Prognostic significance of serum creatinine and its change patterns in patients with acute coronary syndromes

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Background In acute coronary syndromes (ACS), serum creatinine (sCr) levels have short- and long-term prognostic value. However, it is possible that repeated evaluations of sCr during hospitalization, rather than measuring sCr value at admission only, might improve risk assessment. We investigated the relationship between sCr baseline value, its changes, and in-hospital mortality in patients hospitalized with ACS.

Methods In 2,756 ACS patients, sCr was measured at hospital admission and then daily, until discharge from coronary care unit. Patients were grouped according to the maximum sCr change observed: <0.3 mg/dL change from baseline (stable renal function [SRF] group), ≥0.3 mg/dL decrease (improved renal function [IRF] group), and ≥0.3 mg/dL increase (worsening renal function [WRF] group).

Results Of the 2,756 patients, 2,163 (78%) had SRF, 292 (11%) had IRF, and 301 (11%) had WRF. In-hospital mortality in the 3 groups was 0.5%, 2%, and 14% ($P < .001$), respectively. Peak sCr value was a more powerful predictor of mortality (area under the curve 0.86, 95% CI 0.81-0.92) than the initial sCr value (area under the curve 0.69, 95% CI 0.63-0.77; $P < .001$). When sCr and its change patterns during coronary care unit stay were evaluated together, improved mortality risk stratification was found.

Conclusions In ACS patients, daily sCr value and its change pattern are stronger predictors of in-hospital mortality than the initial sCr value only; thus, their combined evaluation provides a more accurate and dynamic stratification of patients' risk. Finally, the intermediate mortality risk of IRF patients possibly reflects acute kidney injury started before hospitalization. (Am Heart J 2015;169:363-70.)

In acute coronary syndromes (ACS), serum creatinine (sCr) levels measured at hospital presentation have been shown to have short- and long-term prognostic value.[1–5] Multiple chronic and acute factors, including advanced age, comorbidities, hemodynamic instability, and use of contrast agents, may affect sCr value at admission and contribute to acute kidney injury during hospitalization in this clinical setting.[6–8]

Some ACS patients may show a decrease of sCr during hospitalization, and this is often paralleled by hemodynamic stabilization and is usually regarded as an indication of a favorable clinical course. However, it is hard to imagine that acute improvement of renal function may occur in patients who previously had stable renal function (SRF). On the contrary, a more plausible explanation is that sCr reduction may be due to the recovery of renal function in patients in whom kidney injury started before hospital admission. In consideration of the close association between acute kidney injury and increased in-hospital mortality,[9] the prognosis of patients with apparent renal function improvement could be worse than that of patients with SRF, and possibly different from that of patients who develop renal dysfunction. However, the clinical and prognostic relevance of sCr change patterns in ACS patients has never been specifically investigated. Therefore, in this study, we assessed the patterns of sCr changes in a large cohort of ACS patients during hospitalization. Our aim was to determine whether daily sCr evaluation and its change pattern could better reflect in-hospital mortality than the initial sCr value only and provide a more accurate and dynamic prognostic evaluation of ACS patients.

Methods

Patient population

This retrospective observational study was conducted at the Centro Cardiologico Monzino, Milan. All consecutive patients who were admitted between January 1, 2002, and March 31, 2011, to our coronary care unit

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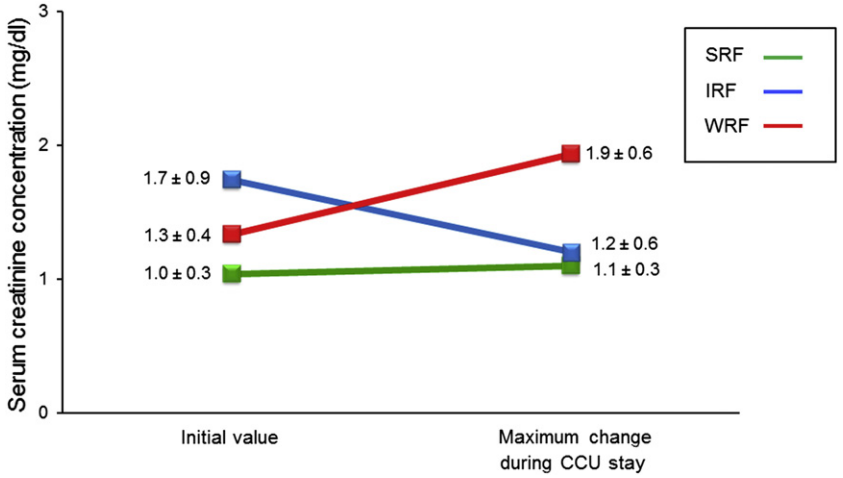
Figure 1



Initial sCr value and its maximum change during CCU stay in patients with SRF, IRF, and WRF. Values are mean ± SD.

(CCU) for ST-elevation (STEMI) and non–ST-elevation myocardial infarction (NSTEMI) were identified through a search of the clinical database and were analyzed. Patients in chronic peritoneal or hemodialysis treatment (n = 3), those who died before 2 consecutive daily sCr samples could be determined (n = 37), and ACS patients requiring renal replacement treatment during hospitalization (n = 83) were excluded. Patients with a myocardial infarction as a complication of elective percutaneous coronary intervention (PCI) were also excluded.

The study was approved by the ethics committee of our institute as a retrospective cohort study. No extramural funding was used to support this work. The authors are solely responsible for the design and conduct of this study, all study analyses, and the drafting and editing of the manuscript.

Study design

The sCr values at hospital admission, every day during CCU stay, and at CCU discharge were retrieved from the hospital database and were available for all patients. The sCr level was measured by means of the Jaffe method. The total coefficients of variation for sCr determinations were no greater than 3%. Glomerular filtration rate (eGFR) was estimated using the abbreviated Modification of Diet in Renal Disease equation.[10] Patients were grouped according to the maximum sCr change, as compared with the admission value, observed during CCU stay. Patients with a reduction in sCr $\geq$0.3 mg/dL were included in the improving renal function (IRF) group, whereas those showing an sCr increase $\geq$0.3 mg/dL from baseline (stage 1 acute kidney injury according to the Acute Kidney Injury Network (AKIN) criteria for changes in sCr)[11] were included in the worsening renal function (WRF) group. Finally, patients not meeting these criteria were classified as the SRF group.

The primary end point of our study was in-hospital mortality: we investigated its association with baseline, daily, and peak sCr values and with sCr change patterns. *Peak sCr* was defined as the highest sCr value observed in each patient, regardless of the time of detection during CCU stay.

In all patients, baseline clinical characteristics, therapeutic strategies, and major in-hospital adverse clinical events were collected.

According to our institute's clinical protocol,[6] physiological (0.9%) saline was given intravenously at a rate of 1 mL kg^{-1} h^{-1} for 12 hours after contrast exposure in all STEMI patients undergoing primary PCI; the same hydration rate was given for 12 hours before and after contrast exposure in NSTEMI patients undergoing coronary angiography/PCI. In patients with left ventricular ejection fraction (LVEF) <40% or overt heart failure, the hydration rate was reduced to 0.5 mL kg^{-1} h^{-1}.

Statistical analysis

Data are expressed as mean ± SD or percentages. The χ^2 test or the Fisher exact test for categorical variables and the analysis of variance test for continuous variables were used to compare characteristics across groups of patients.

Receiver operating characteristic (ROC) curves were calculated, and the area under the ROC curve (AUC) with 95% CIs was used to measure the ability of baseline sCr or maximum sCr value during CCU stay to predict in-hospital mortality. The ROC curves were also used to assess whether an improvement in the ability to predict in-hospital mortality