Characteristics and outcomes of patients admitted for acute heart failure in a single-centre study

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Abstract

**Aims** Acute heart failure represents a medical condition with very high mortality. Accurate risk stratification can help physicians to improve the health care about these patients. The aim of our study was to characterize real-life patients admitted for acute heart failure in a specific region with one tertiary medical centre and to describe risk factors of short-term and long-term mortality.

**Methods and results** We performed a retrospective analysis of patients admitted from January 2017 to December 2017 to Department of cardiology of the tertiary medical centre University Hospital in Hradec Králové. We identified 385 patients admitted for acute heart failure to the standard care and intensive care unit. The median of age was 74 years (IQR 67.5–80) and 34% of patients were female. Hospital admission was due to *de novo* heart failure in 222 (57.7%) patients. The most common comorbidities were arterial hypertension (77.7%), dyslipidaemia (67.3%) and coronary artery disease (63.1%). Coronary artery disease (52.7% of cases) and valve disease (28.1% of cases) were the most common aetiologies of heart failure. The all-cause in-hospital mortality was 12.7%, 30-day mortality was 14.6% and 1 year mortality was 34%. Among risk factors of in-hospital mortality, the most significant factors were haemodialysis during the hospitalization [odds ratio (OR) 15.82, 95% confidence interval (CI) 2.96–84.57, *P* = 0.0008], chronic heart failure (OR 4.27, 95% CI 1.66–11.03, *P* = 0.001) and STEMI as a precipitating factor of heart failure (OR 4.19, 95% CI 1.23–14.25, *P* = 0.023). Haemodialysis during the hospitalization (OR 4.28, 95% CI 1.17–15.61, *P* = 0.025) and the comorbidity depression and anxiety (OR 3.49, 95% CI 1.45–8.39, *P* = 0.005) were the most significant risk factors of long-term mortality.

**Conclusions** Our study confirms very high mortality rates among patients with acute heart failure underlying poor prognosis of these patients. Comorbidities (peripheral artery disease, atrial fibrillation, chronic heart failure and depression and anxiety), precipitating factors of heart failure (myocardial infarction with ST segment elevation), complications occurring during the hospitalization (acute kidney injury, pulmonary ventilation for respiratory failure and haemodialysis) and the age of patients should be included in the risk stratification of in-hospital, 30 day and 1 year mortality.

**Keywords** Heart failure; Risk factors; Mortality; Epidemiology

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**Introduction**

Acute heart failure (AHF) represents one of the most common causes of hospital admissions. Despite successful progress in the therapy of chronic heart failure during last years, the morbidity and mortality of patients admitted with AHF remain still high. Moreover, heart failure care’s overall cost continues to rise as the incidence and prevalence of heart failure have increased during last years,2 with hospitalization for heart failure representing a significant part of the resource burden.3

Hospitalization for AHF (*de novo* or decompensation of chronic heart failure) itself means a negative prognostic factor in the natural history of the disease. Thus, the management of these events warrants careful attention to properly evaluate patients, identify underlying aetiologies and precip-
Study design and methods

The aim of this study was to provide a characterization of hospitalized patients with AHF in a single-centre study and determine risk factors for short-term (in-hospital and 30-day mortality) and long-term mortality (1-year mortality). We performed a retrospective analysis of patients hospitalized for AHF at the Department of Cardiology at the University Hospital in Hradec Kralove during 12 consecutive months from January 2017 to December 2017. Using data collected from Hospital information system and health records of patients we reviewed 3413 hospitalizations and subsequently identified in total 385 patients hospitalized for an AHF during 12 months in the standard care and intensive care unit. It accounted for 422 hospitalizations, but patients were included only once during the year.

We collected data regarding demographic characteristics, comorbidities, medications and basic clinical and imaging methods. The mortality of patients was assessed either directly by the information about the patient’s death in his medical record or by the information about health insurance termination during 12 months after the index hospitalization.

Qualified cardiologists performed the diagnosis of clinical conditions and treatment of patients according to the personal clinical judgement and cardiology guidelines concerning heart failure from 2016.5

Statistical analysis

Categorical data are presented as numbers of patients and percentages, continuous data are presented as median and interquartile range (IQR) because of non-normal distribution. Categorical data were compared by the Pearson’s χ² test or Fisher’s exact test if at least one cell had an expected value less than 5. Continuous data were compared by non-parametrical Mann–Whitney U test or Kolmogorov–Smirnov test. Multivariate logistic regression was performed to assess the effect of several variables on the all-cause in-hospital, 30 day and 1 year mortality, results are presented as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). Variables with between-group significant differences and with relevant clinical interest were included in multivariate analysis. Variables with a significant association with death are characterized as independent predictors of mortality. A P value less than 0.05 is considered as a statistically significant difference.

Statistical analysis was performed using statistical software NCSS 2019 version 19.0.6.

Results

General characterization

During 12 months from January 2017 to December 2017 totally 385 patients with AHF were admitted to our department, from which 131 (34%) were females and the median age at the time of hospitalization was 74 years with 77 years (IQR 72–83) in women and 72 years (IQR 65–77) in men (P < 0.0001). In total 247 (64.2%) patients were older than 70 years. The vast majority of patients (369, 95.8%) were from Hradec Kralove Region and 156 (40.5%) patients were from the city of Hradec Kralove. With respect to the size of the population, with an AHF, we thus hospitalized 0.07% of the population of Hradec Kralove Region and 0.17% of inhabitants of the city of Hradec Kralove. The median length of hospitalization was 10 days and 183 (47.5%) patients spent at least 1 day in the intensive care unit. Most of the patients (241, 71.7%) were discharged home and 75 (22.3%) patients required further hospitalization at another department or hospital. During 12 months, 67 (19.9%) patients surviving the index hospitalization required rehospitalization for an AHF at our hospital. Detailed characteristics are summarized in Table 1.

Of 385 patients, 49 (12.7%) died during the hospitalization with the median day of death 5. Following 30 days after admission, the death occurred in 56 (14.6%) patients and 131 (34%) patients died in 12 months following the hospitalization (Table 2). 71.4% of patients (35 of 49) died in the first 10 days of hospitalization. The cardiogenic shock (developed
The AHF was classified as de novo in 222 (57.7%) patients (without a previous diagnosis of heart failure), the rest of the patients had a recognized chronic heart failure before admission and presented as a decompensation of chronic heart failure (163, 42.3%).

The most common aetiologies of heart failure and precipitating factors are listed in Table 3. More than one causative and precipitating factor can participate in the development and sudden decompensation of heart failure in many patients. In our cohort of patients, totally 26 aetiologies and 30 triggers were recognized. Coronary artery disease was assessed as a causative factor in more than half of patients. STEMI as an aggravating factor was considered in 42 (10.9%) patients, but an acute coronary syndrome (composed of STEMI, non-STEMI, myocardial infarction in a subacute phase, global ischaemia and myocardial infarction with LBBB) was present in 79 (20.5%) patients.

Pharmacological, diagnostic and other therapeutic interventions during the patient’s hospitalization are reported in Table 4. Among complications associated with the hospitalization, at least a mild hepatic injury (defined as the elevation of both ALT and AST or GMT and ALP above the URL) occurred in 164 (42.6%) patients. Acute respiratory insufficiency (defined as resting saturation of O2 below 90%) at admission or occurring during the hospitalization because of heart failure occurred in 156 (40.5%) patients. Electrolyte disturbances (at least two of hyponatraemia <35 mmol/L, hypokalaemia <3.5 mmol/L, hyperkalaemia >5.2 mmol/L or hypochloraemia <97 mmol/L) occurred in 102 (26.5%) pa-

### Table 1 General characteristics of patients at admission

| General characteristics | All (N = 385) |
|-------------------------|--------------|
| Demographic and clinical characteristics | | |
| Age, median (IQR)        | 74 (67.5–80) |
| Female, n (%)            | 131 (34)     |
| Heart rate, median (IQR) | 90 (75–110)  |
| Systolic blood pressure, median (IQR) | 130 (112–150) |
| Diastolic blood pressure, median (IQR) | 75 (64–88) |
| BMI, median (IQR), N = 376 | 29.3 (26–33.8) |
| BSA, median (IQR), N = 376 | 2 (1.85–2.21) |
| EF, median (IQR), N = 376 | 37.5 (25–50) |
| Peripheral swelling, n (%) | 225 (58.4) |
| Crackles, n (%)           | 255 (66.2)   |
| Jugular veins distension, n (%) | 135 (35.1) |
| X-ray pulmonary congestion, n (%) | 255 (66.9) |
| X-ray pleural effusion, n (%) | 132 (34.7) |
| Cardiogenic shock, n (%)  | 28 (7.3)     |
| Cardiopulmonary resuscitation | 12 (3.1) |
| before admission, n (%)   | | |
| Comorbidities             | | |
| Chronic heart failure, n (%) | 163 (42.3) |
| Coronary artery disease, n (%) | 243 (63.1) |
| Diabetes mellitus, n (%)  | 181 (47)     |
| Arterial hypertension, n (%) | 299 (77.7) |
| Atrial fibrillation, n (%) | 210 (54.6) |
| Atrial flutter, n (%)     | 23 (6)       |
| Chronic kidney disease, n (%) | 220 (57.1) |
| Valve disease (at least moderate), n (%) | 283 (73.5) |
| Malignancy, n (%)         | 59 (15.3)    |
| Peripheral artery disease, n (%) | 77 (20) |
| Chronic obstructive pulmonary disease, n (%) | 62 (16.1) |
| Depression, anxiety, n (%) | 31 (8) |
| Dyslipidaemia, n (%)      | 259 (67.3)   |
| Stroke, n (%)             | 38 (9.9)     |
| ICD, n (%)                | 34 (8.8)     |
| Pacemaker, n (%)          | 16 (4.2)     |
| CRT, n (%)                | 21 (5.5)     |
| Pharmacotherapy on admission | | |
| Acetylsalicylic acid, n (%) | 162 (42.1) |
| PZY12 inhibitor, n (%)    | 28 (7.3)     |
| Anticoagulation therapy, n (%) | 131 (34) |
| Beta-blocker, n (%)       | 229 (59.5)   |
| ACE inhibitor, n (%)      | 153 (39.7)   |
| Angiotensin receptor blocker, n (%) | 57 (14.8) |
| Spironolactone, n (%)     | 93 (24.2)    |
| Furosemide, n (%)         | 195 (50.7)   |
| Hydrochlorothiazide, n (%) | 67 (17.4) |
| Amiodarone, n (%)         | 54 (14)      |
| Statin, n (%)             | 146 (37.9)   |
| Amiloride, n (%)          | 44 (11.4)    |
| Digoxin, n (%)            | 18 (4.7)     |
| Ivabradine, n (%)         | 2 (0.5)      |

BMI, body mass index; BSA, body surface area; CRT, cardiac resynchronization therapy; EF, ejection fraction; ICD, implantable cardioverter-defibrillator.

| Table 2 Mortality rates | All (N = 385) |
|-------------------------|--------------|
| Overall mortality       | | |
| In-hospital mortality, n (%) | 49 (12.7) |
| 30 day mortality, n (%)  | 56 (14.6)    |
| 1 year mortality, n (%)  | 131 (34)     |

during 24 h after admission) was present in 28 (7.3%) patients with the in-hospital mortality accounting for 60.7% (17 patients).

### Table 3 The most common aetiologies and precipitating factors of heart failure

| Aetiologies (the most common) | All (N = 385) |
|-------------------------------|--------------|
| Coronary artery disease, n (%) | 203 (52.7) |
| Valve disease, n (%)          | 108 (28.1)   |
| Tachyarrhythmia, n (%)        | 59 (15.3)    |
| Dilated cardiomyopathy, n (%) | 28 (7.3)     |
| Unknown, n (%)                | 26 (6.8)     |
| Diastolic dysfunction, n (%)  | 14 (3.6)     |
| Cor pulmonale, n (%)          | 10 (2.6)     |
| Arterial hypertension, n (%)  | 10 (2.6)     |

| Precipitating factors (the most common) | All (N = 385) |
|----------------------------------------|--------------|
| Progression of heart failure, n (%)    | 134 (34.8)   |
| Infection, n (%)                       | 84 (21.8)    |
| Supraventricular tachyarrhythmia, n (%) | 60 (15.6) |
| STEMI, n (%)                           | 42 (10.9)    |
| Bradycardia, n (%)                     | 17 (4.4)     |
| Exacerbation of COPD, n (%)            | 17 (4.4)     |
| non-STEMI, n (%)                       | 14 (3.6)     |
| Subacute myocardial infarction, n (%)  | 14 (3.6)     |
| Non-adherence, n (%)                   | 13 (3.4)     |
| Hyperhydration, n (%)                  | 12 (3.1)     |
| Uncontrolled arterial hypertension, n (%) | 9 (2.3) |

COPD, chronic obstructive pulmonary disease; non-STEMI, myocardial infarction without elevations of ST segment; STEMI, myocardial infarction with elevations of ST segment.
Continuous renal replacement therapy, intermittent renal replacement therapy, ECMO, extracorporeal membrane oxygenation.

Noradrenaline, Intravenous amiodarone, Dobutamine, Intravenous nitrate, Intravenous furosemide, Coronarography, ECMO, Non-invasive

Patients had the EF ≥ 50%. The median of TAPSE was 18 mm (IQR 13–21).

Comparison of in-hospital, 30 day and 1 year mortality groups

Differences between mortality groups in specific characteristics are shown in Table 5. There are many significant differences in demographic and clinical characteristics between survivors and non-survivors. Those who died in the hospital, compared with those who survived, had a significantly higher rate of atherosclerotic diseases such as coronary artery disease and peripheral artery disease. This difference persisted after 1 year (but not in the 30 day mortality group for peripheral artery disease). The median of the length of hospitalization was 11 days and 5 days for survivors and non-survivors, respectively, for both in-hospital and 30 day mortality with a statistically significant difference. Patients who presented with a decomposition of chronic heart failure had significantly higher mortality during the hospital stay, after 30 days and even after 1 year. The deceased also had significantly lower systolic and diastolic blood pressure compared with survivors in all three groups. Although there is not any difference in BMI or BSA in patients who survived or died in the hospital or after 30 days, the difference is statistically significant in 1-year mortality group.

Predictors of mortality

Results of multivariate logistic regression with clinically relevant variables are performed in Table 6. This analysis revealed that a longer hospital stay and higher systolic blood pressure were related to a better in-hospital outcome. In contrast, patients with an acute kidney injury or patients requiring haemodialysis had a worse prognosis. These factors also persisted in a 30 day mortality model. For 1 year mortality, only a higher BMI and higher systolic blood pressure at admission were associated with a better outcome.

Discussions

In this single-centre retrospective study, we analysed real-life AHF patients admitted to the tertiary medical centre and we yield new and recent information about their demographic characteristics, comorbidities and outcomes. The value and main contribution of our study are in the enrolment of a consecutive and well-defined population of patients in a specific period. We further considered these characteristics for reporting prognostic factors of short-term (in-hospital and 30 day) and long-term (1 year) mortality. Considering the retrospective design, we provide results without large treatment modifications during the relatively short period of data collection.

Most of the data that we know today about the epidemiology of AHF are derived from large-scale registries mainly from the first decade of this century. 1–5–17 selected data are presented in Table 7. More recent registries from Europe or Asia regions follow the trends in outcomes and demographic characteristics observed in those pivotal studies, but differences in local clinical practice or different clinical thresholds for hospital admission may vary among registries and they may also change over a period of time. Comparison of these results with our study is partially limited because of different sizes of the population, multicentre setting and prospective design. However, many similar or distinct findings from our study can be reported.

The median age of 74 years in our study was slightly higher than that observed in most registries. Markedly higher age was reported only in the prospective registry in Japan. 18 We also observed significantly older patients among the deceased compared to survivors in 30 day and 1 year mortality groups. The age (as a continuous variable) was subsequently a mild but significant predictor of 30 day and 1 year mortality.

With the ageing of the population, there is an increase in the prevalence of chronic conditions such as coronary artery disease, diabetes mellitus, arterial hypertension or chronic kid-
Table 5 Comparison between mortality groups

| In-hospital mortality Variable                      | Survivors (N = 329) | Deceased (N = 56) | P       |
|-----------------------------------------------------|---------------------|-------------------|---------|
| Days of hospitalization, median (IQR)               | 11 (7–17.5)         | 5 (2–15)          | <0.0001 |
| Coronary artery disease, n (%)                      | 205 (61.1)          | 38 (77.6)         | 0.025   |
| Peripheral artery disease, n (%)                    | 61 (18.2)           | 16 (32.7)         | 0.018   |
| Chronic heart failure, n (%)                        | 133 (39.6)          | 30 (61.2)         | 0.004   |
| Acute kidney injury, n (%)                          | 121 (36)            | 32 (65.3)         | <0.0001 |
| Haemodialysis, n (%) (during hospitalization)       | 6 (1.8)             | 9 (18.4)          | 0.0001  |
| Artificial pulmonary ventilation, n (%)             | 52 (15.5)           | 21 (42.9)         | <0.0001 |
| Systolic blood pressure, median (IQR)               | 131 (115–151)       | 116 (92–132)      | <0.0001 |
| Diastolic blood pressure, median (IQR)              | 77 (66–89.75)       | 65 (52–75)        | <0.0001 |
| EF, median (IQR)                                    | 37.5 (25–50)        | 30 (18.125–50)    | 0.047   |

Table 6

| 30 day mortality Variable                          | Survivors (N = 329) | Deceased (N = 56) | P       |
|-----------------------------------------------------|---------------------|-------------------|---------|
| Days of hospitalization, median (IQR)               | 11 (7–18.5)         | 5 (2–8.75)        | <0.0001 |
| Age, median (IQR)                                  | 73 (67–79)          | 77 (71–85)        | 0.003   |
| Coronary artery disease, n (%)                      | 201 (61.1)          | 41 (75)           | 0.046   |
| Atrial fibrillation, n (%)                          | 172 (52.3)          | 38 (67.9)         | 0.03    |
| Depression, anxiety, n (%)                         | 22 (6.7)            | 9 (16.1)          | 0.06    |
| Chronic heart failure, n (%)                        | 132 (40.1)          | 31 (55.4)         | 0.033   |
| Acute kidney injury, n (%)                          | 119 (36.2)          | 34 (60.7)         | 0.0005  |
| Haemodialysis, n (%) (during hospitalization)       | 9 (2.7)             | 6 (10.7)          | 0.013   |
| Artificial pulmonary ventilation, n (%)             | 52 (15.8)           | 21 (37.5)         | 0.0001  |
| Systolic blood pressure, median (IQR)               | 132 (116.5–152.5)   | 115.5 (99.25–130.5) | <0.0001 |
| Diastolic blood pressure, median (IQR)              | 77 (65.5–89)        | 67 (58–80)        | 0.005   |
| Pulse pressure, median (IQR)                        | 52 (41–70)          | 45 (30–60.75)     | 0.002   |
| EF, median (IQR)                                    | 37.5 (25–51.875)    | 30 (20–46.87)     | 0.021   |

1 year mortality

| Variable                                           | Survivors (N = 254) | Deceased (N = 131) | P       |
|-----------------------------------------------------|---------------------|-------------------|---------|
| Age, median (IQR)                                  | 72 (65–78)          | 76 (71–84)        | <0.0001 |
| Coronary artery disease, n (%)                      | 149 (58.7)          | 94 (71.8)         | 0.012   |
| Atrial fibrillation, n (%)                          | 129 (50.8)          | 81 (61.8)         | 0.039   |
| Peripheral artery disease, n (%)                    | 41 (16.1)           | 36 (27.5)         | 0.008   |
| Depression, anxiety, n (%)                         | 15 (5.9)            | 16 (12.2)         | 0.031   |
| Chronic heart failure, n (%)                        | 90 (35.4)           | 73 (55.7)         | 0.0001  |
| Acute kidney injury, n (%)                          | 89 (35)             | 64 (48.9)         | 0.009   |
| Haemodialysis, n (%) (during hospitalization)       | 5 (2)               | 10 (7.6)          | 0.007   |
| Artificial pulmonary ventilation, n (%)             | 40 (15.8)           | 33 (25.2)         | 0.025   |
| Spironolactone, n (%)                               | 52 (20.5)           | 41 (31.3)         | 0.019   |
| Furosemide, n (%)                                   | 113 (44.5)          | 82 (62.6)         | 0.0008  |
| Systolic blood pressure, median (IQR)               | 134 (117–153)       | 122 (110–140.75)  | 0.001   |
| Diastolic blood pressure, median (IQR)              | 77 (66–90)          | 73 (62.25–83.75)  | 0.009   |
| BMI, median (IQR)                                   | 29.6 (26.5–34.8)    | 27.6 (24.4–32.2)  | 0.003   |
| BSA, median (IQR)                                   | 2.02 (1.87–2.23)    | 1.97 (1.76–2.16)  | 0.028   |

BMI, body mass index; BSA, body surface area; EF, ejection fraction.
Complication during the hospitalization
At admission

Acute kidney injury, when all of them are important risk factors for the development of heart failure. Compared with previous registries, we also report higher rates of comorbidities such as arterial hypertension (77.7% vs. 53–73.1%), diabetes mellitus (47% vs. 27–45.3%), atrial fibrillation (54.6% vs. 24.4–44%) or chronic kidney disease (57.1% vs. 9.4–32.5%). Similarly, the prevalence of coronary artery disease was higher than in most of these registries. Higher age and comorbidities are generally considered negative prognostic factors in patients with AHF or other critically ill cardiac patients. Thus, they are important variables in many mortality prediction risk scores, including short-term and long-term outcomes. In the multivariate analysis (Table 6), many comorbidities were significantly associated with all-cause mortality. Notably, the presence of chronic heart failure is reported with an odds ratio higher than 4 in the analysis of in-hospital and 30-day mortality. This observation is in contrast with previous reports where patients with de novo heart failure may have higher in-hospital mortality. Another cardiovascular comorbidity, peripheral artery disease (PAD), which occurred in one third of patients who died during the hospitalization, was significantly associated with in-hospital mortality. The presence of PAD is often described as a marker of generalized atherosclerosis together with coronary artery disease and...
Table 6 Risk factors of short-term and long-term mortality

| In-hospital mortality Variable | Odds ratio | Lower and upper 95% confidence limit | P value |
|-------------------------------|------------|--------------------------------------|---------|
| Haemodialysisa                | 15.817     | 2.958–84.571                         | 0.0008  |
| Chronic heart failure         | 4.271      | 1.655–11.026                         | 0.001   |
| STEMi                         | 4.186      | 1.23–14.247                          | 0.023   |
| Peripheral artery disease     | 3.694      | 1.513–9.02                           | 0.004   |
| Artificial pulmonary ventilation | 2.974     | 1.256–7.04                           | 0.015   |
| Acute kidney injurya          | 2.277      | 1.011–5.125                          | 0.045   |
| Depression, anxiety           | 1.574      | 0.462–5.358                          | 0.48    |
| EF                            | 1.015      | 0.989–1.041                          | 0.257   |
| Systolic blood pressurec      | 0.968      | 0.952–0.985                          | <0.0001 |
| Days of hospitalization       | 0.963      | 0.934–0.994                          | 0.008   |
| Supraventricular tachyarrhythmia | 0.343     | 0.071–1.662                          | 0.14    |
| **30 day mortality**          |            |                                      |         |
| Haemodialysisa                | 13.706     | 1.267–148.284                        | 0.031   |
| Chronic heart failure         | 4.291      | 1.531–12.027                         | 0.003   |
| Depression, anxiety           | 4.097      | 1.161–14.457                         | 0.035   |
| Atrial fibrillationd          | 3.627      | 1.401–9.389                          | 0.005   |
| Acute kidney injurya          | 3.357      | 1.374–8.2                            | 0.007   |
| STEMi                         | 3.312      | 0.942–11.639                         | 0.061   |
| Artificial pulmonary ventilation | 2.483     | 0.905–6.813                          | 0.082   |
| Age                           | 1.051      | **1.000–1.105**                      | 0.045   |
| EF                            | 0.989      | 0.962–1.017                          | 0.451   |
| Systolic blood pressurec      | 0.975      | 0.959–0.992                          | 0.002   |
| Days of hospitalization       | 0.887      | 0.834–0.945                          | <0.0001 |
| Crackles at admission         | 0.395      | 0.171–0.91                           | 0.028   |
| BSAa                          | 0.21       | 0.033–1.334                          | 0.088   |
| **1 year mortality**          |            |                                      |         |
| Haemodialysisa                | 4.281      | 1.174–15.611                         | 0.025   |
| Depression, anxiety           | 3.486      | 1.449–9.385                          | 0.005   |
| Furosemidec                  | 2.012      | 1.176–3.441                          | 0.01    |
| Artificial pulmonary ventilation | 1.702     | 0.873–3.18                           | 0.12    |
| Progression of heart failureb | 1.7        | 0.968–2.986                          | 0.065   |
| Atrial fibrillationa          | 1.635      | 0.941–2.841                          | 0.08    |
| Peripheral swellingc          | 1.57       | 0.881–2.799                          | 0.124   |
| Peripheral artery disease     | 1.494      | 0.799–2.792                          | 0.211   |
| Coronary artery disease       | 1.298      | 0.723–2.335                          | 0.383   |
| Valve diseasee                | 1.283      | 0.665–2.477                          | 0.455   |
| Acute kidney injurya          | 1.276      | 0.747–2.179                          | 0.373   |
| Age                           | 1.053      | 1.022–1.085                          | 0.0004  |
| Systolic blood pressurec      | 0.985      | 0.976–0.995                          | 0.002   |
| BSAa                           | 0.954      | 0.912–0.999                          | 0.039   |
| Supraventricular tachyarrhythmia | 0.524     | 0.232–1.182                          | 0.113   |

BMI, body mass index; BSA, body surface area; EF, ejection fraction; STEMI, myocardial infarction with elevations of ST segment.
aComplication during the hospitalization.
bPrecipitating factor.
cAt admission.
dComorbidity.

cerebrovascular disease. In a state of acute hemodynamic decompensation, which occurs in AHF, limited blood flow to target organs may enhance an adverse course of the disease. On the other hand, the optimal modern pharmacotherapy of PAD with the use of antithrombotics, statins or invasive treatment may result in the non-significant impact on 1-year mortality.

Although presented in relatively low numbers of patients, depression or anxiety as a comorbidity in patients with AHF represents another independent predictor of 30 day or 1 year mortality. The prevalence of depression and anxiety disorders in patients with heart failure is significantly higher than in the general population,25,26 accounting for approximately one fifth in heart failure patients. According to the previous reports, depression not only represents a predictor of mortality but is also associated with an increased risk of hospitalization and emergency department visits.27 Once heart failure develops, a correct treatment of these comorbidities together with proper adherence to guideline-directed medical therapy, especially for patients with heart failure with reduced ejection fraction, represents a crucial factor affecting the quality...
| Characteristics and outcomes of patients admitted for acute heart failure in a single-centre study | Table 7: Acute heart failure registries |
|---|---|
| **Time period** | **Dokoupil et al.** | **ADHERE** | **OPTIMISE-HF** | **EHFS I** | **EHFS II** | **ESC-HF Long-term** | **ATTEND** | **ALARM-HF** | **IN-HF** | **AHEAD** | **FINN-AKVA** | **KorAHF** | **KCHF** |
| **number of patients** | 385 | 105 | 388 | 48 | 612 | 11 | 327 | 3580 | 5039 | 4842 | 4953 | 1855 | 4153 |
| **Age (mean, SD)** | 74 (median) | 72 (14) | 73.2 (14) | 71 | 69.9 (12.5) | 71 (median) | 73 | 66-70 | 72 (12) | 71.5 (12.4) | 75 | (10.4) | 68.5 (14.5) | 80 (median) |
| **Female (%)** | 34 | 52 | 52 | 47 | 39 | 37.3 | 42 | 38 | 39.8 | 42.4 | 49.6 | 46.8 | 70.2 |
| **Arterial hypertension (%)** | 77.7 | 73 | 71 | 53 | 62.5 | 64.5 | 69.4 | 70.2 | 57.8 | 73.1 | 54.7 | 62.2 | 72 |
| **Diabetes mellitus (%)** | 47 | 44 | 42 | 27 | 32.8 | 44 | 39.6 | 44 | 36.2 | 41.7 | 51 | 47.8 | 36 |
| **Coronary artery disease (%)** | 63.1 | 57 | 50 | 43 | 38.7 | 44 | 36.2 | 44 | 36.2 | 41.7 | 51 | 47.8 | 36 |
| **Atrial fibrillation (%)** | 46.6 | 44 | 42 | 37.3 | 44 | 39.6 | 44 | 36.2 | 41.7 | 51 | 47.8 | 36 |
| **Chronic kidney disease (%)** | 54.6 | 63.1 | 50 | 43 | 38.7 | 44 | 39.6 | 44 | 36.2 | 41.7 | 51 | 47.8 | 36 |
| **COPD (%)** | 16.1 | 31 | 28 | 17 | 20.2 | 9.5 | 24.8 | 30.1 | 16.2 | 12.6 | 11.3 | 8.2 |
| **Length of hospital stay (median)** | 21 | 6 | 10 | 7.1 | 6.4 | 4.3 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |
| **In-hospital mortality (%)** | 12.7 | 4 | 4 | 11.9 | 21 | 6 | 10 | 21 | 6 | 10 | 7.1 | 7 | 9 |

COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; CCU, cardiac care unit.
AHEAD\(^\text{16}\) registry (19% and 10% for noradrenaline and dobutamine).

Obesity is a well-known risk factor for cardiovascular morbidity, including coronary artery disease, stroke or heart failure.\(^\text{38}\) On the other hand, among patients with heart failure and obesity, a significant reduction in all-cause and cardiovascular mortality was reported.\(^\text{39,40}\) This obesity paradox was also shown in patients with AHF regarding inhospital\(^\text{41}\) or long-term mortality.\(^\text{42,43}\) Our study confirmed that a higher BMI is associated with a better outcome in 1 year following the hospitalization.

Regarding the all-cause mortality rates (in-hospital, 30 day and 1 year) (Table 2) observed in our study, all of them were markedly high. Although the short-term and long-term mortality of patients with AHF remains high, with approximately one-quarter of AHF patients dying in the following year, a recent meta-analysis of 285 AHF studies between 1980 and 2017 reported a decline in 30 day all-cause death that persisted at 1 year.\(^\text{44}\) The authors reported that the 30 day and 1 year all-cause deaths were 7% and 24%. According to the published outcomes from registries (Table 2), the in-hospital mortality varies from 4 to 7.1%, with a higher rate (up to 11–12.7%) in registries with a higher proportion of cardiogenic shock.\(^\text{14,16}\) The trend in lower short- and long-term mortality in patients with AHF was also observed in the United Kingdom National heart failure audit.\(^\text{45}\) Despite this, the in-hospital all-cause mortality was similar to the results observed only in the AHEAD registry.\(^\text{16}\) The in-hospital mortality typically reflects the quality of in-patient care with respect to the severity and stage of the disease, together with proper management of complications during the hospital stay. As mentioned above, the character of our hospital (university hospital and tertiary centre) involves the care about patients with a more severe or complicated course of the disease with a potentially higher risk of adverse outcomes or requiring a higher level of medical cardiology care.

### Limitations

There were several limitations in our study. First, this registry was designed in a retrospective setting. Therefore, the management and follow-up were not standardized and decisions about the treatment, which could further influence the patient’s prognosis, were made individually based on the patient’s clinical state. Second, we assessed the all-cause mortality as the final endpoint without considering other detailed causes (such as heart failure, sudden death or non-cardiac causes). Third, we included patients admitted only to our Department of cardiology and we did not analyse patients admitted to other internal wards during the year. With respect to this, our cohort of patients might not represent the general population in our region.

### Conclusion

Acute heart failure represents a severe medical condition with significant public consequences. Patients, who present with AHF, are at a very high risk of adverse in-hospital and out-of-hospital outcomes. In our single-centre retrospective study with 385 patients admitted to Department of cardiology of the tertiary medical centre, we observed a very high rate of comorbidities, simultaneous complications and causative and precipitating factors with further influence on patient’s prognosis. With regard to the short-time prognosis (in-hospital or 30 day mortality), beside traditional laboratory or clinical markers of unfavourable outcome, our results emphasize further consideration of comorbidities (peripheral artery disease, atrial fibrillation and chronic heart failure), precipitating factors of heart failure (myocardial infarction with ST segment elevation) and complications occurring during the hospitalization (acute kidney injury, pulmonary ventilation for respiratory failure and haemodialysis) in the risk stratification of hospitalized patients with AHF. In the stratification of long-term mortality, higher age, haemodialysis during the hospitalization and a frequently omitted comorbidity depression and anxiety represent a negative prognostic factor. Although there is a global trend in the improvement of care about patients during the hospitalization and follow-up, a proper risk evaluation of patients at the time of admission is necessary. It represents a crucial point in a physician’s approach. Our study provides recent real-life data about patients’ characteristics and outcomes and may contribute to the planning of further clinical trials.

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### Conflict of interest

None declared.

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