Congestive heart failure and renal dysfunction

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Abstract

The kidney plays a key role in the homeostatic maintenance of fluids and electrolytes in the context of chronic congestive heart failure (CHF). CHF carries a spectrum of pathophysiological aberrations, which constitute a stress on the respective renal regulatory mechanisms.
We defined bedside clinical, laboratory and electrocardiographic parameters characterizing CHF patients with and without concomitant renal failure (RF), and analyzed their impact on mortality. We studied 146 symptomatic unselected consecutive furosemide-treated CHF patients hospitalized for various acute conditions. On admission, history taking, physical examination, chest x-ray, ECG and routine laboratory tests were performed. Subsequently, patients were divided into 2 subgroups, those with serum creatinine > 140 µmol/l (58) and those with lower values (88). Prevailing in RF subgroup were older age, male gender, admission pulmonary edema, cardiac arrhythmias, cardiac condition disturbances, lower ejection fraction, anemia, higher furosemide maintenance dosages, insulin treatment and receiving less ACE inhibitors. RF being the parameter most significantly associated with low survival. Using multivariate analysis in the RF subgroup, older age, female gender and diabetes mellitus proved most significantly associated with poorer survival. In the non-RF subgroup, only older age and diabetes mellitus were significantly associated with low survival.
Renal failure is a marker of severity in CHF. Its full-blown deleterious prognostic effect is already manifested at serum creatinine 140 µmol/l. Older age, diabetes mellitus and female gender significantly heralded a shorter survival. Such patients require special care.

Key words: congestive heart failure, renal failure, diabetes mellitus, gender, age

Introduction

The kidney plays a key role in the homeostatic maintenance of fluids and electrolytes in the context of chronic congestive heart failure (CHF)(1). CHF carries a spectrum of pathophysiological aberrations, which constitute a stress on the respective renal regulatory mechanisms. It has been shown that the presence of renal failure in patients with congestive heart failure is associated with shorter survival (2-4). Moreover, renal failure, even moderate, represents not only a marker for poor prognosis, but also an independent risk factor for increased mortality (3).
We defined bedside clinical, laboratory and electrocardiographic parameters, characterizing CHF patients with and without concomitant renal failure (RF), and analyzed their impact on mortality.

Patients and methods

We studied 146 symptomatic unselected furosemide-treated patients with congestive heart failure, hospitalized for various acute conditions. Congestive heart failure was of various etiologies and had been present for at least 6 months prior to admission. All patients had been on chronic furosemide treatments of at least 40 mg/day for more than 3 months.
On admission, blood was drawn for serum biochemical determinations, including glucose, creatinine, chloride, potassium, sodium, bicarbonate, blood pH, calcium, phosphorus, cholesterol, triglycerides and blood count. All determinations were performed using conventional methods. The history taking, physical examination, chest x-ray and ECG were performed. Subsequently, patients were divided into 2 subgroups, those with serum creatinine > 140 µmol/l (58 patients) and those with lower values (88 patients).

Results and discussion

The study group included 146 patients (84 females and 62 males, mean (±SD) age 71,4±19,6 years). Renal failure was present in 58 (39,73%) patients. Table 1 depicts the mean values of quantitative variables in the patients with renal failure as compared to those with normal creatinine values.

Table 1. Mean values of quantitative variables in congestive heart failure patients with versus without renal failure

Characteristic	Patients with renal failure	Patients without renal failure
Weight (kg)	68,7±12,4	70,4±13,6
Age (years)	65,4±6,4	60,3±8,3
Serum potassium (mmol/l)	4,71±0,82	4,5±0,52
Serum bicarbonate (mmol/l)	24,4±4,22	26,24±3,96
Serum chloride (mmol/l)	104,0±5,4	102,88±4,6
Serum phosphorous (mmol/l)	3,8±0,8	3,5±0,5
Blood pH	7,37±0,06	7,39±0,05

It can be seen that patients with renal failure were significantly older (P<0,005), their mean serum potassium, phosphorus levels were higher, while mean serum bicarbonate levels were lower (P<0,0001).
Table 2 illustrated qualitative variables which were significantly more prevalent in the patients with renal failure.

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Table 2. Qualitative variables prevailing in congestive heart failure patients with versus without renal failure

Characteristic	Patients with renal failure - N(%)	Patients without renal failure – N(%)
Male gender	37 (63,79%)	25 (28,41%)
Pulmonary edema on admission	36 (62,07%)	29 (32,95%)
Cardiac arrhythmias on admission	34 (58,62%)	28 (31,82%)
NYHA class III-IV	35 (60,34%)	31 (35,23%)
Ejection fraction < 30%	25 (43,10%)	15 (17,04%)
Presence of anaemia	30 (51,72%)	20 (22,73%)
Furosemide dosage>80mg	20 (34,48%)	10 (11,36%)
Treatment with ACE inhibitors	28 (48,28%)	59 (67,04%)

Male gender, admission pulmonary edema, cardiac arrhythmias (atrial or ventricular premature beats >6 min, couplets, atrial fibrillation, supraventricular or ventricular tachycardia), severe CHF, lower ejection fraction, anemia, higher furosemide maintenance dosages and receiving less ACE inhibitors prevailed in the subgroup with renal failure. Duration of furosemide treatment, presence of hypertension, periferal vascular disease, ischemic heart disease, chronic obstructive pulmonary disease, hypokalemia or hyponatremia on admission, treatment with calcium channel blockers, nitrates or digoxin, were not significantly different between the two subgroups.

The follow-up period extended up to 40 months, median 34±12 months. During this period 24 (16,44%) patients died. 17 patients (70,83%) were from subgroup with renal failure.

Renal failure was the parameter most significantly associated with low survival. Using multivariate analysis in the subgroup with renal failure, older age, severity of CHF, female gender proved to be significantly associated with poorer survival. In the subgroup without renal failure, only older age was significantly associated with low survival. Parameters which did not influence survival in the subgroup with renal failure, included duration of furosemide treatment, hypertension, hyperlipidemia, anaemia, various cardiac arrhythmias, use of vasodilators or digoxin and hypokalemia or hyponatremia on admission.

The pathophysiological interrelationship between CHF and renal insufficiency is bidirectional, involving a variety of factors (1). Activation of the neurohormonal and renin-angiotensin systems, mainly via reduction of effective blood volume in CHF leads to stimulation of aldosterone and ADH secretion. These may produce a rise in cardiac filling pressure, increased extracelular volume, edema and organ dysfunction, including deterioration of CHF. Within the context of the kidney, intravascular volume depletion and the ensuing GFR reduction, eventually limit natriuresis and diuretic capacity despite enhanced nitric oxide production and activation of natriuretic substances. Superposition of renal failure on CHF implies an additional burden of poor prognostic factors. These may include various electrolyte and acid-base balance aberrations, decreased immunological competence, osteoporosis, enhanced bleeding tendency and other factors, which may shorten survival from cardiac and non-cardiac death (5).

Conclusions

Renal failure is a marker of severity in CHF. Its full-blown deleterious prognostic effect is already manifested at serum creatinine of 140 µmol/l. Older age and a female gender significantly heralded a shorter survival. We were unable to find such association in the literature (3). Such patients require special care. Following discharge, patients were managed exclusively by their primary physicians. Therefore our results are not biased by other factors such as those introduced by pharmaceutically oriented studies or those involving intervention by specialized heart failure clinics.

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