National survey on the management of heart failure in individuals over 80 years of age in French geriatric care units

Clémence Boully 1,2, Jean-Sébastien Vidal 1,2, Etienne Guibert 3,4,5, Fanny Nisrin Ghazali 6, Alain Pesce 7, Bérengère Beauplet 8, Jean-Dominique Roger 9, Isabelle Carrière 10, Boubacar Timbely 11, Houria Idiri 12, Jean-Pierre Constensoux 13, Anne-Marie Durocher 14, Delphine Dubail 1,2,15,16, Marc Fargier 10, Claude Jeandel 17, Gilles Berrut 18, Olivier Hanon 1,2* and on behalf of the SFGG study group

Abstract

Background: To evaluate the prevalence and management of heart failure (HF) in very old patients in geriatric settings.

Methods: Members of the French Society of Geriatrics and Gerontology throughout France were invited to participate in a point prevalence survey and to include all patients ≥80 years old, hospitalized in geriatric settings, with HF (stable or decompensated) on June 18, 2012. General characteristics, presence of comorbidities, blood tests and medications were recorded.

Results: Among 7,197 patients in geriatric institution, prevalence of HF was 20.5% (n = 1,478): (27% in acute care, 24.2% in rehabilitation care and 18% in nursing home). Mean age was 88.2 (SD = 5.2) and Charlson co morbidity score was high (8.49 (SD = 2.21)). Left ventricular ejection fraction (LVEF) was available in 770 (52%) patients: 536 (69.6%) had a preserved LVEF (≥ 50%), 120 (15.6%) a reduced LVEF (< 40%), and 114 (14.8%) a midrange LVEF (40–49%). Prescription of recommended HF drugs was low: 42.6% (629) used Angiotensin Converting Enzyme Inhibitors (ACEI) or Angiotensin Receptor Blockers (ARBs), 48.0% (709) β-blockers, and 21.9% (324) ACEI or ARB with β-blockers, even in reduced LVEF. In multivariate analysis ACEI or ARBs were more often used in patients with myocardial infarction (1.36 (1.04–1.78)), stroke (1.42 (1.06–1.91)), and diabetes (1.54 (1.14–2.06)). β blockers were more likely used in patients with myocardial infarction (2.06 (1.54–2.76)) and atrial fibrillation (1.70 (1.28–2.28)).

Conclusion: In this large very old population, prevalence of HF was high. Recommended HF drugs were underused even in reduced LVEF. These results indicate that management of HF in geriatric settings can still be improved.

Keywords: Heart failure, Heart failure treatment, Age > 80 years old, Geriatric settings, Left ventricular ejection fraction

Background

Low birth rates and higher life expectancy are transforming the demographics of Europe. The European Commission has estimated that by 2025, 20% of Europeans will be aged 65 years and older. The proportion of those aged 80 years and older in the Europe is expected to more than double between 2014 and 2050 from 5.1 to 10.9% [1]. Heart failure (HF) is a highly prevalent condition in the older population. After 80 years of age its prevalence varies between 15 and 20% [2–4]. Very old HF patients with multiple comorbidities are an important challenge for healthcare systems and are usually treated in geriatric institutions [5]. Despite a high prevalence and poor outcome, data on geriatric HF patients aged >80 years from randomized controlled trials are limited and guidelines for this population are...
extrapolated from data on younger patients. The growing size of this population, however, requires more information on its optimal management. Although, HF treatment is thought to be beneficial to patients with reduced LVEF regardless of age, the existing literature indicates that the prescription of recommended treatments for HF is low in geriatric HF patients [6]. The aim of the current study was to carry out a point prevalence survey to provide up-to-date data on the prevalence and management of HF in individuals aged 80 years and older in geriatric settings in France and to explore factors influencing drug treatment.

Methods
Study design
This cross-sectional survey was initiated and conducted by the French Society of Geriatrics and Gerontology. A standardized questionnaire was emailed to 1600 geriatrician members of the French Society of Geriatrics and Gerontology throughout France, to evaluate the characteristics of patients with HF aged 80 years and older who were hospitalized in geriatric acute-care units (hospital department for acute patients with multiple chronic comorbidities), rehabilitation care units (hospital department for rehabilitation of patients with various neurological, orthopedic and other medical conditions following stabilization of their acute medical problems) or living in nursing homes (community-based institutions for disabled subjects with stable medical condition otherwise).

Participants
Inclusion criteria were: age 80 years or older, diagnosis of decompensated or stable HF and hospitalized in a geriatric care unit for at least 24 h or living in a nursing home and present in the facility at 9 am on June 18, 2012.

 Decompensated HF was defined as presence of acute symptoms or signs of HF according to ESC guidelines [7, 8]. Stable heart failure was defined as history of hospitalization for heart failure and unchanged HF symptoms and signs for at least 1 month [7].

Data collection
For each patient, the following data were collected: demographic characteristics (age, gender, weight, systolic and diastolic blood pressure, heart rate) presence of cardiovascular comorbidities (hypertension, atrial fibrillation, history of myocardial infarction, history of stroke, diabetes, peripheral arterial disease, orthostatic hypotension) as well as non-cardiovascular comorbidities (anemia, renal insufficiency, malnutrition, dementia, falls (defined as ≥ 2 falls per year), chronic obstructive pulmonary disease (COPD), cancer), results of most recent blood tests (serum creatinine, electrolytes, albumin, hemoglobin, brain natriuretic peptide (BNP) and N-terminal brain natriuretic peptide (NTproBNP)), current medication (loop diuretic, thiazide diuretic, angiotensin converting enzyme inhibitor (ACEI), angiotensin II receptor blocker (ARB), β-blocker, aldosterone receptor antagonist, ivabradine, digoxin, nitrates), and whether the patients was advised to follow a low salt diet.

Antiplatelet and anticoagulant (therapeutic dose or prophylactic dose), and the total number of drug classes (for cardiovascular or non-cardiovascular drugs) were also recorder. Anemia was defined according to the World Health Organization criteria as a hemoglobin level lower than 13 g/dL in men and lower than 12 g/dL in women [9]. Estimated glomerular filtration rate (eGFR) was calculated using the Cockcroft and Gault formula [10]. Severe renal insufficiency was defined as eGFR < 30 ml/min. Malnutrition was defined as serum albumin level < 35 g/L.

The date of the last echocardiogram was noted as well as the left ventricular ejection fraction (LVEF) value. Finally, the burden of comorbidities was calculated using the age adjusted Charlson Comorbidity Index [11, 12].

Procedure
Data were collected by the physician who was in charge of the patient on June 18, 2012. Physicians had 1 month until July 18, 2012 to send the data.

Ethical consideration
The study was conducted in accordance with the ethical standards set forth in the Declaration of Helsinki (1983). The entire study protocol was approved by the ethics committee of Nantes (Groupe Nantais d’Ethique dans le Domaine de la Santé, France), and the study complied with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement guidelines [13]. All patients’ data were anonymized in the local institution before they were uploaded to the central database.

Data Analysis
First, demographic characteristics and clinical variables of the patients were analyzed in the whole sample and according to the type of geriatric care unit (acute care, rehabilitation care and nursing home) using descriptive statistics: means and standard deviations for continuous variables, and numbers and percentages for categorical variables. Comparisons were made with analysis of variance (ANOVA) for continuous data and with χ² test for categorical data.

Because of the non-normal distribution of the brain natriuretic peptide and N-terminal brain natriuretic peptide variables, they were log-transformed for the
calculation of the statistics but for the sake of clarity the non-logged figures are presented in the tables. Demographic characteristics and clinical variables of the patients were then compared between patients with decompensated and stable heart failure with Student’s t-tests for the continuous variables and χ² tests for the categorical variables.

Second, the differences in treatment between 3 groups of LVEF (preserved LVEF (≥ 50%), midrange LVEF (40–49%) and reduced LVEF (< 40%) [7] were graphically presented in a barplot and compared with χ² tests.

Third, comparisons were made between patients with and without ACEI or ARBs treatment and between patients with and without β-blocker treatment. Two logistic regression models were built, one with ACEI or ARB and one with β-blockers as dependent variable and factors univariately associated (p < 0.10) with the dependent variables. In these 2 models, LVEF was not included in the dependent variables because it was only available in 52% of the sample. The results were graphically presented on two forest plots. Because ACEI, ARB and β-blockers are medication recommended for HF with reduced EF, as sensitivity analysis, we built 2 other models, one with ACEI or ARB and one with β-blockers as dependent variables restricted to patients with reduced LVEF.

All analyses were two-sided and a p-value < 0.05 was considered statistically significant. Data analysis was performed using R software version 3.2.3, (R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/).

Results
Participants and patient characteristics
A total of 183 practitioners from 134 geriatric institutions participated in the survey: 58 from acute care units, 50 from rehabilitation care units and 75 from nursing homes. These practitioners were in charge of 7,197 patients: 1,397 acute care, 1,331 rehabilitation care and 4,469 nursing homes. Out of these 7,197 patients, 1,478 presented with HF on the day of the survey and were included in the study giving an overall HF prevalence of 20.5% (95% confidence interval 19.8–21.3%), 27.1% (25.2–29.1%) (N = 379) in acute care units, 24.2% (22.3–26.2%) (N = 322) in rehabilitation care units and 17.6% (16.7–18.5%) (N = 774) in nursing homes.

Demographic characteristics and past medical history of the sample are shown Table 1. The mean (SD) age was 88.2 (SD = 5.2) years and 68.9% (N = 1014) were women. The mean age adjusted Charlson comorbidity index score was 8.49 (2.21). The most common comorbidities were hypertension (77.6%), malnutrition (64.1%), anemia (59.9%), dementia (52.3%), atrial fibrillation (43.2%), depression (34.1%), history of myocardial infarction (28.5%), COPD (24.6%), diabetes (22.1%), peripheral arterial disease (20.0%), history of stroke (19.8%), orthostatic hypotension (18.5%) and cancer (16.3%). Patients were taking on an average of 8.43 (3.29) different drugs. Few patients (3.8% (57)) had a very low systolic blood pressure (< 100 mmHg in a sitting position). Heart rate was greater than 70 beats per minute (bpm) in 56.4% (816) of patients. In patients with permanent atrial fibrillation on the electrocardiogram, 40.7% (247) had a heart rate lower than 70 bpm whereas in patients in sinus rhythm on the electrocardiogram, 46.5% (369) had a heart rate lower than 70 (p = 0.04).

Only 780 (52.8%) patients had an available echocardiogram in their medical records. Ninety (11.6%) had an echocardiogram in the past week, 135 (17.4%) in the past 7–30 days, 181 (23.4%) in the past 1–6 months, 89 (11.5%) in the past 6–12 months, 107 (13.8%) in the past 12–24 months, and 172 (22.2%) over 2 years. Among the 780 patients with an available echocardiogram 770 had an LVEF calculated. The mean LVEF was 52.9% (14.4). 69.6% percent (536) had a preserved LVEF (LVEF ≥50%), 15.6% (120) had a reduced LVEF (LVEF < 40%), and 14.8% (114) had a midrange ejection fraction LVEF (40–49%).

 Decompensated HF was reported in 21.4% (n = 316) and stable HF in 78.4% (n = 1158) for 4 subjects the information was missing.

For decompensated HF, the main precipitating factors leading to decompensation were infections (44.1%), atrial fibrillation (29.9%), anemia (19.7%) and acute coronary syndrome (10.0%).

Overall level of natriuretic peptide was elevated in this population. NTproBNP and BNP were higher in the decompensated than in the stable HF patients (10407 pg/mL (12393) vs. 4208 pg/mL (7621), p < .0001 and 1527 pg/mL (2141) vs. 729 pg/mL (15311), p < .0001).

Heart failure drug treatments
The type of HF drug treatments taken by patients is shown in Table 2. Patients with decompensated HF were more likely to receive loop diuretics and nitrates whereas patients with stable HF had higher prescriptions of ACEI or ARBs either alone or in combination with a β-blocker. A low salt diet was advised in 9.76% (144) most often in patients with decompensated HF (16.5% (52) vs. 7.95% (92), p < 0.0001). Overall, prescription of recommended HF drug treatments was low whether patients had decompensated or stable HF: 629 (42.6%) received ACEI or ARBs and 709 (48.0%) received β-blockers. The prescription of an ACEI or ARB in combination with a β-blocker was also very low (21.9% (324)), as was the prescription of aldosterone antagonists (5.95% (88)).
| Table 1 Baseline characteristics in the whole sample and according to the care settings |
|-----------------------------------------------|-------------|-------------|-------------|-------------|
| General characteristics, % (N) | Whole sample N = 1478 | Acute care N = 382 | Rehabilitation care N = 322 | Nursing home N = 774 |
| Heart failure type | | | | |
| Decompensated | 21.4 (316) | 51.2 (195) | 16.6 (53) | 8.79 (68) | <.0001 |
| Stable | 78.6 (1158) | 48.8 (186) | 83.4 (266) | 91.2 (706) | |
| Age (years), M (SD) | 88.2 (5.2) | 87.8 (4.9) | 87.3 (5.2) | 88.7 (5.3) | <.0001 |
| Women | 68.9 (1014) | 61.4 (234) | 61.4 (197) | 75.7 (583) | <.0001 |
| Weight (Kg), M (SD) | 64.6 (15.4) | 66.8 (16.7) | 63.4 (15.4) | 64.1 (14.7) | 0.005 |
| Systolic blood pressure (mmHg), M (SD) | 77.6 (1144) | 76.4 (291) | 76.9 (594) | 80.4 (259) | 0.37 |
| Diastolic blood pressure (mmHg), M (SD) | 28.5 (421) | 32.8 (125) | 37.2 (119) | 22.9 (177) | <.0001 |
| Orthostatic hypotension | 18.5 (137) | 15.5 (28) | 16.7 (26) | 20.6 (83) | 0.26 |
| Heart rate (beats per minute), M (SD) | 19.8 (293) | 20.4 (78) | 17.7 (57) | 20.4 (158) | 0.55 |
| History of stroke | 28.5 (421) | 32.8 (125) | 37.2 (119) | 22.9 (177) | <.0001 |
| Hypertension | 74.0 (12.7) | 76.3 (13.8) | 74.9 (13.0) | 72.4 (11.7) | <.0001 |
| History of myocardial infarction | 52.3 (772) | 39.0 (149) | 46.0 (148) | 61.4 (475) | <.0001 |
| Peripheral arterial disease | 77.6 (1144) | 76.4 (291) | 76.9 (594) | 80.4 (259) | 0.37 |
| Acute infection | 21.4 (316) | 51.2 (195) | 16.6 (53) | 8.79 (68) | <.0001 |
| Dementia | 68.9 (11.5) | 61.4 (234) | 61.4 (197) | 75.7 (583) | <.0001 |
| Depression | 18.5 (137) | 15.5 (28) | 16.7 (26) | 20.6 (83) | 0.26 |
| History of falls | 19.8 (293) | 20.4 (78) | 17.7 (57) | 20.4 (158) | 0.55 |
| COPD | 24.6 (363) | 249.9 (95) | 22.4 (12) | 25.3 (196) | 0.58 |
| Cancer | 16.3 (241) | 162.7 (62) | 18.9 (61) | 15.2 (118) | 0.32 |
| eGFR (mL/min), M (SD) | 31.5 (163) | 33.7 (15.7) | 35.5 (16.2) | 35.6 (17.5) | 0.19 |
| Hemoglobin (g/dL), M (SD) | 11.8 (1.7) | 116.1 (1.8) | 11.5 (1.5) | 12.1 (1.6) | <.0001 |
| Anemia | 59.9 (864) | 63.5 (240) | 53.7 (400) | 70.2 (224) | <.0001 |
| Albumin (g/L), M (SD) | 32.7 (5.2) | 32.1 (5.7) | 31.6 (5.1) | 33.8 (4.8) | <.0001 |
| Malnutrition (albumin < 35 g/l) | 64.1 (754) | 65.9 (220) | 60.1 (336) | 70.0 (198) | 0.01 |
| Brain natriuretic peptide (pg/mL), M (SD) | 993 (1793) | 1329 (2282) | 1208 (1858) | 622 (1160) | <.0001 |
| NTproBNP (pg/mL), M (SD) | 5926 (9587) | 8489 (12237) | 7165 (9517) | 3317 (6000) | <.0001 |
| LVEF %, M (SD) | 52.9 (14.4) | 51.3 (15.6) | 50.0 (14.4) | 55.7 (13.1) | <.0001 |
| LVEF level in 3 classes | | | | |
| LVEF < 40% | 21.4 (120) | 18.8 (41) | 22.1 (44) | 9.92 (35) | <.0001 |
| LVEF 40–49% | 14.8 (114) | 138.3 (30) | 163.6 (33) | 14.4 (51) | 0.0009 |
| LVEF ≥50% | 69.6 (536) | 67.4 (147) | 61.3 (122) | 75.6 (267) | |
| Atrial fibrillation | 43.2 (614) | 480 (181) | 45.1 (142) | 39.2 (291) | 0.03 |
| Antiplatelet drugs | 44.4 (655) | 430.1 (163) | 46.6 (150) | 44.2 (342) | 0.63 |
| Statins | 21.4 (316) | 239.9 (191) | 274.8 (88) | 17.7 (137) | 0.0007 |
| Anticoagulants | 47.0 (694) | 639.2 (244) | 60.2 (194) | 33.1 (256) | <.0001 |
| Total number of drugs, M (SD) | 8.43 (3.29) | 8.30 (3.43) | 8.71 (3.40) | 8.37 (3.17) | 0.22 |
| Age-adjusted Charlson score, M (SD) | 8.49 (2.21) | 8.48 (2.27) | 8.42 (1.99) | 8.66 (2.60) | 0.25 |

% (N) percentage (number); M (SD) mean (standard deviation), eGFR estimated glomerular filtration rate calculated with Cockcroft formula, LVEF left ventricular ejection fraction, COPD chronic obstructive pulmonary disease

* ANOVA test or χ²
ivabradine (0.88% (13)), nitrates (13.5% (199)) and digoxin (8.32% (123)).

Distribution of drug treatments according to preserved midrange and reduced LVEF
In the 770 patients with an available LVEF, there was low use of recommended HF drug treatments in patients with reduced LVEF. 64 (53.3%) used ACEI or ARB, 82 (68.3%) used β-blocker and 50 (41.7%) used a combination of β-blocker with an ACEI or ARB.

However, the use of ACEI or ARB or β-blocker was higher in patients with reduced LVEF than in patients with preserved or midrange LVEF (See Fig. 1). There was also more prescription of loop or thiazide diuretics and ivabradine among those with reduced or midrange LVEF than among those with preserved LVEF. No difference was observed for aldosterone antagonists, digoxin and nitrates according to LVEF categories.

Factors associated with prescription of ACEI or ARB in very old patients with HF
Additional file 1: Table S1 shows the characteristics of patients according to ACEI or ARB use.

In a multivariate analysis, after adjustment for predictors of ACEI or ARB prescription identified by univariate analysis, ACEI or ARBs were more likely prescribed in patients with cardiovascular diseases including history of myocardial infarction (OR: 1.36 (95% CI: 1.04–1.78)), history of stroke (OR: 1.42 (95% CI: 1.06–1.91)), and diabetes (OR: 1.54 (95% CI: 1.14–2.06)) (Fig. 2). Determinants of the non-prescription of ACEI or ARB included malnutrition (serum albumin levels < 35 g/L) (OR: 0.74 (95% CI: 0.57–0.95)) and eGFR between 30 and 50 ml/min (OR: 0.64 (95% CI: 0.45–0.91)) and eGFR < 30 ml/min (OR: 0.46 (95% CI: 0.32–0.67)).

When the model was run among patients with reduced LVEF, predictors of ACEI or ARB prescription were then diabetes (OR: 2.23 (95% CI: 1.18–4.31), p = 0.02), history of myocardial infarction (OR: 3.26 (95% CI: 1.83–5.96), p < .0001) and eGFR between 30 and 50 ml/min (OR: 0.22 (95% CI: 0.09–0.54), p = 0.001) and eGFR < 30 ml/min (OR: 0.35 (95% CI: 0.14–0.83), p = 0.02).

Factors associated with prescription of β-blockers in very old patients with HF
Additional file 1: Table S2 shows the characteristics of patients according to β-blockers use.

Multivariate analysis indicated that β blockers were more likely prescribed in patients with myocardial infarction (OR: 2.06 (95% CI: 1.54–2.76)) and atrial fibrillation (OR: 1.70 (95% CI: 1.28–2.28)) (Fig. 2).

Table 2  Therapy in the whole sample and according to decompensated and stable heart failure

| Characteristics, % (N) | Whole sample N = 1478 | Decompensated HF N = 316 | Stable HF N = 1158 | p a | p b |
|------------------------|-----------------------|--------------------------|-------------------|-----|-----|
| Low salt diet          | 9.76 (144)            | 16.5 (52)                | 7.95 (92)         | <.0001 | <.0001 |
| Loop diuretic          | 64.7 (957)            | 86.7 (274)               | 58.9 (682)        | <.0001 | <.0001 |
| Thiazide diuretic      | 5.68 (84)             | 5.06 (16)                | 5.87 (68)         | 0.68 | 0.63 |
| Angiotensin converting enzyme inhibitor (ACEI) | 31.7 (468) | 27.8 (88) | 32.7 (379) | 0.11 | 0.12 |
| Angiotensin receptor blocker (ARB) | 11.2 (165) | 7.91 (25) | 12.1 (140) | 0.05 | 0.03 |
| ACEI or ARB            | 42.6 (629)            | 35.4 (112)               | 44.6 (516)        | 0.004 | 0.005 |
| β-blocker (BB)         | 48.0 (709)            | 48.4 (153)               | 47.8 (553)        | 0.89 | 0.71 |
| BB and (ACEI or ARB)   | 21.9 (324)            | 16.8 (53)                | 23.4 (271)        | 0.01 | 0.02 |
| Aldosterone antagonists | 5.95 (88)           | 5.38 (17)                | 6.13 (71)         | 0.71 | 0.69 |
| Ivabradine             | 0.880 (13)            | 1.27 (4)                 | 0.777 (9)         | 0.63 | 0.43 |
| Digoxin                | 8.32 (123)            | 8.23 (26)                | 8.38 (97)         | 0.99 | 0.96 |
| Nitrates               | 13.5 (199)            | 17.1 (54)                | 12.5 (145)        | 0.04 | 0.04 |
| Antiplatelet           | 44.3 (652)            | 38.5 (121)               | 45.9 (531)        | 0.02 | 0.02 |
| Statins                | 21.4 (316)            | 18.2 (57)                | 22.4 (259)        | 0.12 | 0.14 |
| Anticoagulants         | 47.0 (694)            | 46.6 (204)               | 42.2 (489)        | <.0001 | <.0001 |
| Therapeutic anticoagulants | 65.6 (453) | 68.3 (138) | 64.5 (315) | 0.39 | 0.25 |
| Anticoagulant prophylaxis | 34.4 (238) | 31.7 (64) | 35.5 (173) |      |     |
| Total number of drugs  | 8.43 (3.29)           | 8.55 (3.41)              | 8.39 (3.26)       | 0.46 | 0.35 |

a ANOVA test or χ²
b Logistic regression adjusted for age and sex
Determinants of the non-prescription of a β-blocker were older age (OR: 0.96 (95% CI: 0.93–0.99) and infection (OR: 0.69 (95% CI: 0.53–0.91)).

When the model was run among patients with reduced LVEF, β blockers prescription was then no more associated with any of the predictors. However myocardial infarction (OR: 1.77 (95% CI: 0.98–3.24), p = 0.06), atrial fibrillation (OR: 1.68 (95% CI: 0.94–3.06), p = 0.08) and infection (OR: 0.61 (95% CI: 0.35–1.08), p = 0.09) were marginally associated with β blocker prescriptions.

**Discussion**
This large cross-sectional survey study provides information on the current management of very old patients with HF in geriatric settings in France. The overall prevalence of HF was 20.5% (ranging from 27% in acute care departments to 18% in nursing home).

Prescriptions of guideline-recommended HF drug treatments were low whether patients had decompen-sated or stable HF. Less than half of the subjects received ACEI or ARBs or β-blockers. The combination of an ACEI or ARB with a β-blocker was prescribed in less than 22% of the subjects.

The prevalence of HF in this study is in the same range as reported in a systematic review which indicates that about 20% (15–45%) of nursing homes residents are affected by HF [4].

Published studies on the management of HF in geriatric patients with multiple comorbidities are sparse, even though this population is growing rapidly. In the current study, geriatric HF patients had a high number of co-morbidities, in particular non-cardiovascular such as malnutrition, dementia and falls that are generally not evaluated in clinical trials. This result is in line with the SAGE study indicating that in nursing home 32% of HF patients have at least six other concurrent diseases [14] and with the Swedish Heart Failure Registry database, that reported a higher incidence of cardiovascular and non-cardiovascular comorbidities in patients 85 years and older [15].

In the current study, only 53% of patients had an available echocardiogram in their medical records, and among those, 70% had a preserved LVEF. These data highlight the difficulties in obtaining an echocardiogram for patients in geriatric care setting because of the difficulties in transporting patients to a cardiology unit, and lower physician demand for diagnostic confirmation.

Our results confirm previous observations of a higher prevalence of HF with preserved LVEF among the very old [2, 16–19]. In octogenarians hospitalized for HF in the Euro Heart Failure Survey (EHFS), only 38.4% of
patients had a known LVEF and in 60% of these LVEF were preserved [16].

In our study, regardless of whether HF was stable or decompensated, the prescription of recommended treatments for HF such as ACEI (or ARB) and β-blocker was low. Particularly the combination of an ACEI (or ARB) and a β-blocker was very low (less than a quarter of subjects). Among subjects with reduced LVEF, the rate of prescriptions of ACEI (or ARB) or β-blocker was still sub-optimal (53% for ACEI or ARB and 68% % for β-blocker) even though they were more often prescribed than in midrange and preserved LVEF. The greater prevalence of HF with preserved LVEF was therefore not the only reason for the low use of ACEI (or ARB) and β-blockers in older patients. The underuse of recommended HF treatments in the very old age has already been reported in other studies [6, 15, 16, 20–22]. In a large Canadian study in older home-care patients only 28% were receiving the recommended combination therapy of an ACEI and β-blocker [20]. Similar findings were reported in the Swedish Heart Failure Registry database [15] and in an Italian cardiology database [22]. A comparison of HF therapy between the Euro Heart Failure survey I and the EHFS II found a significant increase in prescription rates of recommended HF drugs in HF octogenarians at discharge in EHFS II [2], but these data mainly concerned patients hospitalized in cardiology units. Our data indicate that prescription guidelines remain less implemented in geriatric settings. A number of potential reasons for the low prescription of recommended therapies in very old HF patients can be hypothesized. Some factors may be related to the patients (comorbidities, poor tolerance, non-adherence) and some to the prescribers (fear of side effects, lack of awareness of guidelines, diagnostic uncertainty, focus on

![Fig. 2](image-url)
symptomatic improvement rather than outcome, reluctance to modify existing therapies in very old patients) [16, 23]. Moreover, the lack of definite evidence from specific randomized trial in very old population may also explain the low use of ACEI or beta-blocker. However, all the randomized trials conducted in HF patients with reduced LVEF have shown a benefit of those drugs regardless of age. Also, there is evidence from small trials and observational datasets that HF medications do improve outcomes in older HF patients, including quality of life related outcomes [2, 16].

Finally, the difficulty to get cardiologic advice in a nursing home may also explain the lower prescription of recommended HF drugs in this population, suggesting a potential interest of telemedicine in this population. Multimodal and guideline-based HF management may improve HF patients in geriatrics settings [24]. Specific education on HF for geriatricians and the development of specific tools like portable ultrasound scanner should be investigated in geriatric care units or nursing homes [24].

Similar to previous studies [16], there was a high use of diuretics reflecting the importance of reducing symptoms and maintaining quality of life as the main goals of treatment in very old HF patients. The low use of digoxin was in guidelines that caution against their use in the elderly and in patients with reduced renal function [7]. We observed a low use of nitrates in decompensated HF probably because of an increased risk of orthostatic hypotension in the elderly.

Our data show that in very old HF patients managed in geriatric care units or nursing homes, the factors determining the prescription of first-line HF treatments (ACEI or ARB and β-blocker) were history of myocardial infarction and stroke, diabetes for ACEI or ARBs and history of myocardial infarction and atrial fibrillation for β-blockers. Factors influencing the nonprescription of HF treatment were non-cardiovascular comorbidities (malnutrition and renal insufficiency for ACEI or ARBs) and infections for β-blockers.

Among patients with reduced LVEF, history of stroke and malnutrition were not any more significantly associated with prescription of ACEI or ARBs. For prescription of β-blockers, history of myocardial infarction and atrial fibrillation and infections were not any more significant but the estimates were in the same range as in the whole sample. This is in all likelihood related to a lack of power due to the small sample size.

Over half of the patients in the current study had on average a heart rate faster than 70 bpm, even though a number of large-scale studies have shown that elevated heart rate is associated with morbidity and mortality in HF patients with reduced or preserved LVEF independently of age [25–29].

The OPTIMIZE-HF Registry observed that among 10,696 patients with HF and LVEF < 40, 28.6% did not receive β-blockers and only 6.7% of patients received the target dose of β-blockers [30]. These results stress the difficulties of obtaining such goals in real life mainly in the older people.

Interestingly, BNP or NTproBNP levels remained very high even in stable HF, suggesting a suboptimal treatment. Meanwhile, natriuretic peptide level increases with age and comorbidities (renal dysfunction, atrial fibrillation, left ventricular hypertrophy...) making it difficult to interpret in geriatric population [31].

Our study has several limitations. It is an observational study performed on 1 day and only comprising hospitalized or institutionalized older individuals who might not be representative of the whole elderly population. A reporting bias cannot be ruled out as the accuracy and completeness of the data were entirely reliant upon physicians’ declarations, although the questionnaire was designed to limit variability in readers’ interpretations by asking only factual data. In addition, while selection bias could not be eliminated, investigators were asked to take into account all the patients in their care on the day of the survey. Information on duration and dose of treatments was not collected. No follow-up was available to analyze the adequacy between underuse of recommended HF and mortality. Activities of daily living and frailty status were not recorded in this study because it was difficult to assess in hospitalized patient with HF and unfortunately their status before the hospitalization had not been assessed. Thus, this potential cause for the underuse of medications was not assessed. Meanwhile cognitive status that is a classical cause of underuse of medications was taken into account. Lastly data were collected in 2012 and might not exactly reflect the current status.

The study also had some strengths. This study provides important data on the management of HF failure in patients over 80 years of age in geriatric care unit or nursing home. Few data exist for this population, particularly in real-life settings. Our study had a large sample size and included very old (mean age 88.2 (5.2)) non-selected ‘real-life’ HF patients with numerous comorbidities like dementia, malnutrition, anemia, renal insufficiency, depression, orthostatic hypotension (Charlson score = 8.49). Lastly few studies have analyzed the management of HF according to 3 classes of LVEF (reduced, midrange and preserved LVEF) in geriatric patients.

Conclusion
Our results show a high prevalence of HF in patients aged 80 years and older cared for in a geriatric care unit.
or nursing home (20.5%), characterized by a high prevalence of preserved LVEF and a high burden of cardiovascular as well as non-cardiovascular comorbidities. There was a low prescription of recommended treatment in the overall HF population with less than half of patients receiving an ACEI or ARB and less than a quarter receiving an ACEI or ARB in combination with a β-blocker. This under-prescription was also observed in patients with reduced LVEF. Overall, these results indicate that management of HF in patients cared for in geriatric settings can still be improved.

### Additional file

**Additional file 1** Table S1 Characteristics of patients according to ACEI or ARB use. Table S2 Characteristics of patients according to β-blocker use. (DOCX 47 kb)

### Abbreviations

ACEI: Angiotensin converting enzyme inhibitor; ANOVA: Analysis of variance; ARB: Angiotensin II receptor blocker; BNP: Brain natriuretic peptide; COPD: Chronic obstructive pulmonary disease; EHFS: Euro heart failure survey; HF: Heart failure; LVEF: Left ventricular ejection fraction; NTproBNP: N-terminal brain natriuretic peptide; SD: Standard deviation; STROBE: Strengthening the reporting of observational studies in epidemiology

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Affiliations

[1] Assistance Publique des Hopitaux de Paris, Hopital Broca, 75013 PARIS, France
[2] Université Paris-Descartes, Sorbonne Paris-Cité, Equipe d’Accueil 4468, PARIS, France
[3] Ma Maison, Les Petites soeurs des pauvres, 33000 BORDEAUX, France
[4] Ma Maison, Les Petites soeurs des pauvres, 47000 AGEN, France
[5] Ma Maison, Les Petites soeurs des pauvres, 17100 SAINTES, France
[6] GH Nord-Vienne, Pole 4, Gériatrie, Soins de suite, HAD, 86100 CHATELLERault, France
[7] CH Princesse-Grace, Centre Rainier III, 98000 MONACO, Monaco
[8] CHU de Caen, Départementmètpflegerie gériatrick, 14000 CAEN, France
[9] CH d’Annecy-Genevois, USLD La Tonnelle, 74600 SEYNOUD, France
[10] CH de Saint-Galmier, 42330 SAINT-GALMIER, France
[11] CH de Meaux, Service soins de suite, 77100 MEAUX, France
[12] CH Le Molièn, 92920 WASQUEHAL, France
[13] EHPAD Mon Repos, 44140 AULT, France
[14] CHU de Nantes, Hôpital Bellier, 44300 NANTES, France
[15] CHU de Rennes, Hôpital des Bataillers, 35037 LILLE, France
[16] ORPEA Clamart Maison Blanche, 92140 CLAMART, France
[17] CHU de Angers, Centre Rainier III, 98000 MONACO, Monaco
[18] CHU de Caen, Départementmètpflegerie gériatrick, 14000 CAEN, France
[19] CHU de Poitiers, Hôpital Saint-Urbain, 86000 POITIERS, France
[20] CHU de Strasbourg, Centre gériatrique Champmillo, 67091 STRASBOURG, France
[21] CH Durécu-Lavoisier, 76160 DARNÉTAL, France
[22] EHPAD Sainte Camille, 62000 ARRAS, France
[23] Hôpitaux universitaires de Strasbourg, Pôle de gériatrie, Service de long séjour, 67091 STRASBOURG, France
[24] CHU de Rouen, Médecine interne gériatrick, 76000 ROUEN, France
[25] CHU de Sainte Foy La Grande, 33220 SAINTE-FOY-LA-GRANDE, France
[26] CHU Dijon Bourgogne, Centre gériatrique Champmillo, 21000 DIJON, France
[27] EHPAD Le Verger, 44470 MAUS-VER-SOUL, France
[28] CHU de Bordeaux, EHPAD Lormont, 33300 LORMONT, France
[29] CHU de Bergheim, 68750 BERGHEIM, France
[30] Clinique Les Sources, 06100 NICE, France
[31] EHPAD La Sabotière, 59260 HELLEMES-ULLE, France
[32] EHPAD Sainte Elisabeth, 63210 ROCHEFORT-MONTAGNE, France
[33] Hôpital Bretonneau, Assistance Publique des Hopitaux de Paris, 75018 PARIS, France
[34] Hôpital La Rocheoucauld, Assistance Publique des Hopitaux de Paris, 75014 PARIS, France
[35] CHU de Nîmes, Médecine gériatrick, 30000 NIMES, France
[36] CH de Rouffach, EHPAD Maison Saint-Jacques, 68250 ROUFFACH, France.
[37] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[38] CH Saint Jean d’Angély, Service de médecine géériatique aigüé, 17415 SAINT-JEAN-D’ANGÉLY, France.
[39] Hôpital Baugeois Vallée, 49150 BAUGE, France.
[40] Hôpital Saint-Nicolas, 49000 ANGERS, France.
[41] CHU de Bordeaux, Hôpital Xavier Amoizan, 33604 PESSAC, France.
[42] CH de Vienne Lucien Hussen, Service de géériatrie, 38200 VIENNE, France.
[43] EHPAD Jardin des Aléins, 34190 GANGES, France.
[44] EHPAD Breton, GH Eaubonne MoironMory, 95600 EAUßONNE, France.
[45] CH Ain Val de Savine, Site Pont de Vyle, 01290 PONT-DE-VYLE, France.
[46] CHU de Martinique, Centre Emma Ventura, 97200 FORT DE France, France.
[47] EHPAD Les Plaines, 49800 TRELÁZE, France.
[48] Hôpital Cœur du Bourbonnais, 03500 SAINT-POURÇAIN-SUR-SIOULE, France.
[49] CHU de Nantes, Hôpital Nord-Laennec, Médecine aigüé géériatique, 44300 NANTES, France.
[50] EHPAD Les Papillons d’Or, 63120 COURPIERRE, France.
[51] Etablissement de santé Baugeois Vallée, SSR, 49250 BEAUFORT-EN-VALLEÉE, France.
[52] Etablissement de santé Jean Lachenaud, 83600 FREJUS, France.
[53] Hôpital Henri-Mondor, Assistance Publique des Hopitaux de Paris, 94000 CRETEIL, France.
[54] CH d’Annecy-Genevois, EHPAD Saint François de Sales, 74000 ANNECY, France.
[55] CHRU Brest, Hopital de la Cavale Blanche, 29200 BREST, France.
[56] CH de Rouffach, EHPAD Maison Saint-Jacques, 68250 ROUFFACH, France.
[57] CH de Vienne Lucien Hussen, Service de géériatrie, 38200 VIENNE, France.
[58] EHPAD Le Manso, 67150 GERSTHEIM, France.
[59] CH de Saint Essonne, 91723 LE LAMENTIN, France.
[60] Hôpital Layné, 40000 MONT-DE-MARSAN, France.
[61] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[62] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[63] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[64] CHU de Reims, Hôpital Maison-Blanche, 51000 REIMS, France.
[65] CHU d’Ulster, Centre Paul Spillmann, 54000 UVRY-SUR-SEVRE, France.
[66] CHU de Nancy, Hôpitaux de Brabois, 54500 VANCHEUVRE-LES-NANCY, France.
[67] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[68] CH des quatre villes, SSR géériatique, 92310 SEVRES, France.
[69] CH de Toulon La Seyne sur Mer, Hôpital Clémenceau La Garde, 83000 TOULON, France.
[70] Hôpital Clémenceau, 83130 LA GARDE, France.
[71] Groupement des Hôpitaux de l’Institut Catholique de Lille, Hôpital Saint Philibert, SSR géériatique, 59160 LOMME, France.
[72] EHPAD Maiso Saint Gabriel, 50400 GRANDVILLE, France.
[73] CH de Bayeux, 14400 BAYEUX, France.
[74] Hôpital Les Arcacias, 65500 VC-EN-BIGORRE, France.
[75] Résidence Fontdivina, 06240 BEAUSOLEIL, France.
[76] La Buissonnière 42350 SAINT-MICHEL-DE-MAURIENNE, France.
[77] Hôpital Charpennes, 69100 VILLEURBANNE, France.
[78] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[79] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[80] CHR de Metz-Thionville, Hôpital de Mercy, 57000 METZ, France.
[81] CHU de Reims, Hôpital Maison-Blanche, 51000 REIMS, France.
[82] CHU de Reims, Hôpitaux de Brabois, 54500 VANCHEUVRE-LES-NANCY, France.
[83] CHU de Blois, Médecine interne géériatique, 41000 BLOIS, France.
[84] CH de Moncé, 73400 MONTPELLIER, France.
[85] CHU de Reims, Hôpitaux de Brabois, 54000 ANGERS, France.
[86] CHU de Reims, Service de géontology clinique, 49000 ANGERS, France.
[87] EHPAD La Provalière, 73150 SAINT-POURÇAIN-SUR-SIOULE, France.
[88] EHPAD La Provalière, 73150 SAINT-POURÇAIN-SUR-SIOULE, France.
[89] EHPAD La Provalière, 73150 SAINT-POURÇAIN-SUR-SIOULE, France.
[90] Centre médical MGEN Trois-Epis, 68410 TROIS-ÉPIS, France.
[91] CH de Bazas, 33430 BAZAS, France.
[92] CH de Bazas, 33430 BAZAS, France.
[93] CH de Bazas, 33430 BAZAS, France.
[94] CH de Bazas, 33430 BAZAS, France.
[95] CH de Montpellier, SSR Bellevue, 34000 MONTPELLIER, France.
[96] CH de Montpellier, SSR Bellevue, 34000 MONTPELLIER, France.
[97] CH de Montpellier, SSR Bellevue, 34000 MONTPELLIER, France.
[98] CH de Montpellier, SSR Bellevue, 34000 MONTPELLIER, France.
[99] CH de Montpellier, SSR Bellevue, 34000 MONTPELLIER, France.
[100] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[101] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[102] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[103] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[104] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[105] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[106] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[107] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[108] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[109] CHU de Poissy/Saint-Germain-en-Laye, Site hospitalier de Saint-Germain-en-Laye, 78100 SAINT-GERMAIN-EN-LAYE, France.
[110] Hôpital Clémenceau, 83130 LA GARDE, France.
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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
The study was conducted in accordance with the ethical standards set forth in the Declaration of Helsinki (1983). The entire study protocol was approved by the ethics committee of Nantes (Groupe Nantais d’Ethique dans le Domaine de la Santé, France), and the study complies with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement guidelines.

No consent to participate was sought for the subjects in accordance to the French ethics rules because the study was observational (related to usual care), and no nominative data were collected (Code de la Santé Publique – Article L1121–1. https://www.legifrance.gouv.fr). All patients’ data were anonymized at the patients’ sites before they were uploaded to the study center.

Consent for publication
N/A

Competing interests
OH received consultant/advisory/lecture fees from Bayer, Boehringer-Ingelheim, BMS, Pfizer, Novartis, Servier, Astra-Zeneca, Vifor.
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Author details
1 Assistance Publique des Hopitaux de Paris, Hopital Broca, 54-56 rue Pascal, 75013 Paris, France. 2 Sorbonne Paris-Cité, Université Paris-Descartes, Equipe d Accueil 4468, Paris, France. 3 Ma Maison, Les Petites Sœurs des pauvres, 33000 Bordeaux, Paris, France. 4 Ma Maison, Les Petites Soeurs des pauvres, 47000 Agen, Paris, France. 5 Ma Maison, Les Petites Sœurs des pauvres, 17100 Saintes, Paris, France. 6 GH Nord-Vienne, Pole 4, Gériatrie, Soins de soins de, HAD, 86100 Chateauroux, Paris, France. 7 CH Princesse-Grace, Centre Rainier III, 98000 Monaco, Monaco. 8 CHU de Caen, Départementenfilleière gériatrique, 14000 Caen, Paris, France. 9 CH d’Annecy-Cenevois, USLD La Tonnelle, 74600 Seynod, Paris, France. 10 CH de Saint-Galmier, 42330 Saint-Galmier, Paris, France. 11 CH de Meaux, Service soins de soins, 77100 Meaux, Paris, France. 12 CH Le Molinel, 59290 Wasquehal, Paris, France. 13 EHPAD Mon Repos, 44140 Aigrefeuille-sur-Maine, Paris, France. 14 CHRU de Lille, Hôpital des Matelas, 59037 Lille, Paris, France. 15 ORPEA Clamart Maison Blanche, 92140 Aigrefeuille-Sur-Maine, Paris, France. 16 CHU de Toulouse, Hôpital Bellier, 44300 Nantes, Paris, France. 17 CHU de Nantes, Hôpital Bellier, 44300 Nantes, Paris, France.

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