Journal of
Cardiology & Cardiovascular Therapy
ISSN: 2474-7580

Juniper Publishers
key to the Researchers

Review Article
Volume 19 Issue 3 - August 2024
DOI: 10.19080/JOCCT.2024.19.556014

J Cardiol & Cardiovasc Ther
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Prognostic Factors of Adverse Events in Acute Heart Failure in Older Adults

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Submission: July 29, 2024; **Published:** August 08, 2024

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Highlights

Acute Heart Failure (AHF) is a severe and prevalent disease, especially in older adults. Functional impairment and bedsores were associated with adverse events in AHF patients. Functional impairment and mood disorders were associated with unfavorable follow-up after hospitalization.

Abstract

Objective: Acute heart failure (AHF) is a severe and prevalent disease, especially in older adults. The primary objective of our study was to identify the impact of geriatric factors on adverse events (increased length of hospitalization, death during hospitalization, or transfer to another acute unit) during hospitalization for AHF. The second objective was to identify the impact of geriatric factors on not returning home after hospitalization.

Methods: In this retrospective multicenter study in France, older adults ≥ 75 years old hospitalized in 4 different acute geriatric units in Marseille for AHF from January 2018 to December 2019 were included. All the included patients were identified according to the Program for Medicalization of Information Systems (PMSI) coding, with the main diagnosis of AHF being referred to as the "principal diagnosis".

Results: A total of 187 patients with AHF were included. The mean age was 88.2 years (± 5.5), and 69.5% were women. The death rate was 9.6%, and the length of stay was increased for 41.7% of patients. In multivariate analysis, adverse events significantly increased in patients with functional impairment and bedsores. The odds of an unfavorable follow-up after hospitalization significantly increased in patients with mood disorders and functional impairment.

Conclusion: Our study highlighted functional impairment, mood disorders, and bedsores as factors that impacted adverse events and unfavorable follow-up after hospitalization in patients managed for AHF. These geriatric domains should be considered in the management of AHF to improve survival, functional status, and the number of older patients who return home after hospitalization.

Keywords: Cardiovascular; Frailty; Geriatric cardiology; Risk factors; Length of stay in hospital; Heart failure

Introduction

Acute heart failure (AHF) is a clinical syndrome characterized by signs and symptoms of fluid overload that requires hospitalization in an acute cardiac unit or acute medicine unit in most cases. AHF can be the first presentation of heart disease but is more commonly decompensation of a preexisting chronic cardiomyopathy, also called chronic heart failure (CHF) [1]. The prevalence of AHF in the French population is 2.3% and increases considerably with age [2], reaching up to 15% in individuals over the age of 80 [3]. The 1-year mortality rate is 35% in patients between 80 and 89 years of age and 50% after 90 years [4]. The increase in death rate associated with age can be explained by its cardiovascular origin but also some comorbidities in older adults [5]. Indeed, some factors, such as diabetes, obesity or chronic renal failure, are well known to increase hospitalizations for AHF [1]. Furthermore, diabetes and chronic renal failure increase with age.

Many causes of AHF (myocardial infarction, hypertension, infections, and valve diseases) become more common with age. Among the clinical signs of AHF in older adults, there are often atypical signs (delirium, anorexia, sleep disorders, asthmatic dyspnea), making the diagnosis difficult in this population. Atypical signs of AHF in older adults result in a delayed diagnosis compared to younger adults, sometimes impairing management in the first hours following the onset of symptoms [6].

Frailty is an aging-associated concept that is based on a decline in physiological reserve capacities, resulting in an impaired ability to cope with external stresses. Its clinical expression depends on comorbidities and psychological, social, economic, and behavioral factors [7]. The assessment of frailty in older adults is based on the Comprehensive Geriatric Assessment (CGA), which encompasses several domains, such as functional status, cognitive or mood function, nutritional status, and physical function [8]. The prevalence of frailty can reach 70% in patients with AHF over 80 years of age [9] and could be linked to poor outcomes for older patients [10]. Frailty is also independently associated with a risk of AHF in older adults [11]. Some geriatric syndromes (comorbidities, cognitive impairment, frailty, disability, malnutrition) are also associated with poor survival in older adults with AHF [12].

The primary objective of our study was to identify the impact of geriatric factors on adverse events (increased length of hospitalization, death during hospitalization, or transfer to another acute unit) during hospitalization for AHF in an acute geriatric unit. The second objective of this study was to identify the impact of geriatric factors on the return home after hospitalization in an acute geriatric unit for AHF (transfer to a rehabilitation unit and/or transfer to a nursing home or long-term geriatric care unit).

Materials and Methods

Population and Study Design

This retrospective, multicenter study involved 4 different acute geriatric units in Marseille: 3 acute geriatric units at Marseille University Hospital (La Timone, Nord, and Sainte-Marguerite Hospitals) and the acute geriatric unit at the Departmental Gerontological Center in Marseille. The study was conducted from 1 January 2018 to 31 December 2019 on patients aged ≥ 75 years managed for AHF in these 4 acute geriatric units. Patients were identified for inclusion in the study according to the Program for Medicalization of Information Systems coding with a main diagnosis of AHF, referred to as the "diagnosis-related group: heart failure and cardiogenic shock". Patients with a secondary diagnosis of AHF were not included. Patients aged under 75 years and/or for whom the main diagnosis was not AHF were excluded. According to the above criteria, 187 patients were screened, and no patient was excluded as a result of missing data. All patients were prospectively registered at baseline in a geriatric database in accordance with the French database and privacy law (Commission Nationale de l'Informatique et Liberté CNIL registration number 21-185). The study was approved by the local Aix-Marseille University ethics committee under number 2023-01-05-01.

For each patient, the following data were collected from the medical records at the 4 acute geriatric units by a geriatrician:

a) Demographics: age, sex, and lifestyle

b) Components of the CGA: nutrition status was determined using body mass index (BMI) (impaired < 21 kg/m2), weight loss of 5% in 1 month or 10% in 6 months, albumin levels (impaired < 35 g/L) or Mini Nutritional Assessment (MNA) score (impaired < 17) in accordance with French recommendations in 2007 [13]; cognitive disorders were detected using the Mini Mental State Examination (MMSE) (impaired < 20/30 [14]) or cognitive impairments mentioned in medical records; mood disorders were identified by the use of benzodiazepines and/or antidepressants according to hospital prescriptions or depression or anxiety mentioned in medical records; sensory disorders included vision disorders mentioned in medical records or identified by the presence of untreated macular degeneration or cataracts or hearing disorders mentioned in medical records or identified by the presence of a hearing aid; functional impairment was assessed using Activities of Daily Living (ADL) (impaired ADL < 3/6 [15]) and/or Instrumental Activities of Daily Living (impaired < 4/4 [16]), immobilization with bed rest >12 hours per day, history of two falls in the past year [17], comorbidities as assessed with the Charlson index [18], and polypharmacy (≥ 5 personal drugs [19]); vesico-sphincter disorders were identified by incontinence mentioned in medical records or the use of a penis bag, indwelling catheter, or urinary protection; and the existence of bedsores was determined from medical records on admission (graded from Stage 1 to Stage 4, 1: epidermal damage, 2: dermal and epidermal damage, 3: muscle damage, 4: bone damage) [20].

c) Laboratory data: anemia (hemoglobin (Hb) < 12 g/dL in men, < 13 g/dL in women [21]), martial deficiency (transferrin saturation coefficient < 20% and ferritin < 100 µg/L [22]), NT-pro BNP (impaired ≥ 125 pg/mL), BNP (impaired ≥ 35 pg/mL)

d) Cardiological data: cardiovascular medical history including coronary heart disease, hypertension, CHF, atrial fibrillation, unoperated severe aortic stenosis, presence of a defibrillator, presence of a pacemaker, transcatheter aortic valve implantation (TAVI) or mechanical or biological valve and left ventricular ejection fraction (LVEF) determined by ultrasound

e) Adverse events: increased length of hospitalization (> 14 days, two times the median stay for AHF in French hospitals) [23], death during hospitalization, transfer to another acute unit

f) Follow-up after hospitalization: transfer to a rehabilitation unit, transfer to a nursing home or long-term geriatric care unit or return home (patients who lived in a nursing home before hospitalization were considered as returning home).

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Statistical Analysis

Discrete variables are expressed as total numbers and percentages of each discrete criterion. Continuous data are expressed as the means and standard deviations together with minimum and maximum values. Comparative univariate analysis of the geriatric data was performed using Pearson's chi-square test and Fisher's exact test or Student's t test, as appropriate. Binary logistic regression was used for multivariate analysis of the factors associated with adverse events and outcomes after hospitalization. The statistical results are expressed as odds ratios (ORs) and 95% confidence intervals (CIs). Differences were considered statistically significant at a two-tailed P value of less than 0.05.

Results

Baseline characteristics

A total of 187 patients with AHF were included. The mean age was 88.2 years (± 5.5), and 69.5% (n = 130) were women. The mean length of stay was 12.4 days (± 7.9). The baseline characteristics are shown in Table 1, and the cardiological characteristics are shown in Table 2.

Table 1: Baseline characteristics and geriatric domains in the population.

Characteristics	Total population N = 187	
	N or mean (± SD)	% or min-max
Women	130	69.5
Age	88.2 (± 5.5)	75-105
Malnutrition[1]	78	41.7
Cognitive disorders[2]	110	58.8
Sensory disorders[3]	54	28.9
Mood disorders[4]	87	46.5
Functional impairment[5]	130	69.5
Bedsores[6]	27	14.4
Falls (> 2 per year)	55	29.7
Polypharmacy (≥ 5 drugs)	161	86.1
Immobilization[7]	24	12.8
Vesico-sphincter disorders[8]	99	52.9
Charlson index	8.4 (± 2.2)	4-16

Notes:

[1]Body mass index (BMI) (impaired < 21 kg/m^2), weight loss of 5% in 1 month or 10% in 6 months, albumin levels (impaired < 35 g/L) or Mini Nutritional Assessment (MNA) (impaired < 17) in accordance with French recommendations in 2007 (13). Missing data: 11.

[2]Mini Mental State Examination (MMSE) (impaired < 20/30 (14)), or cognitive impairments mentioned in medical records. Missing data: 7.

[3]Vision disorders mentioned in medical records or presence of untreated macular degeneration or cataracts or hearing disorders mentioned in medical records or presence of hearing aid.

[4]Benzodiazepines and/or antidepressants based on hospital prescriptions, depression or anxiety mentioned in medical records.

[5]Activities of daily living (ADL) (impaired < 3/6 (15)) and/or instrumental activities of daily living (impaired < 4/4 (16)). Missing data: 5.

[6]Bedsores mentioned in the medical records on admission to hospital (Stage 1 to 4, 1: epidermal damage, 2: dermal and epidermal damage, 3: muscle damage, 4: bone damage).

[7]Bed rest > 12 hours per day.

[8]Incontinence mentioned in medical records or use of penis bag, indwelling catheter, or urinary protection. Missing data: 18.

Table 2: Cardiological characteristics in the population.

Characteristics	Total population N = 187	
	N or mean (± SD)	% or min-max
LVEF[1]	46.1 (± 14.3)	15-74
Chronic HF	113	60.4
Coronaropathy	115	61.5

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Unoperated severe aortic stenosis	17	9.1
Atrial fibrillation	137	73.3
Hypertension	134	71.7
TAVI or mechanical or biological valve	10	5.3
Presence of a defibrillator or pacemaker	23	12.3

Fraction; NT-pro BNP: N-terminal pro-brain natriuretic peptide; TAVI: transcatheter aortic valve implantation.

Notes:

[1]Missing data: 64.

Concerning the biological characteristics, 105 patients (56.1%) had anemia, 52 (27.8%) had a martial deficiency, the mean NT-pro BNP level was 9634.1 ng/L (± 8885.9), and the mean BNP level was 1541.7 ng/L (± 2386.2).

Concerning adverse events, 18 patients (9.63%) died during hospitalization, 15 (8%) were transferred to an intensive care unit or another acute unit, the length of stay was increased for 78 patients (41.7%), and 102 patients (54.5%) returned home after hospitalization. Concerning the follow-up after hospitalization, 52 patients (27.8%) were transferred to a rehabilitation unit, nursing home, or long-term care unit.

Association of Geriatric Domains and Adverse Events (Length of Stay, All Causes of Mortality, and Transfer to Another Acute Unit)

The results of the univariate and multivariate analyses are summarized in Table 3.

Table 3: Univariate and multivariate analyses of geriatric domains associated with adverse events.

Variables	Univariate (N = 187)			Multivariate (N = 187)			
	Patients, N (%)	Adverse events, N (%) N = 76 (40.6%)*	No adverse events, N (%) N = 111 (59.4%)*	P	OR	95% CI (inf-sup)	P
Malnutrition[1]	78 (41.7)	40 (51.8)	38 (48.7)	0.032*	1.221	0.539-2.731	0.646
Cognitive disorders[2]	110 (58.8)	51 (46.4)	59 (53.6)	0.042*	1.383	0.546-3.503	0.494
Mood disorders[3]	87 (46.5)	43 (49.4)	44 (50.6)	0.026*	1.327	0.555-3.172	0.524
Neurosensitive disorders[4]	54 (28.9)	22 (40.7)	32 (59.3)	1			
Functional impairment[5]	130 (69.5)	66 (50.8)	64 (49.2)	< 0.001*	3.574	1.481-8.626	0.005*
Immobilization[6]	24 (12.8)	16 (66.7)	8 (33.3)	0.007*	1.117	0.329-3.784	0.859
Falls (> 2 per year)	55 (29.4)	24 (43.6)	31 (56.4)	0.624			
Polypharmacy (≥ 5 drugs)	161 (86.1)	69 (42.9)	92 (57.1)	0.138	3.272	0.921-11.629	0.067
Bedsores[7]	27 (14.4)	19 (70.4)	8 (29.6)	0.001*	3.3	1.192-9.132	0.022*
Vesico-sphincter disorders[8]	99 (52.9)	50 (50.5)	49 (49.5)	0.027*	1.375	0.518-3.647	0.522

Abbreviations: CI: confidence interval; OR: odds ratio.

Notes:

[1]Body mass index (BMI) (impaired < 21 kg/m^2), weight loss of 5% in 1 month or 10% in 6 months, albumin (impaired < 35 g/L) or Mini Nutritional Assessment (MNA) (impaired < 17) in accordance with French recommendations in 2007 (13).

[2]Mini mental state examination (MMSE) (impaired < 20/30 (14)), or cognitive impairments mentioned in medical records.

[3]Vision disorders mentioned in medical records or presence of untreated macular degeneration or cataracts or hearing disorders mentioned in medical records or presence of hearing aid.

[4]Benzodiazepines and/or antidepressants based on hospital prescriptions, depression or anxiety mentioned in medical records.

[5]Activities of daily living (ADL) (impaired ADL < 3/6 (15)) and/or Instrumental activities of daily living (impaired < 4/4 (16)).

[6]Mentioned in medical records on admission to hospital (Stage 1 to 4, 1: epidermal damage, 2: dermal and epidermal damage, 3: muscle damage, 4: bone damage).

[7]Bed rest > 12 hours per day.

[8]Incontinence mentioned in medical records, or use of penis bag, indwelling catheter, or urinary protection.

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In the multivariate analysis, adverse events increased significantly in patients with functional impairment (aOR 3.57 [1.48-8.626], p = 0.005) and bedsores (aOR 3.3 [1.192-9.132], p = 0.022).

Association of Geriatric Domains and Follow-up After Hospitalization (Transfer to Nursing Home, Long-term Care Unit, or Rehabilitation Unit)

Table 4: Univariate and multivariate analysis of geriatric domains associated with not returning home after hospitalization.

Variables	Univariate (N = 187)			Multivariate (N = 187)			
	Patients, N (%)	Did not return home, N (%) N = 52 (27.8%)	Returned home, N (%) N = 135 (72.2%)	P	OR	95% CI (inf-sup)	P
Malnutrition[1]	78 (41.7)	27	51	0.244			
Cognitive disorders[2]	110 (58.8)	36	74	0.087			
Mood disorders[3]	87 (46.5)	56	31	0.033*	2.08	1.08-3.99	0.033*
Neurosensitive disorders[4]	54 (28.9)	17	37	0.589			
Functional impairment[5]	130 (69.5)	42	88	0.046*	2.28	1.08-3.99	0.046*
Immobilization[6]	24 (12.8)	5	19	0.474			
Falls (> 2 per year)	55 (29.4)	19	36	0.213			
Polypharmacy (≥ 5 drugs)	161 (86.1)	45	116	1			
Bedsores[7]	27 (14.4)	6	21	0.504			
Vesico-sphincter disorders[8]	99 (52.9)	29	79	0.382			

Abbreviations: CI: confidence interval; OR: odds ratio.

Notes:

[1]Body mass index (BMI) (impaired < 21 kg/m^2), weight loss of 5% in 1 month or 10% in 6 months, albumin (impaired < 35 g/L) or Mini Nutritional Assessment (MNA) (impaired < 17) in accordance with French recommendations in 2007 (13).

[2]Mini mental state examination (MMSE) (impaired < 20/30 (14)) or cognitive impairments mentioned in medical records.

[3]Vision disorders mentioned in medical records or presence of untreated macular degeneration or cataracts or hearing disorders mentioned in medical records or presence of hearing aid.

[4]Benzodiazepines and/or antidepressants based on hospital prescriptions, depression or anxiety mentioned in medical records.

[5]Activities of daily living (ADL) (impaired ADL < 3/6 (15)) and/or instrumental activities of daily living (impaired <4/4 (16)).

[6]Mentioned in medical records on admission (Stage 1 to 4, 1: epidermal damage, 2: dermal and epidermal damage, 3: muscle damage, 4: bone damage).

[7]Bed rest > 12 hours per day.

[8]Incontinence mentioned in medical records or use of penis bag, indwelling catheter, or urinary protection.

Univariate and multivariate analyses of geriatric domains associated with an unfavorable follow-up after hospitalization are summarized in Table 4.

In the multivariate analysis, transfer to a nursing home, long-term care unit or rehabilitation unit increased significantly in patients with mood disorders (p = 0.033, OR 2.08 [1.08-3.99]) and functional impairment (p = 0.046, OR 2.28 [1.08-3.99]).

Discussion

AHF is a severe disease in older adults because of the high mortality rate during hospitalization (9.6% of patients) and the extended length of hospitalization (41.7% of patients). One-third of older patients did not return home after hospitalization for AHF, which is consistent with the literature [24]. To our knowledge, this is the first study to look at the management of AHF in older patients, which showed that the number of adverse events was related to bedsores and functional impairment and that follow-up after hospitalization (no return home) was related to functional impairment and mood disorders.

The mortality in our study was similar to that in the literature on AHF in older adults, which is up to approximately 10% of patients. In the ALARM-HF study, the mortality rate was 12%, but patients were mainly hospitalized during follow-up care, which was not the case in this study [25]. In acute medicine units in France, the

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all-cause mortality rate varies from 7.7% to 9.4% according to the French Program for Medicalization of Information Systems [26]. On average, our study highlighted that the high mortality rate in pediatric acute units was lower than that in geriatric acute units where patients have more comorbidities and a high number of medical complications. This high mortality can also be explained by the fact that the majority of patients hospitalized with heart failure still have signs of residual congestion seven days after admission, which is associated with a greater risk of death [27].

The mean length of stay was 12.4 days (± 7.9) and was longer than 14 days in 41.7% of cases. For patients hospitalized in French acute geriatric units for AHF, the mean national length of hospitalization is 10 days [28]. The mean stay observed in this study was higher, possibly because our patients were older (mean age 88.2 (± 5.5) years), compared with some studies where the mean age was 80 years [29], and had more comorbidities (mean Charlson index: 8.4 (± 2.2)).

Adverse events and follow-up after hospitalization were related to functional impairment in our study sample. The majority of the included patients had impaired ADL and IADL (69.5%) on admission to the hospital. These results concerning poor outcomes related to functional impairment in AHF management are consistent with the literature. Indeed, functional status was described as an independent factor of mortality [30] in older adults. Some studies, such as the HADES study [31] and the RICA study [32], have shown that in older adults with AHF, a low Barthel index increased 3-month mortality. The link between adverse events and functional impairment can be explained by a greater intolerance to anaerobic exercise, poorer prescribing of and compliance with treatment, or treatment prescribed by hospital practitioners due to greater frailties in older patients. Furthermore, difficulties in instrumental activities of daily living, such as the impossibility of using the telephone (with cognitive disorders, for example), could lead to greater difficulties in accessing care, as well as to less effective alerting of the attending physician and the family in the event of congestive signs or respiratory difficulties, thus delaying care.

AHF can itself be a cause of iatrogenic dependence leading to adverse events. It is also associated with not returning home after hospitalization and a poor prognosis in terms of functional autonomy (almost half of the patients). This iatrogenic dependence could be explained by the abusive use of urinary catheters, excessive intravenous fluid and insufficient diuresis, severe anemia, and sepsis, which are common in older adults [33]. This is important in terms of public health (cost relative to the increased length of stay in hospital, transfer to a rehabilitation center or nursing home) but also in terms of ethics (difficulties in returning directly home after hospitalization for AHF).

On admission, 14.4% of patients had bedsores in our study. The 1999 National Pressure Ulcer Prevalence Survey found a similar prevalence (14.8%), as well as a nosocomial prevalence of 7.1% [34]. Bedsores were also associated with adverse events, with a significantly higher 30-day mortality among patients with a low Norton score compared with those with an intermediate or high score. This trend was similar at 90 days and 1 year [35], which can be explained by malnutrition [36], sarcopenia due to immobilization in particular [37], and a longer stay due to this factor.

Over half of the patients in our study returned home. In France, the rate of institutionalization is approximately 33% after hospitalization in an acute care unit [24]. In a French study, approximately 23% of patients went to a rehabilitation unit because of frailty ($p < 0.001$), neurological ($p < 0.001$) and mood disorders ($p < 0.001$), or isolation ($p < 0.001$). This is consistent with our study, where we found a significant difference in those who did not return home in patients with mood disorders.

In our study, depression and anxiety (46.5%) increased significantly with an unfavorable outcome after hospitalization. These thymic disorders are indeed correlated with a more severe prognosis for chronic heart failure and a decrease in quality of life linked to physical inactivity and poor adherence to diet and treatment [38]. To our knowledge, these data were not available in the case of AHF. We believe that the screening and treatment of these disorders in patients hospitalized for acute heart failure could improve the outcomes and quality of life of these patients.

These results have a potential impact on clinical practice. Management of mood disorders and professional help at home in the case of functional impairment could change the outcomes of older patients hospitalized for AHF. This could have an impact in terms of public health because of the particularly high mortality and longer lengths of stay in this population, with a major societal cost [39]. In fact, Hanlon et al. [40] have shown frailty and pre-frailty were associated with mortality in older adults. Moreover, the recent creation of cardiogeriatric units in certain countries, including university hospitals in France, has shown a real benefit in terms of the management of geriatric patients managing frailty, in particular managing these geriatric syndromes cited in our study [40].

These findings should be considered in the context of several limitations. Because of the retrospective design, the number of patients was limited, and the diagnosis of these geriatric factors remains uncertain with an information bias (e.g., neurocognitive disorders diagnosed by MMSE or declared in the patient medical records). Next, we used a composite main objective, and an endpoint such as all-cause mortality would have been more appropriate in terms of statistical power. In addition, the population sample is small and limited to a small part of Southern France. No mention of the ethnicity of patients has been done. Once more, no information about socioeconomic condition of the patient has been reported. However, our study had several strengths. The population was representative of the general geriatric heart failure population in terms of the prevalence

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of different cardiac pathologies (2) and geriatric factors [41]. Furthermore, we used an original composite outcome including mortality, length of stay, and transfer to another unit because it seemed important from a geriatric point of view to put mortality in the same category as the length of stay in terms of iatrogenic dependence.

Conclusion

AHF is a disease with a poor prognosis in older adults because of the high mortality rates during hospitalization (9.6%), as well as the extended length of stay (41.7%). Our study highlighted functional impairment, mood disorders, and bedsores as affecting adverse events and an unfavorable outcome after hospitalization in patients managed for AHF. These geriatric domains should be considered during AHF hospitalization to improve survival and functional status in this frail population. With these results, a prospective validation study of a geriatric population should be undertaken. We can imagine using a predictive tool, particularly in cardiology departments, to screen frail patients and raise awareness among practitioners regarding geriatric interventions and the multidisciplinary management of older patients.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

F.B., S.B., A-L.C., P.V., F.P., C.M., S.B-G. and P.R. conceived and designed the research. F.B., S.B. and A-L.C. analyzed the data; F.B., S.B. and A-L.C. interpreted the results of the experiments; F.B., S.B. and A-L.C. prepared the tables; F.B., S.B. and A-L.C. drafted the manuscript; F.B.,S.A., F.P; S.B., A-L.C. and P.V. edited and revised the manuscript; F.B., S.B., A-L.C., P.V., F.P., C.M., S.B-G. and P.R; F.P approved the final version of the manuscript.

Funding

This work received no funding.

Acknowledgments

We would like to thank all the acute geriatric units that agreed to participate in this study.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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How to cite this article: Fannie B, Soumeya A, Franck P, Sonia B, Sylvie Bonin-G, et al. Prognostic Factors of Adverse Events in Acute Heart Failure in Older Adults. J Cardiol & Cardiovasc Ther 2024; 19(3):556014 DOI: 10.19080/JOCCT.2024.19.556014

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DOI: 10.19080/JOCCT.2024.19.556014

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