924 patients admitted to the Cardiology Department during the study period were retrieved and analysed by one investigator in order to find eligible patients, meeting one of the following inclusion criteria:

- Primary diagnosis of AHF according to ESC criteria (3);
- AHF secondary to another acute cardiac event (3);
- Acute myocardial infarction classified as Killip II-IV.

Exclusion criteria

Programmed hospitalisations or hospitalisations in the context of cardiac surgery were considered exclusion criteria.

In order to avoid duplicate records, readmissions to the hospital during the study period were not counted as new cases.

Objectives

The primary objective of this study was to describe the clinical characteristics, hospital management and outcomes of patients hospitalised with AHF.

The secondary objectives were:

- The comparison of patients with AHF and an ACS as the precipitating factor versus patients with AHF and no ACS;
- The comparison of drug prescriptions on admission and at discharge;
- The identification of factors associated with a longer length of stay (LOS);
- The identification of risk factors for HF rehospitalisation or death.

Data collection

Patient demographics, cardiovascular risk factors, comorbidities, history of cardiac disease or HF as well as the results of ECG, haemodynamic, echocardiographic examinations and laboratory tests were collected. Data on the aetiology and the possible precipitating factors of AHF, drug prescriptions before and following admission, as well as data on concomitant medication and main diagnostic or therapeutic procedures performed during the hospitalisation were collected, too. The hospital LOS of patients was also recorded and in the case of patients transferred to another hospital or to another ward, it was recorded at the time of transfer. Data regarding death or rehospitalisation were obtained from the patient's electronic record and did not include admissions to another hospital nor death not registered in the hospital administrative or clinical database. For all alive patients, the follow-up period finished on the December 31st, 2011.

Data analysis

Categorical variables were presented as counts and percentages, and quantitative variables as means and standard deviation (SD) or medians and 25^{th} percentile – 75^{th} percentile (p25 – p75) as appropriate, depending on the empirical distribution of the variables.

Subgroups of patients were compared by using chi-square test or Fisher's exact test for categorical variables and T-test and Mann-Whitney rank-sum tests for symmetrical and asymmetrical quantitative variables, respectively. The normality of the distribution of quantitative variables was assessed by the Kolmogorov-Smirnov test.

Simple and multiple linear regression models were used to analyse the variable LOS, which was logarithmically transformed in order to normalise its initially asymmetrical distribution.

Survival analysis was used to analyse determinants of rehospitalisation or death. For graphs of survival probability, the crude effect of each variable was tested with the Log-rank test and the multivariate analysis was performed using the Cox regression model. In the final analysis, all variables were taken into account to obtain a fully adjusted model. For each variable the assumption of proportional hazards was tested.

In the univariate and multivariate regression analysis, the dependent variables were LOS and an adverse event, defined as HF rehospitalisation or death during the follow-up period. The independent variables were age, sex, ischemic aetiology, type (de novo versus decompensate chronic HF), history of HF hospitalisation in the previous 12 months, obesity, diabetes mellitus, ICCU (intensive cardiac care unit) admission, LOS and the following admission findings: systolic blood pressure < 100 mmHg, heart rate < 70 beats per minute, serum sodium < 135 mmol/L, serum potassium > 4,3 mmol/L, creatinine clearance < 30 ml/min, anaemia (haemoglobin lower than 130 g/L in men and 120 g/dL in women), serum B-type natriuretic peptide (BNP) > 500 pg/ml, atrial fibrillation (AF), ventricular ejection fraction

(LVEF) < 50%. In the independent variables, the variable aetiology was included instead of ACS as precipitating factor, because there was close association between the two variables but the aetiology was considered more informative.

All tests were two-sided and p values less than 0.05 were considered as indicating significant differences. Analysis was carried out using the statistical software SPSS 18.0 for Windows.

Ethics

The study was carried out according to the principles of the Declaration of Helsinki and approved by the hospital ethics committee.

Results

Baseline characteristics

From a total of 924 patients admitted to the Cardiology Department over one year, 201 (21%) presenting with AHF were enrolled. Patients' baseline characteristics are summarised in Tables 1 and 2. New-onset AHF occurred in more than 50% of cases. Hypertension and coronary heart disease (CHD) were the most prevalent underlying diseases, but all the cardiovascular risk factors were rather frequent. The most common precipitating factor was ACS (63.3% of patients), immediately followed by arrhythmia (14.4% of patients). The most frequent clinical presentation was, by far, HF in the context of ACS, followed by chronic decompensate heart failure (CDHF) and pulmonary oedema. Interestingly, pulmonary oedema was approximately twice as common in patients presenting with ACS than in those with no ACS, while CDHF was approximately threefold more frequent in those without ACS than in those with ACS. The majority of patients had reduced LVEF on admission.

Patients presenting with ACS were significantly younger, more often women and less likely to have previous HF history; they had more frequent chronic hypertension and CHD. On the other hand, patients without ACS more frequently had valvular disease and dilated cardiomyopathy, left ventricular hypertrophy pattern on the ECG, larger left atrium diameter and more frequently had AF.

Hospital course and management

Echocardiographic examination and BNP were performed in most patients and the majority was admitted to the ICCU and submitted to coronary angiography. The overall use of in-hospital resources was comparable in both ACS and non-ACS groups (Table 3), although a higher proportion of ACS patients was admitted to the ICCU. Non-invasive ventilation, IV nitrates and diuretics were the basis of therapy and the first two were more often used in ACS patients.

Discharge characteristics

Comparing admission with discharge, we observed a significant drop in body weight (median -3 kg [p25 – p75: -6 – 0]; $p<0.001$), systolic blood pressure (mean -17.1 mmHg; SD = 29.7; $p<0.001$), heart rate (mean -18.7 bpm; SD = 32.4; $p<0.001$) and BNP (median -203.5 pg/dl [p25 – p75: -850.5 – 74.9]; $p<0.001$). There was no improvement in creatinine clearance, serum sodium and potassium as well as in serum haemoglobin. The rate of prescription of all cardiovascular drugs increased from admission to discharge, apart from digoxin and calcium channel blockers (Figure 1).

Hospital stay and follow-up

The total length of hospital stay was similar in both groups (median 11 days). In-hospital mortality rate was 5.5% and was not significantly different between the two groups. Rehospitalisation rate for HF was 20.9% and 23.9% at six and 12 months, respectively. Most readmissions occurred within six weeks after the index event. All-cause mortality was 10.9% and 15.9% at six and 12 months, respectively. The variables independently associated with a longer LOS were history of HF hospitalisation in the previous year (p=0.040), BNP > 500 pg/ml (p <0.001) on admission and ICCU admission (p= 0.002) (Table 5S in Supplementary data).

The most important variables predictive of the combined endpoint of rehospitalisation or death during the follow-up were history of HF hospitalisation in the previous year (Hazard Ratio – HR = 3.177 [1.405 – 7.185]), serum sodium < 135 mmol/L on admission (HR = 1.995 [1.032 – 3.856]), AF (HR = 1.791 [1.021 – 3.142]) and reduced LVEF (HR = 0.518 [0.268 – 0.998]) (Table 6S in Supplementary data).

Discussion

Hospitalisations due to AHF are associated with high mortality and readmission rates, representing about 70% of all costs associated with HF (10, 11). They typically occur in Internal Medicine or in Cardiology departments and thus most studies include a mixed population from both proveniences.

Clinical information provided by hospital-based studies is crucial to our understanding of the contemporary clinical characteristics of AHF, including key prognostic factors and details

regarding clinical presentation and medical therapy. Therefore, we conducted an observational hospital-based retrospective study in order to identify the particular characteristics of AHF patients exclusively admitted to a Cardiology department.

Demographics, underlying diseases, type of onset, precipitating factors and clinical presentation of AHF

In our study, the mean age and the gender distribution of the patients were similar to that of previous AHF registries in EU and other parts of the world (7, 12) and in the USA (13). However, our patients were younger and more often male than those included in an earlier Portuguese study performed in Internal Medicine wards (9). Contrary to many previous reports, the majority of our patients had reduced LV function, which was perhaps a consequence of the high prevalence of ACS in our population. Interestingly a recent Italian study (14) also showed that patients admitted to Cardiology departments were younger, more often male and more likely to have reduced LVEF than patients in Internal Medicine wards, which is coincident with our findings when compared with the mentioned Internal Medicine Portuguese study (9).

Cardiovascular diseases were common amongst our patients, with CHD and hypertension being the most frequent, as observed in previous international surveys (7, 12, 13). Conventional cardiovascular risk factors, such as obesity, diabetes and dyslipidemia, were also very frequent. The prevalence of noncardiovascular comorbidities was similar to that observed in previous surveys (12, 13). Chronic pulmonary diseases, anaemia and kidney disease were common, with an average creatinine clearance compatible with renal insufficiency grade 3. This was similar to the observed in ADHERE (13), reinforcing the importance of heart-kidney interaction in AHF.

Most patients had new-onset HF, particularly those with an ACS as the precipitating factor. The prevalence of *de novo* AHF was much higher than that in EHFSII (12) and ALARM-HF (7, 13).

ACS was the precipitating factor in nearly two-thirds of the patients. This was almost twofold the observed in those reports (7, 12) that included patients of a mixed provenience, from Internal Medicine and Cardiology departments. Arrhythmias were the second most frequent precipitating factor and were more common in the non-ACS group. They were mostly of a supraventricular origin which is coincident with previous reports of the high frequency of AF amongst AHF patients.

Similarly to EHFSII (12) and ALARM-HF (7) two of the most common clinical presentations of AHF in our population were CDHF and pulmonary oedema.

Diagnostic investigations and treatment

An ECG, a BNP measurement and an echocardiographic examination were performed in nearly all patients on the admission or, alternatively, within the first days of hospitalisation, showing good adherence to ESC HF guidelines (3). The high prevalence of ACS explains why coronary angiography was performed in more than two-thirds of our patients and why a considerably higher percentage of them was admitted to the ICCU, comparatively with the observed in EHFSII (12).

As previously reported by others (7, 12, 13), ventilatory support and intravenous diuretic therapy played a central role in the acute management of the patients. Non-invasive ventilation was used in the majority of patients. The frequency of administration of intravenous nitrates was similar to that previously reported (7, 12, 13) and the use of inotropes was nearly half of that registered in those surveys. Approximately one-third of the patients

presented with a ST segment elevation myocardial infarction and was submitted to percutaneous coronary intervention. This was considerably more frequent than in ADHERE (13) and EHFSII (12).

The observed decrease in body weight, heart rate and BNP at discharge reflected the clinical improvement with therapy. Interestingly, blood pressure dropped and no improvement in serum creatinine value was observed which demonstrates the limitations of current therapeutic options regarding kidney function.

The prescription of drugs recommended for HF, CHD and hypertension significantly increased from admission to discharge. However, the proportion of patients taking angiotensin converting-enzyme inhibitors or angiotensin receptor blockers (ACEIs/ARBs) was inferior to that in EHFSII (12); a possible explanation for this may be the proportion our patients (26.8%) with HF and preserved LVEF, in which these drugs are not formally indicated. Conversely, the levels of prescription of beta-blockers (BB), statins, aspirin, clopidogrel and nitrates, at discharge, supplanted that of the EHFSII (12), possibly because ACS was more frequent in our study than in that survey and those drugs are recommended as secondary prophylaxis of ACS.

Length of stay, outcomes and follow-up of AHF patients

The overall LOS was 11 days, 2 days longer than that in EHFSII (12) and ALARM-HF (7) and almost threefold the reported in ADHERE (13). The median ICCU stay was 6 days, twice the reported in EHFSII (12) and ALARM-HF (7). However, in our case, the in-hospital mortality rate was 5.5%, which was lower than in EHFSII (12) (in-hospital mortality 6.6%), and ALARM-HF (7) (in-hospital mortality 12%).

The large scale US surveys ADHERE (13) and OPTIMIZE-HF (15) reported an in-hospital mortality of nearly 4%, which is even lower than ours. Nonetheless, this low in-hospital mortality, that in part can be a consequence of the very short LOS, was counterbalanced by a higher readmission rate and long-term mortality (for instance, OPTIMIZE-HF (15) showed 90-day rehospitalisation rates and mortality of 30%, and 35%, respectively). One may speculate that a longer hospital stay could possibly enable a better patient stabilisation, thus reducing long-term morbimortality.

Our results reinforce the notion that AHF hospitalisations are associated with poor prognosis, with more than one-third of the patients dying or being rehospitalised during the subsequent year.

Our patients with new-onset AHF had a more severe clinical presentation, consistently with ALARM-HF (7) observation. However, in the long run, patients with CDHF had a higher risk of rehospitalisation or death.

The probability of being rehospitalised was highest during the first weeks after discharge from index event and this attests the need of an early medical appointment with the patients after discharge, preferably in the setting of a HF management programme (3).

Predictive factors of a longer LOS and an adverse outcome

The predictive factors for rehospitalisation after an AHF event remain largely unexplored in the literature (16). In our study a baseline BNP value higher than 500 pg/ml was the most relevant factor associated with a longer LOS, followed by admission to the ICCU, both indicating a more severe initial clinical picture. The history of HF hospitalisations in the previous year, a recognized marker of bad prognosis (3), was also associated with a longer hospital stay. Furthermore, it was associated with a threefold increase in the risk of dying or

being rehospitalised during the year after discharge. AF also showed a significant association with an increased risk of rehospitalisation or death, which is in line with the literature derived from the CHF scenario (3, 17-21).

Other variables also independently associated with a poor long-term outcome were the history of previous HF hospitalisation, serum sodium <135 mmol/L on admission and reduced LVEF. Together they can help to better select high risk patients for the inclusion into a HF management programmes. This is relevant since these programmes can reduce rehospitalisations and mortality, are cost-effective and have a ESC class of recommendation I with a level of evidence A for HF patients recently hospitalised (3). However, in many countries, due to financial constraints and insufficient manpower, it is not possible to admit all HF hospitalised patients into a HF management programme. Thus, identifying the predictors of increased vulnerability can help to select the patients most in need of these programmes.

Patients with versus patients without an ACS as the precipitating factor

Patients with an ACS typically presented dilated left atria, preserved left ventricular dimensions and reduced LVEF on admission. Left atrial dilation was possibly a consequence of the history of hypertension, present in more than 70% of them. A similar percentage of those patients had no previous history of HF, explaining why, in the early days of new-onset AHF due to an ACS, the left ventricle would not have had enough time to suffer eccentric remodelling.

Patients with an ACS had more frequent and longer ICCU admissions and were more often treated with non-invasive ventilation and intra-aortic balloon pump than those without an ACS. This suggests a worse initial clinical course in the case of ACS patients as compared with those without an ACS. Nonetheless, there was no difference in total hospital LOS, re-

admission rate, in-hospital mortality and mortality at 6-months or 12-months between the groups.

Study limitations

This study holds an inherent limitation derived from its retrospective nature. An additional drawback has to deal with the possibility of the absence of reporting of death or rehospitalisation occurring out of our institution during the follow-up. This could in part be an explanation for the observed low long-term rates of rehospitalisation and death. However, due to the existence of consistency in the referral of patients, we believe that probably was not a major problem. Furthermore, that cannot explain the low rates of in-hospital mortality we also found in our study.

Conclusion

Patients admitted to our Cardiology department with AHF more typically presented new-onset AHF, in the context of an ACS, causing deterioration in left ventricular systolic function. They had a longer LOS but a lower 12-months readmission rate and mortality than reported in US and EU studies. The independent predictors of rehospitalisation or death were HF hospitalisation during previous year, serum sodium < 135 mmol/L on admission, AF and reduced LVEF. They can help in the selection of the patients in need of follow-up in a HF management programme after discharge.

Conflicts of Interest: none declared.

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Legends

Figure 1: Oral medications on admission and at discharge for AHF patients.

McNemmar test for related samples.

CCB, calcium-channel blocker; MRA, mineralocorticoid receptor antagonist.

Tables

Table 1: Underlying diseases, type of onset, precipitating factors and clinical presentation of AHF

	All patients (n=201)	Patients with ACS (n=127)	Patients without ACS (n=74)	p-value
Number (%)	201	127 (63.2)	74 (36.8)	
Age, mean (SD)	69 (13)	71 (11)	66 (14)	0.018
Male (%)	60.7	55.1	70.3	0.034
Body mass index (kg/m^2), mean (SD)	26 (4)	26 (4)	26 (4)	0.459
Cardiovascular diseases (%)				
Chronic Hypertension	66.2	72.4	55.4	0.014
Coronary artery disease	38.3	44.9	27.0	0.012
Valvular disease	14.9	5.5	31.1	<0.001
Dilated cardiomyopathy	7.5	1.6	17.6	<0.001
Comorbidities (%)				
Diabetes mellitus	37.8	37.0	39.2	0.758
Obesity	31.3	22.8	45.9	0.001
Dyslipidemia	51.2	54.3	45.9	0.251
Tobacco smoking	35.3	37.8	31.1	0.337
Chronic pulmonary disease	12.4	10.2	16.2	0.215
Chronic kidney disease	19.4	15.0	27.0	0.037
Anaemia	35.8	33.1	40.5	0.287
Active cancer	3.0	3.1	2.7	1.000
Psychiatric disorder	6.5	8.7	2.7	0.098
Alcohol abuse	8.5	9.4	6.8	0.508
Pacemaker implanted (%)	3.5	1.6	6.8	0.103
ICD (%)	3.5	0.0	9.5	0.001
HF hospitalisation within last 12 months (%)	14.9	8.7	25.7	0.001
New-onset AHF (%)	53.2	74.0	17.6	<0.001
Precipitating factors on admission (%)				
ACS	63.2	127	0	
Arrhythmia	14.4	0	39.2	
Drug or dietary noncompliance	8.0	0	21.6	
Valve disease	7.0	0	18.9	
Infection	6.0	0	16.2	

Clinical presentation (%)				
CDHF	46.8	26.0	82.4	<0.001
Pulmonary oedema	21.4	26.0	13.5	0.038
Hypertensive HF	0.5	0.0	1.4	0.368
Cardiogenic shock	6.0	8.7	1.4	0.035
Isolated Right HF	0.5	0.0	1.4	0.059
HF in the context of ACS	63.2	100.0	0.0	<0.001

p-value for difference between patients presenting with or without ACS.

Anaemia defined as serum haemoglobin on admission <130 g/L for men and 120 g/L for women; all other comorbidities as reported.

ACS, acute coronary syndrome; AHF, acute heart failure; CDHF, chronic decompensate heart failure; ICD, implantable cardioverter/defibrillator; HF, heart failure; SD, standard deviation.

Table 2: Physical, laboratory, ECG and echocardiographic findings on admission

	All patients (n=201)	Patients with ACS (n=127)	Patients without ACS (n=74)	p-value
Physical findings, mean (SD)				
SBP (mmHg)	128 (31)	130 (31)	125 (31)	0.350
DBP (mmHg)	74 (20)	75 (20)	72 (19)	0.191
Heart rate (beats per minute)	88 (31)	87 (28)	89 (35)	0.705
Oxygen Saturation (%), median [p25 – p75]	96 [91 – 98]	95 [90 – 98]	96 [93 – 98]	0.220
Laboratory values, mean (SD) or median [p25 – p75]				
Serum haemoglobin (g/L)	126 [110 – 139]	125 [111 – 141]	128 [106 – 139]	0.732
BNP (pg/ml)	841 [313 – 1804]	765 [266 – 1463]	1001 [377 – 2325]	0.111
Creatinine clearance (ml/min)	57.5 (21.4)	59.3 (21.1)	54.3 (21.7)	0.105
< 30 ml/min (%)	10.0	8.7	12.2	0.482
Serum sodium (mmol/L)	138 [135 – 140]	137 [130 – 140]	138 [136 – 140]	0.300
Serum potassium (mmol/L)	4.1 [3.9 – 4.5]	4.0 [3.7 – 4.5]	4.3 [4.0 – 4.6]	0.025
ECG (%)				
Atrial Fibrillation	30.8	22.0	45.9	<0.001
VT	10.4	7.1	16.2	0.041
Myocardial infarction	66.7	91.3	24.3	<0.001
LVH	8.5	4.7	14.9	0.013
Echocardiography				
LVEF (%)				
Preserved	26.8	22.4	34.8	
Moderately reduced	37.1	44.8	23.2	0.010
Severely reduced	36.1	32.8	42.0	
LA diameter (mm), median [p25 – p75]	43 [40 – 48]	42 [39 – 45]	47 [43 – 55]	<0.001
EDLV diameter (mm), median [p25 – p75]	52 [48 – 59]	51 [47 – 55]	58 [50 – 64]	<0.001

p-value for difference between patients presenting with or without ACS.

DBP, diastolic blood pressure; EDLV, end diastolic left ventricular; LA, left atrial; LVEF, left ventricular ejection fraction; LVH, left ventricular hypertrophy; SBP, systolic blood pressure; SD, standard deviation; VT, ventricular tachyarrhythmia.

Table 3: Diagnostic investigations, procedures and acute cardiac care

Procedure/Treatment (% performed)	All patients (n=201)	Patients with ACS (n=127)	Patients without ACS (n=74)	p-value
Admission to ICCU	77.1	91.3	52.7	<0.001
ECG	98.5	100.0	95.9	0.049
Echocardiography	96.5	98.4	93.2	0.103
BNP	89.6	91.3	86.5	0.340
Cardiac scintigraphy	10.4	13.4	5.4	0.074
Coronary angiography	69.7	85.3	45.9	<0.001
Pulmonary artery catheter	5.5	4.7	6.8	0.188
Percutaneous coronary intervention	32.8	48.8	5.4	<0.001
Invasive ventilation	8.5	8.7	8.1	0.892
Non-invasive ventilation	63.5	69.3	53.4	0.025
Intravenous diuretics	62.5	58.3	59.9	0.103
Intravenous nitrates	34.5	42.5	20.5	0.002
Intravenous inotropes	13.9	13.4	14.9	0.770
Intra-aortic balloon pump	3.5	5.5	0.0	0.048
Dialysis	2.5	2.4	2.7	1.000
Pacemaker	5.0	1.6	10.8	0.004
ICD	6.5	4.7	9.5	0.188

p-value for difference between patients presenting with or without ACS.

ACS, acute coronary syndrome; BNP, B-type natriuretic peptide; ICCU, intensive cardiac care unit; ICD, implantable cardioverter/defibrillator.

Table 4: Length of stay, outcomes and follow-up

	All patients (n=201)	Patients with ACS (n=127)	Patients without ACS (n=74)	p-value
Length of stay (days), median [p25 – p75]				
Total	11 [7 – 16]	11 [7 – 16]	11 [6 – 18]	0.864
ICCU	6 [4;12]	3 [2;5]	1 [0;4]	<0.001
CW	6 [4;12]	6 [4;11]	7 [4;14]	0.131
In-hospital mortality (%)	5.5	3.9	8.1	0.210
Follow-up				
Hospitalisation within 6 months (%)	20.9	18.9	24.3	0.361
Hospitalisation within 12 months (%)	23.9	22.8	25.7	0.649
Department of first readmission (%)				
Cardiology department	27.1	24.1	31.6	
Internal medicine department	66.7	69.0	63.2	0.843
ICU of emergency department	6.3	6.9	5.3	
Months after index admission, median [p25 – p75]	1.5 [0.8 – 4.5]	2.0 [1.0 – 5.0]	1.5 [0.5 – 4.0]	0.586
Rehospitalisations *, median [p25 – p75]	1 [1 – 2]	1 [1 – 2]	1 [1- 2]	0.605
Mortality at 6 months (%)				
Heart failure	7.5	4.7	12.2	0.053
All cause	10.9	8.7	14.9	0.174
Mortality at 12 months (%)				
Heart failure	10.9	8.7	14.9	0.174
All cause	15.9	14.2	18.9	0.375
Adverse endpoint **	34.8	31.5	40.5	0.301

* Number of heart failure rehospitalisations during the year after index admission.

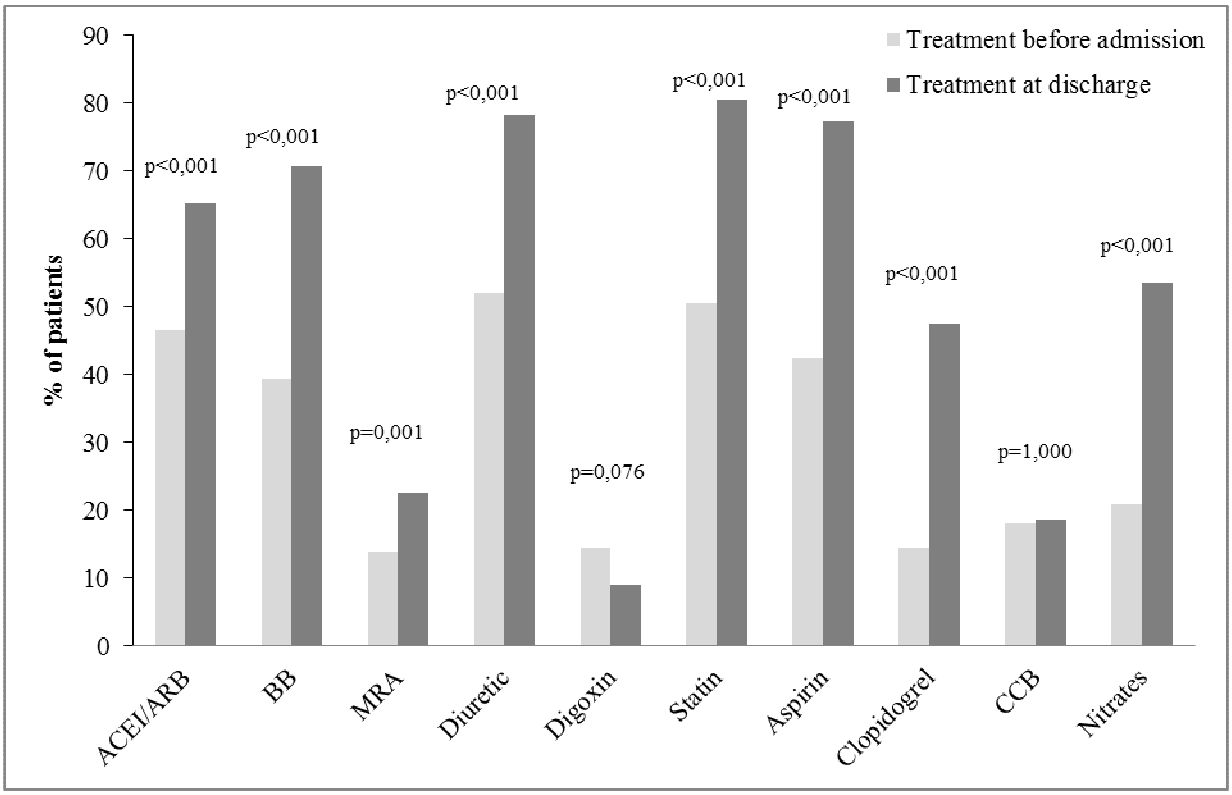
** Adverse endpoint defined as death or heart failure rehospitalisation during the total follow-up period.

p-value for difference between patients presenting with or without ACS.

CW, cardiology ward; ICCU, intensive cardiac care unit; ICU, intensive care unit.

Figures

Figure 1



Supplementary data

Table 5S: Variables associated with death or rehospitalisation within one year after index admission

Variables		Crude HR* [CI 95%]	p-value	Adjusted HR* [CI 95%]	p-value
Age (≤65 versus >65)		2,041 [1,151 – 3,619]	0,015	1,360 [0,674 – 2,742]	0,390
Sex (male versus female)		1,192 [0,729– 1,947]	0,484	1,175 [0,618 – 2,234]	0,623
Aetiology (ischemic versus nonischemic)		0,860 [0,518 – 1,427]	0,560	1,515 [0,718 – 0,3200]	0,276
De novo versus decompensate		1,697 [1,052 – 2,738]	0,030	1,228 [0,615 – 2,451]	0,561
HF hospitalisation in the previous year		2,370 [1,369 – 4,102]	0,002	3,177 [1,405 – 7,185]	0,006
Diabetes mellitus		1,590 [0,991 – 2,553]	0,055	1,847 [0,969 – 3,519]	0,062
Obesity (BMI>30 kg/m^2)		1,354 [0,832 – 2,205]	0,222	1,105 [0,571 – 2,139]	0,767
	SBP <100 mmHg	1,472 [0,851 – 2,545]	0,167	1,126 [0,577 – 2,198]	0,729
	Heart rate <70 bpm	0,735 [0,394 – 1,373]	0,335	0,876 [0,417 – 1,842]	0,727
	Anaemia	2,189 [1,364 – 3,512]	0,001	1,112 [0,574 – 2,152]	0,754
	BNP >500 pg/ml	1,592 [0,907 – 2,791]	0,105	1,317 [0,682 – 2,542]	0,412
Admission assessment	CrCl <30 ml/min	2,260 [1,155 – 4,419]	0,017	0,763 [0,256 – 2,276]	0,628
	Na <135 mmol/L	1,899 [1,128 – 3,197]	0,016	1,995 [1,032 – 3,856]	0,040
	K >4,3 mmol/L	0,962 [0,595 – 1,556]	0,876	0,609 [0,330 – 1,123]	0,112
	AF	1,820 [1,130 – 2,931]	0,014	1,791 [1,021 – 3,142]	0,042
	LVEF <50%	0,703 [0,422 – 1,170]	0,175	0,518 [0,268 – 0,998]	0,049
ICCU admission		1,215 [0,710 – 2,080]	0,478	0,833 [0,407- 1,708]	0,619
Length of stay		1,010 [0,993 – 1,027]	0,243	0,995 [0,960 – 1,030]	0,757

* Crude HR was calculated using univariate Cox regression models. Adjusted HR was calculated using multivariate weighted Cox regression models. Fully adjusted estimates took into account all 18 variables.

Anaemia defined as serum haemoglobin on admission <130 g/L for men and 120 g/L for women.

AF, atrial fibrillation; BNP, B-type natriuretic peptide; BMI, body mass index; CrCl, creatinine clearance; HF, Heart failure; HR, hazard ratio; ICCU, intensive cardiac care unit; LVEF, left ventricular ejection fraction; SBP, systolic blood pressure.

Table 6S: Variables associated with a longer length of stay

Variables		Crude mean difference* [95% CI]	p-value	Adjusted mean difference* [95% CI]	p-value
Age (≤65 versus >65)		0,056 [-0,156 – 0,269]	0,602	0,160 [-0,036 – 0,355]	0,110
Sex (male versus female)		0,010 [-0,194 – 0,215]	0,922	-0,041 [-0,234 – 0,152]	0,676
Aetiology (ischemic versus nonischemic)		-0,141 [-0,360 – 0,077]	0,204	-0,194 [-0,417 – 0,028]	0,087
Decompensate versus de novo		0,245 [0,048 – 0,442]	0,015	0,140 [-0,074 – 0,354]	0,198
HF hospitalisation in the previous year		0,412 [0,138 – 0,687]	0,003	0,287 [0,013 – 0,560]	0,040
Diabetes mellitus		0,011 [-0,195 – 0,217]	0,915	0,011 [-0,179 – 0,201]	0,909
Obesity (BMI>30 kg/m^2)		-0,059 [-0,275 – 0,156]	0,587	-0,234 [-0,433 – -0,035]	0,021
Admission assessment	SBP <100 mmHg	0,071 [-0,187 – 0,328]	0,590	-0,007 [-0,224 – 0,209]	0,946
	Heart rate <70 bpm	-0,130 [-0,373 – 0,112]	0,291	-0,026 [-0,240 – 0,188]	0,810
	Anaemia	0,180 [-0,027 – 0,386]	0,088	0,050 [-0,158 – 0,258]	0,638
	BNP >500 pg/ml	0,518 [0,317 – 0,719]	<0,001	0,368 [0,174 – 0,563]	<0,001
	CrCl <30 ml/min	0,390 [0,045 – 0,736]	0,027	0,233 [-0,113 – 0,579]	0,186
	Na <135 mmol/L	0,065 [-0,185 – 0,315]	0,610	-0,031 [-0,250 – 0,188]	0,784
	K >4,3 mmol/L	-0,105 [-0,306 – 0,096]	0,305	-0,063 [-0,242 – 0,116]	0,490
	AF	0,101 [-0,115 – 0,317]	0,356	0,069 [-0,122 – 0,260]	0,478
	LVEF <50%	0,066 [0,149 – 0,281]	0,546	0,070 [0,137 – 0,276]	0,507
ICCU admission		0,272 [0,037 – 0,507]	0,023	0,362 [0,131 – 0,593]	0,002

* Crude mean differences were calculated using univariate linear regression models. Adjusted mean differences were calculated using multivariate weighted linear regression models. Fully adjusted estimates took into account all 17 variables.

Anaemia defined as serum haemoglobin on admission <130 g/L for men and 120 g/L for women.

95% CI, 95% confidence interval; AF, atrial fibrillation; BMI, body mass index; BNP, B-type natriuretic peptide; CrCl, creatinine clearance; HF, Heart failure; ICCU, intensive cardiac care unit; LVEF, left ventricular ejection fraction; SBP, systolic blood pressure.

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