Rev Port Cardiol. 2018;37(2):159–165

Revista Portuguesa de Cardiologia
Portuguese Journal of Cardiology
www.revportcardiol.org

ORIGINAL ARTICLE

Clinical characteristics and one-year mortality according to admission renal function in patients with a first acute heart failure hospitalization

Francesc Formiga[a,*], Rafael Moreno-Gonzalez[a], David Chivite[a], Jesús Casado[b], Francesc Escrihuela-Vidal[a], Xavier Corbella[a,c]

[a] *Geriatric Unit, Internal Medicine Department, Bellvitge University Hospital, Barcelona, Spain*
[b] *Internal Medicine Department, Getafe University Hospital, Madrid, Spain*
[c] *Hestia Chair in Integrated Health and Social Care, Faculty of Medicine and Health Sciences, Catalunya International University, Barcelona, Spain*

Received 28 February 2017; accepted 26 June 2017

KEYWORDS
Heart failure;
Chronic kidney disease;
Hospitalization;
Readmission;
Mortality

Abstract
Introduction and Objectives: Chronic kidney disease is related to poor outcomes in patients with heart failure (HF). Few studies have assessed whether renal function influences one-year mortality risk in patients admitted for the first time for acute HF.
Methods: We reviewed the medical records of all patients aged >50 years admitted within a two-year period for a first episode of decompensated HF. The sample was divided according to the patients' estimated glomerular filtration rate (eGFR) on admission into three groups (eGFR >60, 30-60 and <30 ml/min/1.73 m^2). Index admission and one-year all-cause mortality rates were compared between groups using Cox regression analysis.
Results: A total of 985 patients were included in the study, mean age 78.4±9 years, and with mean admission eGFR of 60.5±26 ml/min/1.73 m^2. Of these, 516 (52.3%) patients had eGFR <60 ml/min/1.73 m^2. One-year all-cause mortality was 25.4%, with a significant association between worse eGFR category and mortality (p<0.0001). Cox regression analysis assessing eGFR as a categorical variable confirmed this association (HR 1.378; p=0.030), together with older age (HR 1.066; p<0.001), previous diagnosis of hypertension (HR 0.527; p<0.001), and both lower systolic blood pressure (HR 0.993; p=0.009) and higher serum potassium on admission (HR 1.471; p <0.001).
Conclusions: Renal impairment is common in HF patients, even at the time of first admission. In this group of HF patients the presence of renal impairment was associated with higher mid-term (one-year) mortality risk.

* Corresponding author.
E-mail address: fformiga@bellvitgehospital.cat (F. Formiga).

PALAVRAS-CHAVE
Insuficiência cardíaca;
Doença renal crónica;
Hospitalização;
Readmissão;
Mortalidade

Características clínicas e mortalidade a um ano de acordo com a função renal à admissão, em doentes com a primeira hospitalização por insuficiência cardíaca aguda

Resumo

Introdução e objetivos: A doença renal crónica (CKD) está relacionada com um pior prognóstico em doentes com insuficiência cardíaca (HF). Poucos estudos avaliaram se a função renal influencia o risco de mortalidade a um ano, em doentes admitidos pela primeira vez por insuficiência cardíaca aguda.

Métodos: Revimos os registos médicos de todos os doentes > 50 anos, admitidos num período de dois anos por um primeiro episódio de descompensação de HF. Dividimos a amostra de acordo com a taxa de filtração glomerular estimada dos doentes (eGFR) após a admissão em três grupos (eGFR >60, 30-60 e <30 ml/min/1,73 m^2). Comparamos a admissão inicial e as taxas de mortalidade por todas as causas num ano, com análises de regressão de Cox.

Resultados: Foram incluídos 985 doentes no estudo, a média foi de 78,4 $\pm$ 9 anos e a eGFR média na admissão foi de 60,5 $\pm$ 26. Do total, 516 (52,3%) doentes apresentaram eGFR < 60. A um ano, a taxa de mortalidade por todas as causas foi de 25,4%, com uma associação significativa entre a pior categoria eGFR e a taxa de mortalidade (p < 0,0001). A análise de regressão de Cox que avaliou a eGFR como variável categórica confirmou essa associação (HR 1,378; p = 0,030) juntamente com idade avançada (HR 1,066; p < 0,001), diagnóstico prévio de hipertensão (HR 0,527; p < 0,001) e pressão arterial sistólica inferior (HR 0,993; p = 0,009) e maiores valores de potássio sérico após a admissão (HR 1,471; p < 0,001).

Conclusões: A insuficiência renal é comum em doentes com insuficiência cardíaca, mesmo no momento da primeira admissão. Nesse grupo de doentes com insuficiência cardíaca a presença de insuficiência renal está associada a um maior risco de mortalidade em médio prazo (um ano).

Introduction

The prevalence of heart failure (HF) increases with age, and so does the prevalence of comorbidities, including chronic kidney disease (CKD).[1] Worsening renal function is considered to be a sensitive marker of decreased organ perfusion, and is an important independent predictor of increased mortality and hospitalization in patients with chronic or acute HF.[2]

Glomerular filtration rate is the most commonly used and best overall marker of renal function. Renal dysfunction, defined as an estimated glomerular filtration rate (eGFR) of <60 ml/min/1.73 m^2, is found in two-thirds of patients admitted to hospital with acute HF,[3] with varying rates depending on the type of acute HF patients studied. The presence of renal dysfunction in such patients is a marker of poor prognosis in terms of both mortality and readmission for worsening HF.[4–8] Most studies have assessed this relationship only in patients with HF with reduced ejection fraction (HFrEF) or who have previously been hospitalized for acute HF. Fewer studies have focused on patients with preserved ejection fraction (HFpEF) or in the early stages of HF.[9,10]

To shed more light on the role of renal dysfunction in acute HF, this study aimed to investigate the potential impact of impaired baseline renal function, defined as eGFR <60 ml/min/1.73 m^2, on the risk of one-year mortality in the subset of real-world HF patients (regardless of type of ventricular dysfunction) undergoing their first admission for HF decompensation.

Methods

Patient selection and study design

This retrospective study was performed in the Hospital Universitari de Bellvitge, a 750-bed tertiary-care public hospital for adults from Barcelona, Spain. Administrative data were retrieved regarding all 1333 admissions to our hospital within a 24-month period (January 2013-December 2014) with HF as the primary discharge diagnosis (identified by the ICD 9-CM codes 398.91, 402.91, 404.01, 404.03, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43 and 428.9). Following this first selection, a thorough review of all these patients' medical records was undertaken in order to select only those who (a) fulfilled clinical criteria for acute HF and (b) were undergoing their first ever admission due to a first episode of acute HF (those who had already been discharged with a primary or secondary diagnosis of HF were excluded). We also excluded patients younger than 50 years; those in stage 5 CKD undergoing renal replacement therapy; kidney or heart transplant recipients; those already receiving palliative therapy for any cause; patients whose acute HF episode was secondary to an acute coronary syndrome; patients with cirrhosis, ascites or nephrotic syndrome; and patients discharged directly home within 24 hours or transferred to other acute care hospitals from the emergency department. Any doubts regarding a patient's inclusion in the study were discussed by a review panel. The study conformed to the principles outlined in the Declaration of Helsinki and the ethics committee of the University Bellvitge Hospital approved the overall protocol.

The presence of HF was established using the Framingham criteria.[11] When echocardiographic data were available, the patient's left ventricular ejection fraction (LVEF) was recorded and HF was coded as HFpEF when LVEF was ≥50% and as HFrEF for lower LVEF values. Demographic data, past medical history diagnoses and all clinical data related to HF history and acute HF signs and symptoms were collected for all patients. A basic blood chemistry panel was obtained, which besides renal function included ionic, lipid and blood glucose profiles and a complete blood count. Admission plasma concentrations of N-terminal pro-B-type natriuretic peptide (NT-proBNP) were not available in most patients and for this reason this biomarker was not included in the patient database. Patients' index admission length of stay (LOS) and HF-related medication prescribed on discharge, including angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), aldosterone blockers, beta-blockers and diuretics, were also recorded.

Assessment of renal function

eGFR on admission to hospital was calculated using the four-variable Modification of Diet in Renal Disease (MDRD-4) equation, using the formula eGFR (ml/min/1.73 m^2)=186.3×(serum creatinine)-1.154×(age)-0.203×(1.212 if black race)×(0.742 if female). Patients were divided into three groups according to the eGFR-defined CKD stages of the National Kidney Foundation[12]: normal or mild (stages 1 and 2, eGFR >60), moderate (stage 3, eGFR 30-60) and severe (stages 4 and 5, eGFR <30). The MDRD-4 formula was chosen because of its usefulness for predicting HF hospitalization.[13]

Follow-up

The main outcome of the present study was one-year all-cause mortality, defined as death measured as time to event within the year following discharge after the index acute HF admission. Subjects were categorized as alive after 12 months of follow-up, or censored when they died. Secondary outcomes were in-hospital, one- and three-month all-cause mortality. Mortality status was determined by trained physician adjudicators on the basis of medical records from hospitalizations, emergency department visits, death certificates, and autopsy and coroner's reports, when available. No patients were lost to follow-up.

Statistical analysis

Normally distributed continuous variables are reported as mean ± standard deviation. Categorical variables are reported as proportions. The Student's t test was used to compare continuous variables, preceded by the Levene test for equality of variances, while either the chi-square statistic or Fisher's exact test was used to compare categorical or dichotomous variables, respectively. For non-normally distributed continuous outcomes we used the Wilcoxon rank sum test for independent variables and the Wilcoxon signed rank test for paired variables.

A multivariate linear regression model was constructed to identify independent associated variables of renal function at baseline, with eGFR as the dependent variable. Kaplan-Meier survival curves were created to identify prognostic differences in terms of mortality between groups. Univariate and multivariate analyses were performed to calculate the hazard ratio (HR) between renal dysfunction and all-cause mortality using forward stepwise Cox proportional hazards models. For multivariate analysis, previously selected covariates considered relevant for prognosis were adjusted and the covariates associated with mortality on univariate analysis (p<0.10) were analyzed using eGFR as a categorical variable (with a cut-off of 60 ml/min/1.73 m^2) as a definition of renal dysfunction.

The analyses were performed with SPSS version 21.0 (IBM SPSS, Armonk, NY). Tests were two-sided and p-values of <0.05 were considered statistically significant.

Results

Baseline

A total of 985 patients with a validated diagnosis of first hospital admission for HF within the two-year study period were included in the analysis. Their mean age was 78.36±9 years and 54.7% (n=539) were female. Mean eGFR at admission was 60.5±26 ml/min/1.73 m^2; 516 (52.3%) of the patients had stage 3, 4 or 5 CKD (eGFR <60 ml/min/1.73 m^2) at the time of admission. When patients were stratified by eGFR, 469 (47.6%) had eGFR >60 ml/min/1.73 m^2, 411 (41.7%) 30-60 ml/min/1.73 m^2 and 105 (10.6%) <30 ml/min/1.73 m^2. Table 1 shows the baseline characteristics of these three patient groups. Some baseline characteristics differed significantly according to eGFR group: patients with lower admission eGFR were older, with a higher prevalence of a previous diagnosis of hypertension or anemia, and presented with higher potassium and lower hemoglobin values on admission. The multivariate linear regression model confirmed the independent association of these variables with worse admission renal function (Table 2).

Outcomes during hospital admission

Patients' mean LOS was 7.7±8.9. Those with lower eGFR at admission had a significantly longer LOS (Table 3).

Overall in-hospital mortality was 5.2%. Mortality (Table 3) increased linearly and significantly across the different categories of eGFR (eGFR >60 2.8% vs. 5.4% for eGFR 30-60 vs. 15.2% for eGFR <30; p<0.0001) (Table 3).

Heart failure treatment after discharge

Table 3 shows the discharge HF medication prescribed in the 934 surviving patients, stratified by the three eGFR categories. Patients with poor admission eGFR received significantly less ACEIs/ARBs and there was also a trend towards less prescription of aldosterone blockers. No differences

Table 1 Baseline patient characteristics of the overall cohort by estimated glomerular filtration rate at admission.

	eGFR at admission			p
	>60 ml/min/1.73 m^2 (n=469)	30-60 ml/min/1.73 m^2 (n=411)	<30 ml/min/1.73 m^2 (n=105)	
Age (years), mean ± SD	75.8±9.6	80.5±9.1	80.9±8.8	<0.0001
Female gender, n (%)	244 (52.%)	240 (58.4%)	55 (52.4%)	0.014
Ischemic etiology, n (%)	108 (23%)	108 (26.3%)	25 (23.8%)	0.528
Diabetes, n (%)	165 (35.2)	168 (40.9%)	39 (37.1%)	0.219
Hypertension, n (%)	372 (79.3%)	359 (87.3%)	95 (90.5%)	0.001
Dyslipidemia, n (%)	244 (52%)	239 (58.2%)	58 (55.2%)	0.191
Atrial fibrillation, n (%)	189 (40.3%)	141 (34.3%)	32 (30.5%)	0.068
Known anemia, n (%)	74 (15.8%)	90 (21.9%)	32 (30.5%)	0.001
COPD, n (%)	108 (23%)	82% (20%)	22 (21%)	0.535
LEVF (%), mean ± SD (n=428)	49.6±15	50.4±15	49.7±15	0.861
Preserved LEVF (of 428), n (%)	139 (65.3%)	116 (69%)	32 (68.1%)	0.728
Stroke, n (%)	70 (14.9%)	64 (15.6%)	15 (14.3%)	0.934
Dementia, n (%)	30 (6.4%)	29 (7.1%)	9 (8.6%)	0.091
Vital signs, mean ± SD				
SBP (mmHg)	140.4±62.9	135.6±25.4	130.7±30.5	0.117
DBP (mmHg)	75.6±16.7	74.1±40.4	69.9±16.8	0.214
Heart rate (bpm)	86.4±21.9	86.8± 36.8	90.6±63.9	0.534
Laboratory tests, mean ± SD				
Hemoglobin (g/dl)	12.6±6.2	11.6±1.9	10.4±1.8	<0.0001
Creatinine (μmol/l)	77.8±18.1	121.4±27.4	247.9±91.7	<0.0001
eGFR (MDRD) (ml/min/1.73 m^2)	81.8±22	46.3±8.6	21.4±6.1	<0.0001
Potassium (mEq/l)	4.1± 0.5	4.3±0.5	4.6±0.7	<0.0001

COPD: chronic obstructive pulmonary disease; DBP: diastolic blood pressure; eGFR: estimated glomerular filtration rate; LVEF: left ventricular ejection fraction; MDRD: modification of diet in renal disease; SBP: systolic blood pressure; SD: standard deviation.

Table 2 Linear regression model with the dependent variable of baseline estimated glomerular filtration rate.

Variables	Beta	T	p
Age	0.181	5.583	<0.0001
History of anemia	0.607	2.128	0.034
History of hypertension	0.076	2.413	0.016
Hemoglobin	−0.115	−3.665	<0.0001
Potassium	0.232	0.7369	<0.0001

regarding beta-blockers or diuretics were found between the three eGFR groups.

Follow-up

As was the case with in-hospital mortality, all-cause mortality increased linearly and significantly across eGFR categories in all the post-discharge periods analyzed (Table 3). One-year all-cause mortality, the main outcome variable, increased as eGFR worsened (25.4% overall; 19.2% for eGFR >60 vs. 29.9% for eGFR 30-60 and 35.2% for eGFR <30; p<0.0001). Figure 1 shows the one-year survival curves according to the three eGFR categories.

In Cox univariate analysis, worse renal function measured using eGFR as a categorical variable (HR 1.7; p<0.0001) or as a continuous variable (HR 0.990; p<0.0001) was significantly associated with mortality. For continuous variables this was also the case for admission plasma creatinine (HR 1.013; p<0.0001) and BUN (HR 1.021; p<0.001).

Multivariate Cox regression analysis (Table 4) analyzing eGFR as a categorical variable (<60) confirmed this independent association (HR1.378; p=0.030), and identified other variables as risk factors for increased all-cause mortality: older age (HR 1.066; p<0.001), previous diagnosis of hypertension (HR 0.527; p<0.001), and both lower admission systolic blood pressure (HR 0.993; p=0.009) and higher serum potassium at admission (HR 1.471; p<0.001).

Discussion

Main findings

Our study sheds more light on the role of renal function impairment in HF, which has previously been assessed in only a few groups of patients. It shows that reduced eGFR is not only already present in more than half of patients presenting with a first clinical episode of decompensation serious enough to warrant hospitalization, but also acts as a marker of poor short- and mid-term prognosis in such patients.

Impaired renal function commonly accompanies both acute and chronic HF.[8] Results from the ADHERE database in 118 465 hospitalization episodes show that the majority of patients admitted with acute decompensated HF have

Table 3 In-hospital outcomes, treatment at discharge and mortality during follow-up according to renal function assessed by estimated glomerular filtration rate at admission.

	eGFR at admission			p
	>60 ml/min/1.73 m² (n=469)	30-60 ml/min/1.73 m² (n=411)	<30 ml/min/1.73 m² (n=105)	
LOS (days), mean ± SD	7.5±9.4	7.4±7.1	9.8±11.9	0.038
Medication at discharge, n (%)				
ACEIs/ARBs	327 (71.7%)	237 (60.9%)	25 (28.1%)	<0.001
Beta-blockers	247 (54.2%)	202 (51.9%)	53 (59.6%)	0.416
Loop diuretics	432 (94.7%)	372 (95.6%)	81 (91%)	0.223
Thiazides	22 (4.8%)	29 (17.5%)	4 (4.5%)	0.211
Aldosterone blockers	75 (16.4%)	52 (13.4%)	7 (4.9%)	0.083
Mortality, n (%)				
In-hospital	13 (2.8%)	22 (5.4%)	16 (15.2%)	<0.0001
One month	22(8.3%)	43 (10.5%)	22 (21%)	<0.0001
Thee months	39 (8.3%)	63 (15.3%)	27 (25.7%)	<0.0001
One year	90 (19.2%)	123 (29.9%)	37 (35.2%)	<0.0001

ACEIs: angiotensin-converting enzyme inhibitors; ARBs: angiotensin receptor blockers; eGFR: estimated glomerular filtration rate; LOS: length of stay; SD: standard deviation.

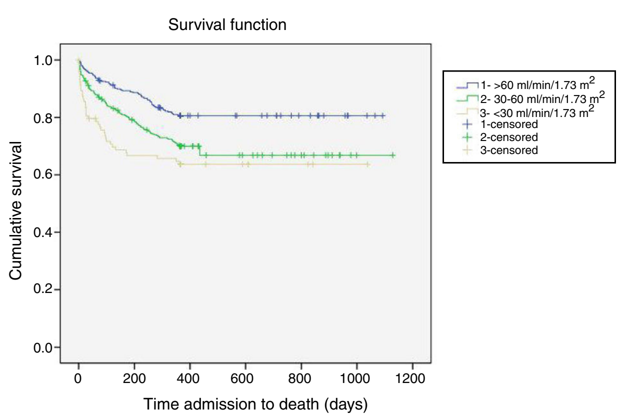

Figure 1 Kaplan-Meier analysis of one-year mortality according to estimated glomerular filtration rate. Log-rank test 23.559; p<0.0001.

significant renal impairment, which influences treatment and outcomes.[14] Our percentage (52.3%) of abnormal eGFR (<60 ml/min/1.73 m²) on admission is striking, and is almost identical to the 53% reported in patients admitted for the first time because of acute HF, all of them however with HFpEF.[8] It should be noted that the mean age of our patients is much older than in other studies.[8] The prevalence of CKD in outpatients with HF has also been reported at around 50%.[15]

Our patients with impaired renal function were characterized by older age, higher prevalence of a known risk factor (hypertension) and a well-known complication (anemia) of CKD, and laboratory findings that were also consistent with this diagnosis (high potassium and low hemoglobin).[9,16] As has been described in other cohorts of patients with acute HF,[9] our patients' discharge prescriptions are similar for those with mild or moderate CKD, but show significantly lower use of ACEIs and ARBs in the presence of eGFR <30 ml/min/1.73 m² and almost significantly lower use of aldosterone blockers. The guidelines do indeed suggest caution in the use of these drug classes in patients with severely impaired renal function, and therefore their underprescription is probably justified for reasons of safety.

The relationship between poor renal function and worse outcomes in HF has been studied mainly in patients with HFrEF, but also in HFpEF.[4-10] In our study, mean LOS was significantly greater in patients with worse eGFR, and mortality increased linearly and significantly with decreasing eGFR in all assessments.

The main finding of our study is the confirmation that impaired renal function, defined by eGFR <60 ml/min/1.73 m², in patients first admitted due to HF, is associated with higher one-year mortality. This risk is observed not only in univariate analysis but also when controlling for other well-known causes of one-year mortality in acute HF patients. These findings are in line with other reports,[2] but with the distinguishing feature that in our study only first hospital admissions were analyzed, which in most cases was the time of diagnosis of HF. This risk probably persists over time, since some studies have identified increases in mortality after a first hospitalization for HF at as many as seven years of follow-up when baseline renal function was impaired.[9]

Other factors associated with increased mortality have been previously reported in patients with first admission or new-onset HF, such as age[17] and lower systolic blood pressure.[18] In our study patients diagnosed with hypertension had a better prognosis, which may be related to the fact that HF of ischemic etiology has a worse prognosis.[19] Potassium levels were also associated with higher mortality in our study; abnormal potassium levels are associated with arrhythmogenic processes, especially ventricular arrhythmias and consequent cardiac arrest, and previous studies

Table 4 Univariate and multivariate analyses by one-year overall mortality.

Variable	Univariate analysis		Multivariate analysis	
	HR (95% CI)	p	HR (95% CI)	p
Age	1.063 (1.047-1.038)	<0.0001	1.066 (1.048-1.085)	<0.0001
Female gender	1.150 (0.895-1.478)	0.275		
CAD	1.154 (0.859-1.550)	0.343		
Diabetes	1.182 (0.911-1.535)	0.290		
Dyslipidemia	1.182 (0.992-1.514)	0.187		
Hypertension	0.712 (0.525-0.967)	0.031	0.527 (0.377-0.736)	<0.0001
COPD	0.900 (0.670-1.209)	0.483		
Atrial fibrillation	1.053 (0.813-1.363)	0.696		
Stroke	0.982 (0.696-1.387)	0.982		
Dementia	1.746 (1.163-2.621)	0.007		
Known anemia	1.502 (1.132-1.992)	0.005		
Preserved LVEF	0.749 (0.484-1.153)	0.193		
SBP	0.994 (0.988-0.998)	0.004	0.993 (0.996-0.999)	0.009
DBP	0.994 (0.986-1.002)	0.132		
Heart rate	1.003 (1.001-1.005)	0.011		
eGFR <60 ml/min/1.73 m^2	1.798 (1.388-2.327)	<0.0001	1.378 (1.027-1.851)	0.030
Hemoglobin	0.859 (0.808-0.913)	<0.0001		
Sodium	0.971 (0.945-0.997)	0.031		
Potassium	1.618 (1.323-1.977)	<0.0001	1.471 (1.180-1.834)	<0.001
Glucose	0.996 (0.962-1.031)	0.807		
Number of chronic therapies	1.012 (0.979-1.048)	0.476		

CAD: coronary artery disease; CI: confidence interval; COPD: chronic obstructive pulmonary disease; DBP: diastolic blood pressure; eGFR: estimated glomerular filtration rate; HR: hazard ratio; LVEF: left ventricular ejection fraction; SBP: systolic blood pressure.

report that both hypokalemia and hyperkalemia are associated with poor prognosis among HF patients.[20,21]

Some strengths of this study should be mentioned. It is based on a sizable number of real-world patients with all types of HF, whose medical records were thoroughly reviewed to confirm that they truly fulfilled the diagnostic criteria for HF and that no previous episodes of acute HF requiring admission had ever taken place. eGFR was assessed using the same technique at a single laboratory. Moreover, the MDRD-4 formula is a simple and standardized method requiring only four clinical parameters, and is not influenced by the patient's weight, which may vary significantly in an acute HF scenario.[22] However, it should be pointed out that some studies favor the use of other formulas in this clinical scenario.[23,24] Plischke et al. reported that the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula was marginally better in predicting all-cause mortality than MDRD-4,[25] and a recent study that compared five different formulas (Cockcroft-Gault, MDRD-4, MDRD-6, CKD-EPI in patients <70 years and Berlin Initiative Study-1 (BIS-1) in older patients) applied to 1104 unselected acute HF patients reported that the Cockcroft-Gault formula showed the highest prognostic accuracy to predict death.[26]

Study limitations

Several limitations should be taken into account when interpreting our results. First, and probably most important, we calculated our patients' eGFR using a spot determination of plasma creatinine obtained at the time of hospital admission. Beyond the presence of a previous diagnosis of CKD, we could not determine whether this value truly reflected the patient's usual renal function or reflected a transient worsening associated with the acute HF episode. Similarly, data were not collected on changes in patients' eGFR during and after hospitalization, so the effect of worsening or improving renal function (beyond the spot admission data) on prognosis cannot be ascertained. We excluded patients in stage 5 CKD (eGFR <15 ml/min/1.73 m^2) even if they were not undergoing renal replacement therapy; however, the number of such patients was low and unlikely to alter the prognostic role of eGFR found for stage 4 patients. Although our study includes some patients over 50-65 years of age, the CKD-EPI equation might have been a better estimator of eGFR given the mean age of our study sample.[27] Finally, we did not have access to a basic prognostic HF biomarker (NT-proBNP) for most patients, or to other markers of renal function such as albuminuria or cystatin C, which have been found to provide valuable prognostic information in HF patients regardless of their eGFR – in the latter case, however, our study follows standard clinical practice, in which most HF patients are managed without access to plasma cystatin C levels.

Conclusions

Our study confirms a high prevalence of renal impairment on first admission of HF patients. Renal dysfunction was shown to be a marker of higher short- and mid-term mortality even in this patient population of HF patients presumed to be in the earlier stages of the disease, free from previous acute HF episodes that could have triggered prior kidney damage. Further prospective studies focusing on this population, with a more thorough assessment of renal function before, during and after the acute episode, may shed more light on this subject.

Funding

This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Ruiz-Laiglesia FJ, Sánchez-Marteles M, Pérez-Calvo JI, et al. Comorbidity in heart failure. Results of the Spanish RICA Registry. QJM. 2014;107:989–94.
2. Löffler AI, Cappola TP, Fang J, et al. Effect of renal function on prognosis in chronic heart failure. Am J Cardiol. 2015;115:62–8.
3. Givertz MM, Postmus D, Hillege HL, et al. Renal function trajectories and clinical outcomes in acute heart failure. Circ Heart Fail. 2014;7:59–67.
4. Dries DL, Exner DV, Domanski MJ, et al. The prognostic implications of renal insufficiency in asymptomatic and symptomatic patients with left ventricular systolic dysfunction. J Am Coll Cardiol. 2000;35:681–9.
5. De Silva R, Nikitin NP, Witte KK, et al. Incidence of renal dysfunction over 6 months in patients with chronic heart failure due to left ventricular systolic dysfunction: contributing factors and relationship to prognosis. Eur Heart J. 2006;27:569–81.
6. Klein L, Massie BM, Leimberger JD, et al. Admission or changes in renal function during hospitalization for worsening heart failure predict postdischarge survival: results from the Outcomes of a Prospective Trial of Intravenous Milrinone for Exacerbations of Chronic Heart Failure (OPTIME-CHF). Circ Heart Fail. 2008;1:25–33.
7. Berra G, Garin N, Stirnemann J, et al. Outcome in acute heart failure: prognostic value of acute kidney injury and worsening renal function. J Card Fail. 2015;21:382–90.
8. Damman K, Solomon SD, Pfeffer MA, et al. Worsening renal function and outcome in heart failure patients with reduced and preserved ejection fraction and the impact of angiotensin receptor blocker treatment: data from the CHARM-study programme. Eur J Heart Fail. 2016;18:1508–17.
9. Rusinaru D, Buiciuc O, Houpe D, et al. Renal function and long-term survival after hospital discharge in heart failure with preserved ejection fraction. Int J Cardiol. 2011;147:278–82.
10. Casado J, Montero M, Formiga F, et al. Clinical characteristics and prognostic influence of renal dysfunction in heart failure patients with preserved ejection fraction. Eur J Intern Med. 2013;24:677–83.
11. McKee PA, Castelli WP, McNamara PM, et al. The natural history of congestive heart failure: the Framingham study. N Engl J Med. 1971;285:1441–6.
12. National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis. 2002;39:S1–266.
13. Tancredi M, Rosengren A, Olsson M, et al. The relationship between three eGFR formulas and hospitalization for heart failure in 54 486 individuals with type 2 diabetes. Diabetes Metab Res Rev. 2016;32:730–5.
14. Heywood JT, Fonarow GC, Costanzo MR, et al. High prevalence of renal dysfunction and its impact on outcome in 118,465 patients hospitalized with acute decompensated heart failure: a report from the ADHERE database. J Card Fail. 2007;13:422–30.
15. Waldum B, Westheim AS, Sandvik L, et al. Renal function in outpatients with chronic heart failure. J Card Fail. 2010;16:374–80.
16. Waldum-Grevbo B. What physicians need to know about renal function in outpatients with heart failure. Cardiology. 2015;131:130–8.
17. Franco J, Formiga F, Chivite D, et al. New onset heart failure – clinical characteristics and short-term mortality. A RICA (Spanish registry of acute heart failure) study. Eur J Intern Med. 2015;26:357–62.
18. Buiciuc O, Rusinaru D, Lévy F, et al. Low systolic blood pressure at admission predicts long-term mortality in heart failure with preserved ejection fraction. J Card Fail. 2011;17:907–15.
19. Hernández G, Anguita M, Ojeda S, et al. Heart failure with preserved ejection fraction. Effect of etiology on prognosis. Rev Esp Cardiol. 2006;59:346–51 [in Spanish].
20. Hoss S, Elizur Y, Luria D, et al. Serum potassium levels and outcome in patients with chronic heart failure. Am J Cardiol. 2016;118:1868–74.
21. Ahmed MI, Ekundayo OJ, Mujib M, et al. Mild hyperkalemia and outcomes in chronic heart failure: a propensity matched study. Int J Cardiol. 2010;144:383–8.
22. Cioffi G, Mortara A, Maggioni AP, et al. Predictors of mortality in acute heart failure and severe renal dysfunction. Does formula for glomerular filtration rate have any impact? Data from IN-HF outcome registry. Int J Cardiol. 2014;172:e96–7.
23. Casado Cerrada J, Carrasco Sánchez FJ, Pérez-Calvo JI, et al. Prognostic value of glomerular filtration rate estimation equations in acute heart failure with preserved versus reduced ejection fraction. Int J Clin Pract. 2015;69:829–39.
24. Zamora E, Lupón J, Vila J, et al., Estimated glomerular filtration rate and prognosis in heart failure: value of the Modification of Diet in Renal Disease Study-4, chronic kidney disease epidemiology collaboration, and cockroft-gault formulas. J Am Coll Cardiol. 2012;59:1709–15.
25. Plischke M, Neuhold S, Kohl M, et al. Renal function in heart failure: a disparity between estimating function and predicting mortality risk. Eur J Heart Fail. 2013;15:763–70.
26. Weidmann ZM, Breidthardt T, Twerenbold R, et al. Prediction of mortality using quantification of renal function in acute heart failure. Int J Cardiol. 2015;201:650–7.
27. Mora-Gutiérrez JM, Slon Roblero MF, Castaño Bilbao I, et al. Chronic kidney disease in the elderly patient. Rev Esp Geriatr Gerontol. 2017;52:152–8.