



Discrepancies in the RIFLE classification are due to the method used to assess the level of derangement of kidney function

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Keywords:

Acute kidney injury;
Cockcroft-Gault;
Creatinine clearance;
Outcome;
RIFLE

Abstract

Purpose: We hypothesized that RIFLE based on creatinine clearance (CrCl) is superior to that based on serum creatinine (sCr) or Cockcroft-Gault (C-G) because it is an earlier marker of kidney dysfunction.

Materials and Methods: At day 3 of admission, we compared the RIFLE based on sCr, C-G, and CrCl with 28-day mortality and development of RIFLE-F during intensive care unit stay.

Results: Percentages in the RIFLE levels were similar for the 3 estimates, but the patients included in each level were different; with CrCl as the reference, κ statistic was 0.29 (95% confidence interval, 0.15–0.43) for sCr and 0.21 (0.07–0.36) for C-G. Mortality at day 28 was 19.3%, with percentages of mortality increasing with RIFLE based in CrCl but not sCr or C-G (area under the curve, 0.57 [45–72] for C-G; 0.57 [44–72] for sCr; and 0.64 [52–79] for CrCl). Logistic regression only showed an independent relationship with mortality for RIFLE measured with CrCl.

Conclusions: RIFLE classification using sCr or C-G at the third day of admission predicts outcome less accurately than with the use of CrCl. Because of the delay in the rise of sCr after a sudden glomerular filtration rate decrease, RIFLE based in CrCl may represent an advantage in terms of precocity.

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1. Introduction

Acute kidney injury (AKI) is a common complication in the intensive care unit (ICU) [1]. Recent years have witnessed an increase in our understanding of AKI, and we no longer assume that it is just one component of the multiple

organ dysfunction syndrome [2] and accept that it is associated with attributable mortality [3,4].

These findings have led to a change in AKI definition [5], with emphasis in the early detection [6] and in the stratification with the RIFLE or Acute Kidney Injury Network (AKIN) systems [7–9], based in small changes in diuresis or the glomerular filtration rate (GFR). Even though equations aimed to estimate GFR and based in serum creatinine (sCr) were initially designed to be used in patients with a steady renal function, they are now widely used in the ICU setting to evaluate renal function, and the RIFLE system contemplates the possibility of include creatinine clearance

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(CrCl) as GFR estimate, but both RIFLE and AKIN systems rest mainly in changes in sCr and therefore share the same strengths and weaknesses. The fact that sCr levels experience a delay in their rise after sudden deterioration of the GFR suggested that the cases classified by this estimate will undergo the same delay. Different results would be shown by RIFLE stratification using sCr or by CrCl [10]. We hypothesized that the use of the CrCl may represent an advantage in terms of precocity.

2. Subjects and methods

Post hoc analysis of a prospective study designed to validate CrCl measured with a 2-hour urine sample against the standard 24-hour procedure [11] in 307 adult ICU patients. Because we needed to calculate CrCl, anuric (but not oliguric) patients were excluded. The database included basal sCr (medical records or estimated with the Modification of Diet in Renal Disease [MDRD] tables), age, sex, weight, height, and diagnosis at admission. During follow-up, daily sCr, day of detection of RIFLE-F stage during ICU stay, need for renal replacement therapy, date of discharge from the ICU, and outcome were recorded [11].

From this registry, we selected those patients with known (not estimated) basal sCr at admission and with more than 3 days of ICU stay (because the 2-hour CrCl calculated between 48 and 72 hours of admission was needed for the study) and excluded those with a history of chronic renal failure (basal CrCl below 60 mL/min per 1.73 m² estimated with basal sCr and the Cockcroft-Gault [C-G] equation). The final study sample comprised 114 cases.

Basal CrCl was estimated with C-G (based on the basal sCr recorded at admission). Creatinine clearance on the third day was measured from a 2-hour urine collection and also estimated with C-G from the sCr obtained in this 2-hour period. We calculated RIFLE stage at the third day of ICU stay with these 3 approaches: RIFLE-sCr, RIFLE-CG, and RIFLE-CrCl.

Results of statistical tests are presented as the mean and 95% confidence interval (CI) for the mean or number of

cases (percentage). Variables related to time are presented as medians (interquartile range). The χ^2 test was used for univariate comparisons. Agreement was evaluated with κ statistics. Two outcomes were analyzed, mortality at 28 days after ICU admission and development of RIFLE-F during the stay, using the area under the receiver operating characteristic curves (AUC). A logistic regression analysis was performed for each 1 of the 3 calculated RIFLE used in this study, with 28-day mortality as the dependent variable. SPSS for Windows 11.0 (SPSS, Chicago, Ill) was used for calculations.

3. Results

Mean age was 53.7 (50.2-57.2) years, and 76 (66.7%) were male. Thirty (26.3%) were septic, and 24 (21.1%) were admitted after trauma, 33 (37.7%) after surgery, and 9 (7.9%) after liver transplantation. The basal sCr was 76.9 (71.6-80.4) μ mol/L, and the basal GFR was 112.2 (103.3-108.6) mL/min per 1.73 m². Median ICU stay was 6.5 days (4-14.25 days).

At the third day in ICU, 32, 43, and 44 cases of AKI were detected using RIFLE-sCr, RIFLE-CG, and RIFLE-CrCl, respectively. At this time, only 1 AKI-F was detected with RIFLE-sCr, none with RIFLE-CG, and 8 with RIFLE-CrCl (see Table 1). Eighteen patients (15.8%) reached RIFLE level F during their stay, with a median delay of 10 (7-20.75) days; 7 (38.9%) required RRT, and 12 (66.7%) died.

When comparing RIFLE-CrCl with RIFLE-sCr or RIFLE-CG, there were significant differences in these measures ($P < .05$; Table 1), and the agreement was poor: $\kappa = 0.29$ (95% CI, 0.15-0.43) for RIFLE-sCr and $\kappa = 0.21$ (0.07-0.36) for RIFLE-CG.

The ICU mortality was 20.2% (23 cases); 22 (19.3%) died during the first 28 days. We calculated a receiver operating characteristic curve for RIFLE level against development of RIFLE-F during ICU stay, and the AUC was 0.64 (95% CI, 0.48-0.76) for RIFLE-CG, 0.68 (0.53-0.80) for RIFLE-sCr, and 0.77 (0.63-0.91) for RIFLE-CrCl. For mortality, the AUC was 0.57 (95% CI, 0.45-0.72)

Table 1 Difference between RIFLE classification based on CrCl (in rows) against sCr or C-G (in lines)

		CrCl			
		None (n = 70)	R (n = 20)	I (n = 16)	F (n = 8)
sCr	None (n = 82)	61 (74.4%)	15 (18.3%)	5 (6.1%)	1 (1.2%)
	R (n = 18)	7 (38.9%)	4 (22.2%)	7 (38.9%)	0
	I (n = 9)	2 (22.2%)	1 (11.1%)	3 (33.3%)	3 (33.3%)
	F (n = 5)	0	0	1 (20.0%)	4 (80%)
C-G	None (n = 71)	52 (73.2%)	14 (19.7%)	4 (5.6%)	1 (1.4%)
	R (n = 29)	16 (55.2%)	5 (17.2%)	8 (27.6%)	0
	I (n = 11)	2 (18.2%)	1 (9.1%)	4 (36.4%)	4 (36.4%)
	F (n = 3)	0	0	0	3 (100%)

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