Management of octogenarians hospitalized for heart failure in Euro Heart Failure Survey I

Michel Komajda1*, Olivier Hanon2, Matthias Hochadel3, Ferenc Follath4, Karl Swedberg5, Anselm Gitt6, and John G.F. Cleland7

1Department of Cardiology, Pitie Salpetriere Hospital, University Pierre et Marie Curie, 47/83, boulevard de l’Hôpital, 75013 Paris, France; 2Department of Geriatrics, Broca Hospital, University Paris-Descartes, Paris, France; 3Stiftung Institut für Herzinfarktforschung, Ludwigshafen am Rhein, Germany; 4University Hospital, Zurich, Switzerland; 5Department of Medicine, Sahlgrenska University Hospital, Göteborg, Sweden; 6Department of Cardiology, Institut für Herzinfarktforschung Ludwigshafen, Germany; and 7Department of Cardiology, University of Hull, Kingston upon Hull, UK

Received 9 April 2006; revised 13 November 2006; accepted 30 November 2006; online publish-ahead-of-print 21 December 2006

Keywords
Heart failure; Very elderly; Treatment; Guidelines; Mortality

Aims Here, the aim is to study the management of octogenarians hospitalized for heart failure in Euro Heart Failure Survey I. Heart Failure (HF) is common in older people and associated with poor outcome.

Methods and results We compared clinical characteristics, treatment, and short-term outcomes in 2780 octogenarians (group A, median age 85 years) and in 7912 younger patients (group B, median age 69 years) enrolled in the Euro Heart Failure Survey I.

There were 37% males in group A vs. 59% in group B (P < 0.001). Co-morbidities were more common in group A. Ejection fraction was measured only in 38% in group A vs. 65% in group B (P < 0.001) and when measured was preserved in 50 vs. 40% (P < 0.001). In-hospital and 12 weeks follow-up mortality were, respectively, 13 vs. 5% (P < 0.001) and 12 vs. 6% (P < 0.001) in groups A and B. Acute cardiac conditions and co-morbidity predicted mortality, whereas the use of angiotensin-converting enzyme inhibitor (ACE-I) and beta-blockers was associated with a better outcome. ACE-I and beta-blockers were used in 50 vs. 66% (P < 0.001) and 24 vs. 42% (P < 0.001) in groups A and B, respectively, whereas diuretics, digitals, and nitrates were more commonly used in octogenarians.

Conclusion Preserved systolic function, multiple co-morbidities, and high mortality are observed in octogenarians with HF. In these patients, cardiac function is assessed in only a minority and treatments known to improve prognosis in younger patients under-utilized. Overall, the management of octogenarians with HF does not follow international guidelines.

Introduction
Heart failure (HF) is associated with high mortality and prolonged and frequent hospitalizations and is responsible for a tremendous burden on health care systems.1 The prevalence of this condition increases markedly with age.2 Available data suggest that outcome is particularly poor in elderly patients and treatment is often complicated by the presence of multiple co-morbid factors.3–6 Moreover, evidence-based therapies are less frequently used in this subset of patients.7–10 The objectives of the present study were therefore to evaluate (i) the clinical characteristics and major co-morbidities; (ii) treatment; (iii) short-term outcomes in the octogenarian population enrolled in the Euro Heart Failure Survey I database.

Methods
Euro Heart Failure Survey I was conducted by the European Society of Cardiology (ESC) between March 2000 and May 2001 and aimed to investigate the implementation of guidelines in clinical practice. The design details were published elsewhere.11 In brief, all consecutive discharges and deaths in cardiology, cardiovascular surgery, general/ internal medicine, and geriatrics departments from 115 hospitals across 24 ESC member countries were recorded. Patients were enrolled if they fulfilled one or more of the following criteria: a clinical diagnosis of HF during admission; a diagnosis of HF recorded at any time in the last 3 years; administration of treatment for HF or major ventricular dysfunction within 24 h of death or discharge; administration of treatment for HF or major ventricular dysfunction within 24 h of death or discharge; administration of treatment for HF or major ventricular dysfunction within 24 h of death or discharge.

A clinical follow-up (FU) was performed and data on vital status (dead/alive) or re-admission were collected. Surviving patients were contacted and asked to attend an interview at 12 weeks. This analysis included 10 692 patients: 2780 (26%) of these patients were 80 years or more (group A), and we compared their clinical profile, treatment, and mortality with younger patients (group B).

Deaths were classified as cardiovascular if they were sudden deaths or precipitated by myocardial infarction, cardiogenic shock, pulmonary oedema, stroke, or cardiac cachexia. Non-cardiovascular death was defined as death secondary to infection, cancer, and renal or organ failure, and accident ischaemic heart disease was confirmed by a diagnosis of prior myocardial infarction,
angina pectoris, prior percutaneous coronary intervention, or coronary artery bypass graft. An assessment of preserved left ventricular systolic function was given by echocardiographic ejection fraction (EF) >45% or a rating of no left ventricular dysfunction, but was available only for 63% of the patients.

For the conversion of haemoglobin (Hb) and creatinine measurements into SI units, the factors given by Kratz and Lewandrowski were used. Anaemia was defined by Hb <13 g/dL in men and <12 g/dL in women, severe anaemia by Hb <11.5 g/dL in men and <10.5 g/dL in women, and hypoaesthesia by sodium <135 meq/L. The glomerular filtration rate (GFR) was calculated according to the abbreviated MDRD formula.

Statistical analysis

The patient population is described by absolute numbers and percentages. The distribution of continuous variables is characterized by medians and inter-quartile range (IQR). Categorical variables were compared between subgroups by Pearson chi-square test and continuous variables by Mann-Whitney U-test.

Determinants for the use of angiotensin-converting enzyme inhibitor (ACE-I) and beta-blocker medication were analysed by multiple logistic regression. The following clinically relevant variables were considered as endpoints. Multiple logistic regression analysis was based on a significance level of P < 0.1 in the univariate comparison and stepwise selection procedures using significance levels of 0.05 for entry and 0.1 for removal, as well as on clinical considerations. Model discrimination was assessed with the C-statistic. The model discrimination might be lower when applying the model to an independent data set.

Therefore, the optimism of the apparent C-statistic was estimated by fitting the model to 200 bootstrap samples and computing the difference between the C-statistics evaluated on the original sample and on the original sample. The average of these differences over the 200 bootstrap replications was subtracted from the apparent C-statistic in order to get a corrected value of the predictive discrimination. Regarding goodness of fit, the observed and expected numbers of responses were compared in the deciles of predicted probabilities and the Hosmer–Lemeshow test was performed. Adjusted odds ratios with 95% confidence limits are reported for the determinants of medication use and the predictors of mortality. A significance level of 0.05 was assumed for the statistical tests. All P-values are results of twotailed tests. The calculations were performed using SAS statistical software, version 9.1 (Cary, North Carolina, USA).

Results

Demographic data

Main demographic data on the two age groups are given in Table 1. Median age of group A (>80 years) was 85.3 years (82.5–88.5). Only 37% of these patients were males vs. 59% in group B. Octogenarians were more often referred to a general/internal medicine department than group B patients. HF was less often the primary reason for admission in group A. Atrial fibrillation/SVT was more common at presentation in group A.

<table>
<thead>
<tr>
<th>Table 1 Demographic data</th>
<th>Group A (age &gt;80 years)</th>
<th>Group B (age &lt;80 years)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>85.3 (82.5–88.5)</td>
<td>69.0 (60.3–74.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>36.7% (1017/2771)</td>
<td>58.6% (4620/7882)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>24.7 (21.9–27.2)</td>
<td>26.7 (24.0–30.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hb (mmol/L)</td>
<td>7.7 (6.8–8.4)</td>
<td>8.1 (7.1–8.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>112 (90–142)</td>
<td>102 (84–129)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>GFR (MDRD equation) (mL/min)</td>
<td>47.5 (36.9–59.9)</td>
<td>60.3 (45.8–76.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypoaesthesia (Na &lt;135 meq/L)</td>
<td>18.2% (491/2691)</td>
<td>14.1% (1057/7515)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General/internal medicine</td>
<td>63.8% (1769/2774)</td>
<td>42.4% (3349/7897)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiology</td>
<td>21.2% (588/2774)</td>
<td>46.9% (3706/7897)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HF as primary reason</td>
<td>37.6% (1043/2771)</td>
<td>40.5% (3188/7880)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Diagnoses during or prior to admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischaemic HF</td>
<td>55.1% (1529/2777)</td>
<td>61.8% (4886/7906)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diagnosis of AF/SVT</td>
<td>48.9% (1354/2770)</td>
<td>39.9% (3149/7899)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ventricular tachycardia/fibrillation</td>
<td>4.8% (132/2763)</td>
<td>9.4% (742/7880)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diagnosis of dilated cardiomyopathy</td>
<td>4.3% (120/2759)</td>
<td>13.8% (1085/7856)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pace-maker implanted</td>
<td>10.1% (280/2777)</td>
<td>7.6% (598/7901)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACS on admission</td>
<td>9.4% (260/2780)</td>
<td>9.5% (755/7912)</td>
<td>0.77</td>
</tr>
</tbody>
</table>

aMedian and quartiles.
bHb, haemoglobin plasma level; GFR, glomerular filtration rate.
anaemia, gout, arthritis, and infection were more frequent in octogenarians, (Table 2) but diabetes, hypertension, or ischaemic heart disease was less common. Only 13.1% of group A patients had none of the aforementioned co-morbid factors reported vs. 22.4% in group B (P < 0.001). Conversely, 30% of octogenarians had at least three co-morbid factors vs. 18.6% in group B (P < 0.001).

Cardiac function and other investigations

A report of left ventricular ejection fraction (L VEF) measurement was made in only a minority of group A patients and left ventricular dimensions reported in only 1/4 of cases. The proportion of patients with preserved systolic function (defined by an EF > 45% or absence of left ventricular dysfunction) was higher in group A. Standard blood tests were performed in a similar proportion in the two age groups except cholesterol and blood glucose which were less likely to be measured in group A (data not shown). Renal function was significantly worse and the prevalence of hyponatraemia < 135 meq/L increased in octogenarians (Tables 1 and 3).

Outcome

During the index admission, overall mortality (13.2 vs. 5.3%, P < 0.001), cardiovascular death (7.1 vs. 3.3%, P < 0.001), and non-cardiovascular death (3.5 vs. 1.1%, P < 0.001) were higher in group A (Figure 1). Out of the patients discharged alive, vital status at FU was obtained for 2026 patients in group A with a median FU time of 89 days (IQR 83–101) and for 6374 patients in group B with a median FU time of 87 days (IQR 81–97). After discharge, FU mortality was 11.7% in octogenarians, about twice that observed in younger patients (6.1%) (P < 0.001) (Figure 1).

A modelling analysis on independent predictors of in-hospital mortality in group A is shown in Figure 2. The C-statistic of 0.761, or 0.745 after the bootstrap correction for optimism, indicates a satisfactory discrimination of the model.

Age, acute coronary syndrome on admission, ventricular tachycardia/fibrillation, presence of pulmonary congestion, severe renal dysfunction, presence of cancer, dementia/confusion, and infection were all associated with increased in-hospital mortality.
Out of the relevant medications, only the use of ACE-I/ARBs, anti-platelet agents, and marginally of beta-blockers was significantly associated with a better outcome.

The number of days in hospital during FU (10 vs. 9) and rehospitalization rate (28.7 vs. 27.3%, \( P = 0.21 \)) were similar in both groups. There was no significant gender difference in death rate during index admission.

Increased mortality in octogenarians was observed both in patients with depressed systolic function (24.0 vs. 11.5%, \( P < 0.001 \)) and in those with preserved systolic function (18.8 vs. 7.3%, \( P < 0.001 \)).

**Treatment**

Overall, diuretic agents, particularly loop diuretics, were more commonly prescribed to octogenarians. ACE-I or ARBs, beta-blockers, and spironolactone were less commonly prescribed in octogenarians than in younger patients. Conversely, an increase in the rate of prescription of oral/transdermal nitrates and digitalis was observed in the older patients (Table 4).

We observed a marked reduction in the use of ACE-I, beta-blockers, and combination ACE-I + beta-blockers in group A, both in patients with preserved systolic function (ACE-I: 50.4 vs. 59.6%, \( P < 0.001 \); beta-blockers: 26.9 vs. 41.8%, \( P < 0.001 \); combination: 13.6 vs. 27.1%, \( P < 0.001 \)) and in those with depressed systolic function (ACE-I: 66.1 vs. 79.3%, \( P < 0.001 \); beta-blockers: 28.3 vs. 49.2%, \( P < 0.001 \); combination: 18.4 vs. 40.3%, \( P < 0.001 \)). This under-use was still observed for ACE-I when patients with severe renal dysfunction were excluded (51.6% in group A vs. 67% in group B, \( P < 0.001 \)) and for beta-blockers when patients with a history of respiratory disease were excluded (29.5% in group A vs. 49.4% in group B, \( P < 0.001 \)). Moreover, the under-prescription of beta-blockers was also confirmed when the analysis was restricted to recommended beta-blockers in HF (Table 4). Our findings on clinical profile and treatment modalities were also observed in patients with diagnosis of HF during admission and in those with diagnosis of HF at any time (see Supplementary material online supplement).

We also examined the proportion of patients treated with high doses of ACE-I (defined by a daily dose of enalapril \( \geq 20 \) mg, captopril \( \geq 75 \) mg, ramipril \( \geq 5 \) mg, perindopril \( \geq 4 \) mg, lisinopril \( \geq 20 \) mg) or high doses of beta-blockers (defined by a daily dose of bisoprolol \( \geq 5 \) mg, carvedilol \( \geq 25 \) mg, metoprolol succinate \( \geq 100 \) mg, atenolol \( \geq 100 \) mg/day): in group A, 13.9% of the patients fulfilled the definition of ACE-I high-dose regimen vs. 25.9% in group B (\( P < 0.001 \)). Similarly, only 4.6% of group A patients were under high-dose beta-blocker regimen vs. 10.7% in group B (\( P < 0.001 \)). In the subgroup of patients with documented depressed systolic function, octogenarians were less frequently under high dose of ACE-I (22.1% in group A vs. 32.6% in group B, \( P < 0.001 \)) or under high dose of beta-blocker (5.2% group A vs. 11.4% group B, \( P < 0.001 \)).

Determinants of ACE-I and beta-blocker prescription are shown in Figure 3A and B.

HF as a major reason for hospitalization, diagnosis of dilated cardiomyopathy, depressed ventricular function, ischaemic aetiology, diabetes, and an history of hypertension were predictors of ACE-I therapy, whereas age, severe renal dysfunction, dementia/confusion, stroke/TIA, infection, and cancer were associated with their non-prescription.

For beta-blockers, clinical admission to cardiology, presentation with an acute coronary syndrome, ischaemic HF, and hypertension were associated with their prescription and age; HF as a major reason for admission and an history of respiratory disease were predictors of non-prescription. Anti-coagulant therapy was also less frequently prescribed in group A, whereas the use of aspirin, clopidogrel, and dipyridamole was slightly increased in octogenarians. Anti-arrhythmic agents were used less frequently in group A, as were lipid-lowering drugs. Polypharmacy was present in both groups, but more older patients were taking four or more cardiovascular medications (78.6 vs. 67.8%, \( P < 0.001 \)).

Finally, a greater proportion of group A patients received dietary supplements, antibiotics, bronchodilators, and drugs for gastro-intestinal, neurological, or psychological disorders or pain relief.

**Discussion**

We observed major differences in characteristics, management, prescriptions, and outcome in octogenarians compared with younger patients in this large survey.

**Demographic data**

Octogenarians were more frequently managed in general/internal medicine or geriatric department and less often referred to a department of cardiology. Such findings have been reported in other surveys\(^{16,15}\) and suggest a limited access to cardiology units for older patients with suspected HF. Co-morbidities, particularly infection and neurological disorders, were common in octogenarians, and few patients had no other co-morbid factor. Moreover, we probably under-estimated the real situation due to the lack of specific cognitive assessment and the absence of records of other common co-morbidities such as urinary incontinence or musculo-skeletal problems.\(^{13}\) We also found an increase in the prevalence of AF, renal dysfunction, and severe anaemia in the elderly. Overall, our findings emphasize the
Figure 2  Predictors of in-hospital all-cause mortality in octogenarians; adjusted OR with 95% confidence intervals as results of multiple logistic regression (Hosmer–Lemeshow test \( P = 0.79 \)). ACS, acute coronary syndrome; VT/VF, ventricular tachycardia/ventricular fibrillation.

Table 4  Drug treatment

<table>
<thead>
<tr>
<th>Drug treatment</th>
<th>Group A (age ( \geq 80 ) years)</th>
<th>Group B (age &lt;80 years)</th>
<th>Difference (%) (95% CI)</th>
<th>( P )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diuretics</td>
<td>90.5% (2767/100%)</td>
<td>84.3% (7895/100%)</td>
<td>+6.2 (+4.9, +7.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Furosemide</td>
<td>83.7%</td>
<td>73.9%</td>
<td>+9.8 (+8.1, +11.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Thiazide diuretics</td>
<td>7.6%</td>
<td>12.3%</td>
<td>-4.7 (-6.0, -3.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Spironolactone</td>
<td>14.6%</td>
<td>22.7%</td>
<td>-8.2 (-9.8, -6.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- ACE-I</td>
<td>50.5%</td>
<td>66.0%</td>
<td>-15.5 (-17.6, -13.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- High-dose ACE-I(^a)</td>
<td>13.9%</td>
<td>25.9%</td>
<td>-12.0 (-13.6, -10.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- ACE-I/ARBs</td>
<td>53.6%</td>
<td>69.7%</td>
<td>-16.1 (-18.2, -14.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Beta-blockers</td>
<td>23.8%</td>
<td>41.6%</td>
<td>-17.8 (-19.7, -15.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Recommended beta-blockers(^b)</td>
<td>14.5%</td>
<td>28.1%</td>
<td>-13.6 (-15.2, -11.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- High-dose beta-blockers(^c)</td>
<td>4.6%</td>
<td>10.7%</td>
<td>-6.1 (-7.1, -5.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Intravenous inotropes</td>
<td>4.9%</td>
<td>8.0%</td>
<td>-3.1 (-4.1, -2.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Nitrates</td>
<td>49.4%</td>
<td>46.8%</td>
<td>+2.6 (+0.4, +4.8)</td>
<td>0.02</td>
</tr>
<tr>
<td>- Digitalis</td>
<td>34.4%</td>
<td>29.8%</td>
<td>+4.6 (+2.5, +6.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Antithrombotic agents</td>
<td>74.2%</td>
<td>79.1%</td>
<td>-4.9 (-6.7, -3.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Warfarin or other oral anticoagulants</td>
<td>14.7%</td>
<td>25.9%</td>
<td>-11.2 (-12.8, -9.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Aspirin, clopidogrel, or dipyridamole</td>
<td>53.1%</td>
<td>50.6%</td>
<td>+2.5 (+0.3, +4.7)</td>
<td>0.02</td>
</tr>
<tr>
<td>- Antiarrhythmic agents</td>
<td>12.0%</td>
<td>15.7%</td>
<td>-3.8 (-5.2, -2.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Lipid-lowering drugs</td>
<td>6.7%</td>
<td>25.3%</td>
<td>-18.6 (-19.9, -17.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Gastrointestinal therapy</td>
<td>40.1%</td>
<td>33.7%</td>
<td>+6.4 (+4.3, +8.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Dietary supplements</td>
<td>31.2%</td>
<td>22.8%</td>
<td>+8.4 (+6.5, +10.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Antibiotics</td>
<td>36.5%</td>
<td>28.4%</td>
<td>+8.1 (+6.1, +10.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Bronchodilators</td>
<td>23.3%</td>
<td>19.2%</td>
<td>+4.1 (+2.3, +5.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Drugs for neurological and psychological disorders</td>
<td>35.5%</td>
<td>28.0%</td>
<td>+7.4 (+5.4, +9.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>- Pain-relieving drugs</td>
<td>25.8%</td>
<td>16.6%</td>
<td>+9.2 (+7.4, +11.1)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

\(^a\)Enalapril \( \geq 20 \) mg/day, captopril \( \geq 75 \) mg/day, ramipril \( \geq 5 \) mg/day, perindopril \( \geq 4 \) mg/day, or lisinopril \( \geq 20 \) mg/day.

\(^b\)Bisoprolol, carvedilol, or metoprolol.

\(^c\)Metoprolol succinate \( \geq 100 \) mg/day, atenolol \( \geq 100 \) mg/day, bisoprolol \( \geq 5 \) mg/day, or carvedilol \( \geq 25 \) mg/day.
complexity of HF in the elderly and are consistent with other reports.3,6,8–10

Interestingly, the frequency of hypertension, diabetes, and coronary heart disease was lower in older patients.6,8 Explanations for this observation include the fact that patients with HF have a higher mortality and a reduced likelihood of surviving until the age of 80 years and an underestimate of coronary heart disease and/or hypertension and diabetes is also common. It has been particularly demonstrated that older subjects were less frequently aware of their hypertension than younger patients.16 Body mass index was lower in older HF subjects. Malnutrition in elderly people has been associated with an increased mortality rate.17 However, in our study, body mass index was not associated with short-term mortality in older HF patients.

Cardiac function
Our study shows that elderly patients with suspected HF are less likely to undergo echocardiography in European hospitals. This suggests that diagnosis of HF in the elderly
does not follow European guidelines and indicates a lower quality of care in the ageing population.\(^8,18,19\) When assessed, LVEF was more frequently preserved in the elderly subjects as previously reported.\(^6,8,10,20\) Age-related factors, such as ventricular hypertrophy and fibrosis, can predispose to HF with preserved systolic function. Finally, valvular abnormalities were more common in older patients and particularly aortic stenosis was twice as frequent in octogenarians as in younger patients.

### Treatment

Under-prescription of recommended HF drugs (ACE-I and beta-blockers) was observed in octogenarians, including the subgroup with depressed systolic function. We observed a slightly higher rate of ACE-I prescription in the very elderly\(^19\) when compared with previous studies,\(^3,8,10\) but even so, the proportion treated and dose used suggest considerable room for improvement. This may reflect the physician’s perception of side effects, higher prevalence of contraindications, and lack of randomized controlled study specifically conducted in patients over 80 years. Our findings indicate that age itself together with non-cardiovascular co-morbidities predicts the non-prescription of ACE-I.

Few surveys have reported beta-blocker use in the very elderly HF population. This report shows that few octogenarians hospitalized with HF are treated with beta-blockers even if they have depressed systolic function and very few receive doses at >50% of target levels. Several reasons can explain this lack of implementation of guidelines in practice.

(i) A gap in the physician’s awareness of the benefit conferred by beta-blockade despite recent evidence that beta-blockers are beneficial in elderly HF patients.\(^21\) Patients admitted to cardiology departments were more likely to receive a beta-blocker but not an ACE-I when compared with those admitted to general/internal medicine wards. This finding suggests that there is a delay in the uptake in the more recently introduced drugs such as beta-blockers among non-specialists, which might be overcome either by including more patients in specialized FU or by more intense education of non-specialists.

(ii) The fact that many of these patients were hospitalized for decompensated HF, whereas international guidelines in 2001 recommend that therapy should be initiated only once the patient is stable. Admission with HF as the main reason was a strong predictor of non-prescription in our analysis.

(iii) Presence of co-morbid factors that might complicate beta-blocker therapy, such as respiratory disease, which was an important predictor of non-prescription. However, the frequency of this co-morbid factor was not different in older and younger groups.

(iv) High prevalence of HF with preserved systolic function, a situation for which evidence of benefit is lacking for beta-blockers as well as for ACE-I. However, under-use was observed also in patients with documented depressed systolic function.

(v) Reluctance to modify existing therapies in very old patients.

Strong predictors of the use of beta-blockers were the presence of ischaemic heart disease or hypertension. Such patients commonly received beta-blockers that are not known to be effective in HF, suggesting that beta-blockers may have been prescribed for the underlying cause of HF rather than HF itself.

Very few elderly patients received the combination of an ACE-I and a beta-blocker. This finding, together with the fact that under-use of ACE-I and beta-blockers was observed in patients without severe renal dysfunction or respiratory disease, suggests that age itself is a barrier to the implementation of guidelines and induces self-limiting behaviour among physicians. Age itself, reinforced by co-morbidity, appears to be a major deterrent to physicians for the implementation of guidelines. The key role of the ‘primum non nocere’ principle (first do no harm) over the goal of implementing the most effective therapy may also account for the very low use of aldosterone antagonists in older patients with a high prevalence of renal dysfunction.\(^22\) Oral anticoagulant therapy was also less frequently prescribed in the older group despite the higher rate of AF.\(^23\)

Treatment patterns, including a high use of diuretics, nitrates, and digitalis, reflected the short-term control of symptoms as the principle treatment goal. As might be expected, medications for the treatment of co-morbid factors were more commonly prescribed in octogenarians. More than one-third of the octogenarians received antibiotics during hospitalization, presumably reflecting a high rate of infection as both a precipitant and a complication of HF.

### Outcomes

Mortality was higher in octogenarians than in younger patients during admission and after 12 weeks of FU.\(^6,8,10\) Our results confirm those of previous studies, showing that age appears as an independent predictor of mortality in HF patients.\(^1,8,9,24,25\) The fact that both cardiovascular and non-cardiovascular mortality increased in the octogenarian group reflects the complexity of the HF syndrome associated with multiple co-morbidities. It also highlights the problem of studying the effects of interventions that are likely only to influence cause-specific mortality in this population. The effect of prevention of death by one mechanism may not be sufficient to change all-cause mortality. Prevention of death for one reason may soon be followed by death due to another potentially unrelated cause.

Our study provides additional information on the factors associated with mortality. Age, acute cardiovascular conditions such as acute myocardial infarction or unstable angina pectoris, ventricular tachycardia or pulmonary congestion, and non-cardiovascular co-morbidities were related to in-hospital mortality. In contrast with other studies performed on younger populations and identifying male sex as a factor of poor survival,\(^25\) we found no gender difference in the death rate. This might be due to the short FU period or due to the fact that no gender difference in treatment modalities was observed here.

The use of recommended HF drugs ACE-I/ARBs and/or beta-blockers was associated with a significant reduction of short-term mortality in octogenarians, suggesting a benefit of these drugs even in patients over 80 years, although there is no definite evidence for the benefit of ACE-I in very elderly patients due to the lack of specific
randomized controlled trials. The mean age of the study population in CONSENSUS was 71 years, and no difference on outcome was observed between patients above or below 65 years of age in an ACE-I meta-analysis. The recently completed PEP-CHF trial suggests an improvement of symptoms and fewer hospitalizations in HF patients with preserved systolic function, aged ≥70, receiving ACE-I. The SENIORS study showed that the beta-blocker nebivolol reduced mortality and morbidity in HF patients aged ≥70. Finally, observational studies have shown a beneficial effect of ACE-20,29 or beta-blockers in elderly patients, particularly when high doses were used. Overall, our results suggest a significant under-prescription and under-dosage of recommended drugs for HF in elderly subjects, although it has been shown that adherence to guidelines is associated with better outcome.

We did not observe any difference in index hospitalization length or rehospitalization rate between the two groups. This might be due to the fact that (i) symptomatic treatments of HF are beneficial in short term; (ii) FU period was too short to observe any difference; (iii) the rate of death was higher in octogenarians.

Limitations
Our survey was not population-based, but an observational study conducted in patients hospitalized with suspected HF. Eighty three percent were considered by those managing them to have HF and a substantial additional proportion had left ventricular systolic dysfunction and/or were treated with loop diuretics. Sites volunteered for the study were mainly University hospitals or regional centres, although, by design, each centre had to recruit one or more satellite community hospitals. Accordingly, our results might be different from and possibly better than average clinical practice. We did not record all co-morbid factors associated with ageing, and this might have resulted in an under-estimate of their overall prevalence. In particular, no specific cognitive assessment was performed. The study included only hospitalized patients. Our survey did not record reasons of non-prescription of HF medications. We, therefore, are unable to assess the respective role of physician’s reluctance, contraindications, or side effects. The effect of treatments on short-term outcome must be cautiously interpreted since this was an observational study and not designed to evaluate the impact of prescriptions, which may be influenced by unmeasured confounding variables, on prognosis.

Conclusions
Octogenarians constitute a substantial proportion of patients with HF, commonly have preserved left ventricular systolic function and multiple co-morbidities, and have a poor prognosis but are rarely represented in clinical trials. Failure to carry out appropriate investigations, treatment directed mainly at short-term improvement, avoiding treatment due to fear of side effects, and the lack of relevant clinical trials conspire to ensure that octogenarians with HF rarely receive disease-modifying interventions suggested by guidelines. However, older patients receive more medications overall, although it is not clear what proportion is necessary. It may be possible to improve prescribing so that fewer but more effective drugs are used. Overall, these results suggest that there is room for improvement of guidelines implementation in this population.

Conflict of interest: none declared.

References
Clinical vignette

Biventricular non-compaction and giant left atrial appendage

Andrew Michael Crean1, Yves Provost2, and Narinder Paul2

Academic Unit of Cardiovascular Medicine, Level G, Jubilee Wing, Leeds General Infirmary, Great George St, Leeds, West Yorkshire, UK; and 2 Department of Cardiac MRI, Toronto General Hospital, Toronto, Ontario, Canada

Corresponding author. Tel: +44 113 3928483; fax: +44 113 3925405. E-mail address: crean67@hotmail.com

A young man with unexplained symptoms of breathlessness presented for cardiovascular magnetic resonance imaging (MRI) following a non-contrast echocardiogram that had suggested mild impairment of function. As he was being placed on the MRI table, the technologist spontaneously commented upon his unusual facial features with the words ‘he’s a funny looking kid’.

Cardiac MRI revealed dramatic evidence of non-compaction cardiomyopathy affecting both ventricles. The diagnostic appearance of excessive and long trabeculations with deep intratrabecular recesses is shown in axial (Panel A) and short axis (Panel B) steady state free precession (SSFP) images together with a 4 chamber ‘delayed enhancement’ image post-gadolinium (Panel C). A thin outer layer of normally compacted myocardium was also apparent. From the MRI examination, it was clear that the pathological process was affecting both ventricles. The other striking abnormality in the MRI was the unusual size and prominence of the left atrial appendage (Panel D).

Non-compaction affecting both ventricles is only rarely described. It is likely that there exists a direct genetic linkage between the patient’s dysmorphic appearance and his cardiac phenotype. Non-compaction certainly occurs in association with a range of congenital disorders. Giant left atrial appendage has not been previously described in association with this condition. It may be important given the prevalence of systemic embolism, which can be a presenting feature of left ventricular non-compaction.

Panel A. Axial SSFP image.
Panel B. Short-axis SSFP image.
Panel C. Four-chamber delayed enhancement image without evidence of myocardial fibrosis.
Panel D. Giant left atrial appendage on axial SSFP image.

Supplementary video clips demonstrating left and right ventricular contraction in axial and short axis oblique imaging planes are available at European Heart Journal online.