Acute heart failure in the elderly: setting related differences in clinical features and management

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ABSTRACT

BACKGROUND  Administrative data show that acute heart failure (HF) patients are older than those enrolled in clinical registries and frequently admitted to non-cardiological settings of care. The purpose of this study was to describe clinical characteristics of old patients hospitalised for acute HF in Cardiology, Internal Medicine or Geriatrics wards.

METHODS  Data came from ATHENA (AcuTe Heart failurE in advaNced Age) registry which included elderly patients (≥ 65 years) admitted to the above mentioned settings of care from December 1, 2014 to December 1, 2015.

RESULTS  We enrolled 396 patients, 15.4% assigned to Cardiology, 69.7% to Internal Medicine, and 14.9% to a Geriatrics ward. Mean age was 83.5 ± 7.6 years (51.8% of patients ≥ 85 years) and was higher in patients admitted to Geriatrics (P < 0.001); more than half were females. Medical treatments did not differ significantly among settings of care (in a context of a low prescription rate of renin-angiotensin-aldosterone system inhibitors) whereas significant differences were observed in comorbidity patterns and management guidelines recommendation adherence for decongestion evaluation with comparison of weight and N-terminal pro-B-type natriuretic peptide levels on admission and at discharge (both P = 0.035 and P < 0.001), echocardiographic evaluation (P < 0.001) and follow-up visits planning (P < 0.001), all higher in Cardiology. Mean in-hospital length of stay was 9 ± 5.9 days, significantly higher in Geriatrics (13.7 ± 6.5 days) and Cardiology (9.9 ± 6.7 days) compared to Internal Medicine (8 ± 5.2 days), P < 0.001. In-hospital mortality was 9.3%, resulting higher in Geriatrics (18.6%) and Cardiology (16.4%) than Internal Medicine (5.8%), P = 0.001.

CONCLUSIONS  In elderly patients hospitalised for acute HF, clinical characteristics and management differ significantly according to the setting of admission.

Heart failure (HF) represents a major public health issue in developed countries, because it affects as many as 1%−2% of the adult population, in which it is associated with an exceeding burden of morbidity, mortality, reduced quality of life, and increasing healthcare costs, mainly driven by hospitalisations.¹⁻³ Improved immediate survival after acute coronary syndromes and a general increase in average life expectancy have led to a remarkable expansion of the oldest segments of the population, in which HF prevalence rises to 7%⁻11%;⁴⁻⁶ therefore, the overall prevalence of HF has increased almost exponentially over the last decades. However, elderly and
very elderly patients are frequently excluded from both HF randomised clinical trials\(^7\) and, to a lesser extent, HF registries, which maintain some selection bias by including mostly younger patients, hospitalised mainly in Cardiology wards.\(^8–11\) On the other hand, administrative data show that only a minority of older patients with acute HF are admitted to Cardiology wards, while the majority of them are hospitalised in Internal Medicine and Geriatric wards and may have significantly different clinical features, management and prognosis.\(^1\) Therefore, the aim of our study was to describe the clinical characteristics and in-hospital management of elderly patients accessing the Emergency Department (ED) of a tertiary level, academic hospital for acute HF and then admitted to Cardiology, Internal Medicine or Geriatrics wards.

**METHODS**

**Study Design**

ATHENA (AcuTe Heart failurE in advaNced Age) was a retrospective, single-centre observational study carried out at Careggi University Hospital, Florence, Italy from December 1, 2014 to December 1, 2015. The investigation conformed to the principles outlined in the Declaration of Helsinki.\(^12\) Demographic data were anonymized, according to Italian rules on privacy protection and the study was approved by the local institutional review board.

We consecutively enrolled patients aged 65 years or older accessing the ED for acute HF (new onset or worsening chronic HF) and subsequently admitted to the Cardiology, Internal Medicine or Geriatric wards participating in the study. In light of the retrospective nature of the study, there was no pre-specified criteria of setting assignment. Therefore, assignment was mainly driven by clinical judgment and bed ward availability. The diagnosis of acute HF was based on the co-occurrence on admission of signs and/or symptoms of systemic and/or pulmonary congestion on physical examination, need for intravenous diuretics, and pulmonary venous congestion on chest X-ray or, alternatively, elevated N-terminal pro-B-type natriuretic peptide (NT-proBNP, > 2,000 pg/mL). No pre-specified exclusion criteria were adopted.

**Data Collection**

Data were collected by study investigators who filled a clinical record form after reviewing medical charts and documentation. Medical history (HF aetiology, comorbidities and current medications), clinical characteristics, tests, laboratory parameters, and treatments were recorded for each patient on admission to the ED and during hospital course. Estimated glomerular filtration rate (eGFR) was calculated from serum creatinine using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation.\(^13\) Functional status one week prior to hospital admission and the burden of comorbidities were assessed with the Barthel Index and the Charlson-Age Comorbidity Index (CACI), respectively. Acute coronary syndrome or tachyarrhythmias like atrial fibrillation were referred as precipitating cardiovascular (CV) causes of HF hospitalisation while pneumonia, acute kidney disease, sepsis or poor compliance non-CV causes. In-hospital mortality, length of hospital stay, and discharge planning were recorded as well.

**Statistical Analysis**

Data were analysed with SPSS\(^\circledast\) 18.0 statistical package (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean ± SD and categorical variables as percentages. Bivariate associations were tested using ANOVA or the chi-squared test, as appropriate. Correlations were analysed using Pearson’s or Spearman’s tests for variables with normal or non-normal distribution, respectively. A P-value < 0.05 was considered statistically significant.

**RESULTS**

The study population consisted of 396 patients with a mean age of 83.5 ± 7.6 years, 15.4% assigned to Cardiology, 69.7% to Internal Medicine, and 14.9% to a Geriatrics ward. Data regarding demographics and medical history are reported in Table 1. Age was significantly different across the three settings of care resulting greater in patients admitted to Geriatrics, intermediate in those admitted to Internal Medicine and lowest in Cardiology. The prevalence of ischemic aetiology of HF was different across the three settings resulting higher in Cardi-
Among the different settings of care and resulting for 12.6% of all causes with a prevalence varying the CV precipitating causes of acute HF accounted significantly across the three settings of care. Overall, with new onset HF, whose prevalence did not differ among patients admitted to Cardiology or Geriatrics and Internal Medicine. Significantly among the three settings as shown by the body weight monitoring (on admission and in less than three quarters of patients received echocardiographic evaluation, much more frequently in Cardiology than in Geriatrics and Internal Medicine. Based on left ventricular ejection fraction (EF), 33.1% of patients were classified as HF with reduced EF (HFrEF), 20.2% as HF with mid-range EF (HFmrEF), and 46.7% as HF with preserved EF (HFpEF). The overall prevalence of anaemia approached 50% with similar prevalence in the three settings; moreover, almost 20% had a severe CKD, without significant differences across the three settings of care. Analysing in detail in-hospital management and clinical evaluation, we found that less than three quarters of patients received echocardiographic evaluation, much more frequently in Cardiology than in Geriatrics and Internal Medicine. NT-proBNP was measured on admission in almost 90% of cases but was re-assessed before discharge in less than 10% and more frequently in Cardiology, while body weight monitoring (on admission and discharge) was performed in less than 20% of patients with significant differences among the different settings of care but again more frequently in Cardiology.

Table 1  Demographic and clinical characteristics on admission across the different settings of care.

| Variable                        | Total population (n = 396) | Cardiology (n = 61) | Geriatrics (n = 59) | Internal Medicine (n = 276) | P-value |
|---------------------------------|---------------------------|---------------------|---------------------|----------------------------|---------|
| Demographics                    |                           |                     |                     |                            |         |
| Age, yrs                        | 83.5 ± 7.6                | 81.0 ± 6.6          | 86.9 ± 6.5          | 83.4 ± 7.7                 | < 0.001 |
| Age ≥ 85 yrs                    | 205 (51.8%)               | 18 (29.5%)          | 42 (71.2%)          | 145 (52.5%)                | < 0.001 |
| Females                         | 209 (52.8%)               | 34 (55.7%)          | 29 (49.2%)          | 146 (52.9%)                | 0.768   |
| Cardiovascular risk factors     |                           |                     |                     |                            |         |
| Dyslipidaemia                   | 117 (29.5%)               | 28 (45.9%)          | 20 (33.9%)          | 69 (25.0%)                 | 0.004   |
| Diabetes mellitus               | 134 (33.8%)               | 20 (32.8%)          | 12 (20.3%)          | 102 (37.0%)                | 0.049   |
| Hypertension                    | 305 (77.0%)               | 47 (77.0%)          | 40 (67.8%)          | 218 (79.0%)                | 0.179   |
| Cardiovascular history          |                           |                     |                     |                            |         |
| Heart failure ischemic aetiology| 145 (36.6%)               | 34 (55.7%)          | 27 (45.8%)          | 84 (30.4%)                 | < 0.001 |
| Atrial fibrillation*            | 183 (46.2%)               | 26 (44.1%)          | 26 (44.1%)          | 131 (47.5%)                | 0.741   |
| Peripheral artery disease       | 42 (10.6%)                | 8 (13.1%)           | 8 (13.6%)           | 26 (9.4%)                  | 0.507   |
| Stroke/Transitory ischemic attack| 62 (15.7%)                | 11 (18.0%)          | 8 (13.6%)           | 43 (15.6%)                 | 0.795   |
| Comorbidities                   |                           |                     |                     |                            |         |
| Chronic obstructive pulmonary disease| 126 (31.8%)           | 22 (36.1%)          | 19 (32.2%)          | 85 (30.8%)                 | 0.725   |
| Chronic kidney disease          | 115 (29.0%)               | 27 (44.3%)          | 25 (42.4%)          | 63 (22.8%)                 | < 0.001 |
| Anaemia                         | 112 (28.3%)               | 18 (29.5%)          | 15 (25.4%)          | 79 (28.6%)                 | 0.861   |
| Cognitive impairment            | 88 (22.2%)                | 8 (13.1%)           | 20 (33.9%)          | 60 (21.7%)                 | 0.022   |
| Depressive symptoms             | 61 (15.4%)                | 12 (19.7%)          | 18 (30.5%)          | 31 (11.2%)                 | 0.001   |
| Charlson-age comorbidity index  | 6.9 ± 2.2                 | 8.1 ± 2.5           | 8.6 ± 2.2           | 6.3 ± 1.9                  | < 0.001 |

Data are presented as means ± SD or n (%). *Presented as paroxysmal or permanent.

The trend was similar for coronary artery disease risk factors such as dyslipidaemia while diabetes mellitus was more frequently reported among patients admitted to Internal Medicine. Among non-CV comorbidities, the prevalence of chronic kidney disease (CKD) was similar in patients admitted to Cardiology or Geriatrics and lower in those managed in Internal Medicine. Significant differences were also observed for cognitive impairment and depressive symptoms. Overall, the burden of chronic comorbidities differed substantially among the three settings as shown by the CACI score.

The clinical presentation, bio-humoral profile and clinical monitoring of acute HF are summarised in Table 2. Almost one out of four patients presented with new onset HF, whose prevalence did not differ significantly across the three settings of care. Overall, the CV precipitating causes of acute HF accounted for 12.6% of all causes with a prevalence varying among the different settings of care and resulting higher in Cardiology. Based on left ventricular ejection fraction (EF), 33.1% of patients were classified as HF with reduced EF (HFrEF), 20.2% as HF with mid-range EF (HFmrEF), and 46.7% as HF with preserved EF (HFpEF). The overall prevalence of anaemia approached 50% with similar prevalence in the three settings; moreover, almost 20% had a severe CKD, without significant differences across the three settings of care. Analysing in detail in-hospital management and clinical evaluation, we found that less than three quarters of patients received echocardiographic evaluation, much more frequently in Cardiology than in Geriatrics and Internal Medicine.

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Table 2: Clinical presentation, laboratory data and clinical monitoring across the different settings of care.

| Variable                                      | Total population (n = 396) | Cardiology (n = 61) | Geriatrics (n = 59) | Internal Medicine (n = 276) | P-value |
|-----------------------------------------------|---------------------------|---------------------|---------------------|-----------------------------|---------|
| **Clinical presentation**                     |                           |                     |                     |                             |         |
| New onset heart failure                       | 112 (28.3%)               | 17 (27.9%)          | 15 (24.4%)          | 80 (29%)                    | 0.856   |
| Cardiovascular precipitating causes           | 50 (12.6%)                | 14 (23.0%)          | 5 (8.5%)            | 32 (11.2%)                  | 0.026   |
| Heart rate, beat/min                          | 90.0 ± 23.2               | 90.7 ± 24.7         | 85.3 ± 18.7         | 90.8 ± 23.6                 | 0.428   |
| Systolic blood pressure, mmHg                 | 138.8 ± 23.0              | 139.0 ± 35.2        | 139.3 ± 25.1        | 140.0 ± 30.5                | 0.975   |
| Diastolic blood pressure, mmHg                | 76.7 ± 16.5               | 75.5 ± 20.4         | 75.5 ± 12.8         | 77.2 ± 16.2                 | 0.428   |
| Left ventricular ejection fraction, %         | 44.8 ± 13.0               | 42.6 ± 12.8         | 47.1 ± 11.2         | 44.9 ± 13.4                 | 0.208   |
| Heart failure with reduced ejection fraction  | 95 (33.1%)                | 23 (40.4%)          | 12 (24.5%)          | 60 (33.1)                   |         |
| Heart failure with mid-range ejection fraction| 58 (20.2%)                | 13 (22.8%)          | 10 (20.4%)          | 35 (19.3%)                  | 0.378   |
| Heart failure with preserved ejection fraction| 134 (46.7%)               | 21 (36.8%)          | 27 (55.1%)          | 86 (47.5%)                  |         |
| **Laboratory data**                           |                           |                     |                     |                             |         |
| Hemoglobin* < 12 g/dL                         | 182 (46.7%)               | 28 (47.5%)          | 34 (58.6%)          | 120 (44.0%)                 | 0.126   |
| Serum creatinine*, mg/dL                      | 1.5 ± 1.2                 | 1.8 ± 2.0           | 1.4 ± 0.3           | 1.4 ± 1.0                   | 0.056   |
| eGFR, mL/min                                  | 52.8 ± 24.4               | 48.5 ± 24.1         | 51.0 ± 24.4         | 54.1 ± 24.4                 | 0.244   |
| eGFR < 30 mL/min                              | 74 (19.2%)                | 14 (24.1%)          | 14 (24.6%)          | 46 (17.0%)                  | 0.324   |
| NT-proBNP, pg/mL                              | 15860.4 ± 26573.5         | 17415.1 ± 31780.0   | 19307.2 ± 25913.2   | 14833.8 ± 25390.2           | 0.503   |
| **Clinical evaluation monitoring**            |                           |                     |                     |                             |         |
| Echocardiography performed                    | 287 (72.5%)               | 57 (93.4%)          | 49 (83.1%)          | 181 (65.6%)                 | < 0.001 |
| NT-proBNP assessed                            | 355 (89.6%)               | 58 (95.1%)          | 48 (81.4%)          | 249 (90.2%)                 | 0.041   |
| Admission vs. discharge of NT-proBNP          | 34 (8.6%)                 | 7 (11.5%)           | 0                   | 27 (9.8%)                   | 0.035   |
| Weight assessment                             | 209 (52.8%)               | 58 (95.1%)          | 20 (33.9%)          | 131 (47.5%)                 | < 0.001 |
| Admission vs. discharge of weight assessment  | 75 (18.9%)                | 40 (65.6%)          | 5 (8.5%)            | 30 (10.9%)                  | < 0.001 |

Data are presented as means ± SD or n (%). *Presented as data available for 390 patients (59 patients in Cardiology, 58 patients in Geriatrics and 273 patients in Internal Medicine). †Presented as data available for 387 patients (59 patients in Cardiology, 57 patients in Geriatrics and 271 patients in Internal Medicine). eGFR: estimated glomerular filtration rate; NT-proBNP: N-terminal pro-B-type natriuretic peptide.

As shown in Figure 1A, in the whole population, the average in-hospital length of stay was 9 days, significantly shorter in Internal Medicine and Cardiology than in Geriatrics. In-hospital mortality is shown in Figure 1B: 37 patients (9.3%) died during hospitalisation, including 10 patients (16.4%) in Cardiology, 11 patients (18.6%) in Geriatrics, and 16 patients (5.8%) in Internal Medicine.

Pharmacological treatments on admission and at discharge are reported in Table 3. The prescription of agents recommended by guidelines [angiotensin-converting enzyme inhibitors (ACE-Is) or angiotensin II receptor blockers (ARBs), beta-blockers (BBs), and mineralocorticoid receptor antagonists (MRAs)] increased from admission to discharge in all settings of care, more frequently in Cardiology and Internal Medicine, with a consensual increase also in the total number of drugs prescribed at discharge which reached the considerable number of nearly 12. Interestingly, in Geriatrics not only the increase in prescription was less marked but also a decrease in diuretics prescription and a reduction in the total number of drugs at discharge were observed. When restricting the analysis to the prescription of drugs recommended at discharge in HFrEF (Table 4), we observed a higher prescription of diuretics and BBs in all three settings of care and a lower prescription of ACE-Is/ARBs and MRAs. Finally, an outpatient follow-up was planned at discharge in only 74 patients (20.6%), including 34 patients (66.7%) in Cardiology, 9 patients (18.8%) in Geriatrics and 31 patients (11.9%) in Internal Medicine (Figure 2).
Figure 1  Total in-hospital length of stay (A) and in-hospital mortality (B) in the study population and among the different settings of care.

Table 3  Pharmacological treatments on admission and at discharge among the different settings of care.

| Variable | Admission | Discharge |
|----------|-----------|-----------|
|          | Total population (n = 396) | Cardiology (n = 61) | Geriatrics (n = 59) | Internal Medicine (n = 276) | P-value | Total population (n = 359) | Cardiology (n = 51) | Geriatrics (n = 48) | Internal Medicine (n = 260) | P-value |
| ACE-Is/ARBs | 195 (49.2%) | 28 (45.9%) | 28 (47.5%) | 139 (50.4%) | 0.784 | 182 (50.7%) | 34 (66.7%) | 25 (52.1%) | 123 (47.3%) | 0.040 |
| BBs | 203 (51.3%) | 36 (59.0%) | 33 (55.9%) | 134 (48.6%) | 0.267 | 240 (66.9%) | 39 (76.5%) | 31 (64.6%) | 170 (65.4%) | 0.287 |
| MRAs | 67 (16.9%) | 9 (14.8%) | 7 (11.9%) | 51 (18.5%) | 0.416 | 150 (41.8%) | 18 (35.3%) | 14 (29.2%) | 119 (45.8%) | 0.205 |
| Ivabradine | 10 (2.5%) | 3 (4.9%) | 1 (1.7%) | 6 (2.2%) | 0.423 | 13 (3.6%) | 4 (7.8%) | 1 (2.1%) | 8 (3.1%) | 0.207 |
| Furosemide | 275 (69.5%) | 42 (68.8%) | 43 (72.9%) | 190 (68.8%) | 0.562 | 326 (90.8%) | 46 (90.2%) | 38 (79.2%) | 242 (93.1%) | 0.026 |
| Digoxin | 47 (11.9%) | 4 (6.6%) | 8 (13.6%) | 35 (12.7%) | 0.371 | 42 (11.7%) | 11 (21.6%) | 4 (8.3%) | 27 (10.4%) | 0.056 |
| Total drugs | 7.9 ± 3.8 | 7.6 ± 4.1 | 7.7 ± 3.6 | 8.0 ± 3.8 | 0.642 | 11.6 ± 3.8 | 11.2 ± 3.4 | 9.6 ± 2.9 | 12.1 ± 3.9 | < 0.001 |

Data are presented as means ± SD or n (%). ACE-Is: angiotensin-converting enzyme inhibitors; ARBs: angiotensin receptors blockers; BBs: beta-blockers; MRAs: mineralocorticoid receptors antagonists.

Table 4  Pharmacological treatments of patients with heart failure with reduced ejection fraction at discharge among the different settings of care.

| Variable | Total population (n = 88) | Cardiology (n = 22) | Geriatrics (n = 10) | Internal Medicine (n = 56) | P-value |
|----------|---------------------------|---------------------|--------------------|---------------------------|---------|
| ACE-Is/ARBs | 49 (55.7%) | 15 (68.2%) | 7 (70.0%) | 27 (48.2%) | 0.129 |
| BBs | 73 (83.0%) | 19 (86.4%) | 10 (100.0%) | 44 (78.6%) | 0.430 |
| MRAs | 48 (54.5%) | 9 (40.9%) | 5 (50.0%) | 34 (60.7%) | 0.487 |
| Furosemide | 86 (97.7%) | 22 (100.0%) | 8 (80.0%) | 56 (100.0%) | 0.111 |
| Ivabradine | 6 (6.8%) | 2 (9.1%) | 0 | 4 (7.1%) | 0.520 |
| Digoxin | 12 (13.6%) | 3 (13.6%) | 1 (10.0%) | 8 (14.3%) | 0.008 |

Data are presented as n (%). ACE-Is: angiotensin-converting enzyme inhibitors; ARBs: angiotensin receptors blockers; BBs: beta-blockers; MRAs: mineralocorticoid receptors antagonists.

DISCUSSION

Although most of existing acute HF registries describe patients admitted to Cardiology wards,[8–11] about three quarters of patients with this condition are assigned to Internal Medicine or Geriatrics.[11] Consistent with this potential selection bias, cardiological clinical registries enrol populations that are generally younger than those included in administrative registries.

To our knowledge, ATHENA represents the only clinical registry of acute HF that includes older patients assigned to either Cardiology, Internal Medicine or Geriatrics, after accessing the ED of a large, tertiary academic hospital. Accordingly, the mean age of our study population was much higher than in clinical cardiological registries, such as the European Society of Cardiology Heart Failure Long-Term (ESC-HF-LT) registry (64.8 years)[11] and the Italian registry on Heart Failure (IN-HF) Outcome (72
years),[10,14] being closer to the mean age of the ARNO Observatory Administrative registry (78 years).[1] If, on one hand, this is an obvious consequence of having selected patients ≥ 65 years for enrolment in ATHENA registry; on the other hand, the lower age of patients admitted to Cardiology than to Geriatrics or Internal Medicine suggests that age itself is probably one of the criteria for setting assignment after evaluation in the ED.

Consistent with an average older age, in our study more than 50% of patients were females, who in fact are known to be at higher risk of developing HF as they age.[4,5] In the ARNO Observatory Administrative registry, females represented 51.4% of subjects, being absolutely prevalent in the subset ≥ 85 years,[1] while rarely their prevalence reaches 40% in cardiological registries.[10,11,14]

Comorbidities and Clinical Presentation

The high prevalence of non-CV comorbidities is a further finding consistent with the advanced age in ATHENA registry. A history of CKD was observed in as many as a third of our patients, a rate similar to those reported in the IN-HF Outcome,[10,14] and the European Society of Cardiology Heart Failure Pilot (ESC-HF Pilot) registry.[15] However, severe renal dysfunction (eGFR < 30 mL/min) during hospitalization occurred in 20% of our study population, with a prevalence being remarkably higher than that observed in the ESC-HF-LT registry (~11%).[13] Anaemia on admission was another frequent finding in our population, with rates that were higher than those reported in the ESC-HF-LT registry (~37%).[11] The high prevalence of depressive symptoms and cognitive impairment were in line with those of the ARNO Observatory Administrative registry[1] and was higher in Geriatrics. This finding may have at least three different explanations: epidemiology-related (older population are at higher risk of cognitive impairment), cultural education-related (greater attention of geriatricians to recognise these clinical conditions) and setting-related (presence of these conditions on admission may increase the probability of assignment to Geriatrics). Due to the well-recognized negative prognostic impact of these non-CV comorbidities in HF, this would recommend their prompt assessment and treatment, ideally by a multidisciplinary team.[16–18]

In keeping with previous administrative[1] and cardiological registries,[10,11,14] one third of our patients had a history of diabetes mellitus. Interestingly, the prevalence of diabetes mellitus was lower in Geriatrics, as a probable consequence of increased, selective early mortality observed in diabetic HF patients.[19]

In ATHENA registry, de novo HF accounted for a quarter of presentations, much less commonly than reported by cardiological registries (43% in the Italian Network on Heart Failure Outcome registry and 49% in the Global Research on Acute Conditions Team registry).[10,20] The percentage of de novo HF assigned to Geriatrics was only marginally lower than that to Internal Medicine and, most surprisingly, to Cardiology, while one would expect this should be a feature favouring assignment to a setting devoted to fully assess disease aetiology. Furthermore, we observed a high prevalence of HFpEF that was coherent with the advanced age of the population and was significantly higher than in the ESC-HF-LT registry (21.6%).[21] Consistent with the characteristics of our population, the main causes of hospitalization were non-CV, as already shown by the administrative registries.[1]

A history of ischemic aetiology was found in over 35% of the whole series, in significantly lower percentages in Internal Medicine and Geriatrics compared to Cardiology, where data were in line with cardiological registries.[11,14]

In-hospital Clinical Management and Treatments

Analysing in-hospital management according to European Society of Cardiology guidelines for the diagnosis and treatment of acute and chronic HF[2] that were operative at the time of ATHENA re-
gistry, we found a suboptimal adherence to recommendations. In fact, nearly one third of the study population did not receive an echocardiographic examination, with significant differences across settings of care, which ranged from 6% to 34% of missing exams in Cardiology and in Internal Medicine, respectively. Furthermore, recommendations for weight measurement were largely unattended (52.8% and only 18.9% had at least one measurement and a measurement control prior to discharge, respectively), again with significant setting-related differences in favour of Cardiology. NT-proBNP was measured in about 90% of patients, generally on admission but rarely prior to discharge, as suggested by guidelines in order to evaluate decongestion and achievement of euvolemic status. A follow-up visit was scheduled only in 20.6% of cases, more frequently in Cardiology than in Geriatrics or Internal Medicine; similar results were observed in the TEMISTOCLE (hearT failurE epideMIological STudy in itaLian pEople) study,[22] in which the planning of a follow-up visit was greater in Cardiology than in Internal Medicine. This highlights the need for extensive planning of post-discharge multidisciplinary care services, particularly in these very frail and comorbid elderly individuals, who are at high risk of readmission, mainly in the so-called transition phase early after discharge.[23]

When analysing treatments at discharge, we observed an under-prescription of Guideline Directed Medical Therapy respect to cardiological registries, especially for renin-angiotensin-aldosterone system inhibitors.[11] This observation was more evident analysing in detail pharmacological treatments of patients with HFrEF: again, we observed a good prescription rate of BBs, while the prescription of ACE-Is/ARBs and MRAs was only slightly above 50%. These data differed from cardiological registries, such as the ESC-HF-LT registry, in which the prescription rate of ACE-Is/ARBs and MRAs were around 90% and 60%, respectively.[11] These findings may have different explanations: cultural, due to lack of knowledge and therefore implementation of guidelines; but also clinical, secondary to comorbid conditions, such as CKD, and multimorbidity-related polypharmacy. Indeed, elderly patients enrolled in our study had a high burden of comorbidity and, hence, it is not surprising the very high mean number of drugs they were discharged on. This might have been a factor limiting Guideline Directed Medical Therapy implementation, as the risk of pharmacological interactions exponentially rises with increasing numbers of medications.[24] Data concerning the number of medications in acute HF patients at discharge are quite scarce: the only available in the literature reports an average number of 8 drugs, but in patients much younger than ours.[29]

In-hospital Outcomes and Length of Stay

In our study, the mean duration of total in-hospital length of stay was 9 days. This result was similar to what observed in cardiological registries, such as the IN-HF Outcome (10 days)[10,14] and the ESC-HF Pilot registry (8 days),[15] slightly shorter than reported in the ARNO Observatory Administrative registry study (12 days),[1] but much longer than in the Get With The Guidelines-HF (GWTG-HF)[8] and the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) registries (about 6 days).[26,27] The mean total length of stay in our study was shorter in patients admitted to Internal Medicine (~8 days) than in those admitted to Geriatrics (~14 days). Total in-hospital mortality was high (9%), reflecting the complexity of this old and comorbid population, and higher than in previous registry study, such as the IN-HF Outcome (6.4%), the ESC-HF-LT registry (5.5%), OPTIMIZE-HF registries (3.8%) and GWTG-HF (3.4%).[8,10,21,26,27] The lower in-hospital mortality observed in Internal Medicine may reflect either a lower risk profile of patients admitted to this setting or a different management strategy aiming at shorter in-hospital stay. Nevertheless, these data should only be considered exploratory, since results on outcomes will need to be adjusted by the baseline clinical characteristics of patients enrolled in the different settings.

LIMITATIONS

The main limitation of our study is in its retrospective design, with data drawn from medical records. Therefore, the incidence of some complications or clinical findings may not be in keeping with those reported in previous studies as a consequence
of the different sensitivity of physicians in the various settings in reporting such information. Furthermore, setting assignment from the ED was based on clinical judgment and bed availability leading to a potential bias (i.e., sicker patients admitted to Cardiology). Moreover, though the sample size was large, it was not as large as other observational studies conducted on acute HF. Finally, the monocentric nature of our study may limit its generalizability to the universe of acute HF which, as we observed, may be admitted to different settings of care.

CONCLUSIONS

To the best of our knowledge, ATHENA is the only clinical registry designed to enrol selectively older patients hospitalised for acute HF in the three settings that most frequently care this syndrome: Cardiology, Internal Medicine and Geriatrics. For this peculiarity, our study population, made of elderly and very elderly patients, largely differs from that of randomised clinical trials and cardiological registries, and hence provides a real-world portrait of the typical patient hospitalised nowadays for acute HF: frequently an older woman, with a high burden of mainly non-CV comorbidities, usually admitted to non-cardiological settings of care, with highly prevalent HfPEF and hospitalisations frequently due to worsening of chronic HF, driven by non-CV precipitating factors. Moreover, our study highlighted relevant differences across the three settings for the adherence to management and treatment guidelines, which was overall suboptimal, particularly among Internal Medicine and Geriatrics. Finally, we may argue that the higher in-hospital mortality observed in our study, compared to other clinical registries further, reinforces the need for a multidisciplinary approach to manage multimorbid, elderly patients, who are today most prevalent among those hospitalised for acute HF.

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