RIFLE criteria for acute kidney injury in the intensive care units

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Background: Acute kidney injury (AKI) is commonly occurred in intensive care unit (ICU) patients. The aim of the study was a comparison of RIFLE (Risk of renal injury/Injury to the kidney/Failure of kidney function/Loss of kidney function/End stage disease) classification with other scoring systems in the evaluation of AKI in ICUs. **Materials and Methods:** We performed a retrospective study on 409 ICU patients who were admitted during the 5 years period. **Results:** At the 1st day of admission and time of discharge, the total and non-renal Acute Physiology and Chronic Health Evaluation II and sequential organ failure assessment scores were compared to max RIFLE criteria. In this assessment, there was concordance among the results ($P < 0.05$). **Conclusion:** The RIFLE classification can be used for detection of AKI in ICU patients.

Key words: Acute kidney injury, acute physiology and chronic health evaluation II, intensive care units, outcome

INTRODUCTION

Acute kidney injury (AKI) is a common and serious complication in intensive care unit (ICU) patients that effects on mortality rate in them.[1-4] There are different methods for evaluation of these patients consists of Acute Physiology and Chronic Health Evaluation (APACHE) II and III, Sequential Organ Failure Assessment (SOFA) and Risk, Injury, Failure, Loss, and End-stage (RIFLE) classification.[5-7] The RIFLE classification is based on changes in serum creatinine or urine output from baseline condition.[7] The maximum RIFLE means the criteria evaluation based on the worst glomerular filtration rate (GFR) or the least urine output during admission.[1] In this study, we tried to characterize AKI defined by the maximum RIFLE classification and compare it with APACHE II and SOFA classification in high risk ICU patients.

MATERIALS AND METHODS

We constructed a retrospective study of all ICU patients over 5 years of period from 21 March 2003 to 21 March 2009 at Imam Reza Hospital a university affiliated hospital, in Mashhad, Iran. Patients with a history of chronic hemodialysis were excluded. In total 628 patients were included, but due to incomplete data in 219 patients they were omitted and finally 409 patients enrolled in the study. Those who readmitted to ICU that fulfilled the criteria of study every patient with the occurrence of AKI in hospital with complete data records entered as well. All patients were classified according to the maximum RIFLE class (class R, class I, or class F) that reached during their hospital stay. In addition to the RIFLE classification SOFA, APACHE II are widely used in critically ill patients.[8] SOFA scoring is based on assessment of organ failure in each of the respiratory, cardiovascular, hepatic, coagulation, renal, and neurological systems. Twelve physiological variables including the respiratory rate and oxygenation, blood pressure, body temperature, heart rate, etc., during the first 24 h after admission are used in providing of the APACHE II system.[9] The total and non-renal APACHE II and SOFA scores were calculated based on the worst variables recorded during 1st day of admission in ICU and discharge along with max RIFLE.[8,9]

Statistical analysis

Data were analyzed using the SPSS 11.5. The central tendency for continuous data is expressed as mean ± standard deviation (SD) or the median (interquartile range). We compared means using *t*-test or Mann-Whitney tests according to the parametric pre assumptions. In all comparisons $P < 0.05$ was considered significant.

RESULTS

There were 409 eligible adult admissions to study. The mean age of these patients was 41.9 years (SD), 21.8), and 50.37% were males. Primary diagnostic categories of ICU admission included intoxication 98 (24%), pulmonary disease 62 (15.2%), infection 53 (13%), cardiovascular disease 26 (6.4%), neurological disease 22 (5.4%), renal

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disease 17 (4.2%), gastrointestinal disease 13 (3.2%), others 118 (28.6%).

The mean (SE) of baseline serum creatinine was 1.2 ± 0.41 mg/dl. The mean and SE of baseline GFR was 59.96 ± 2.09. According to RIFLE classification, the AKI and non-AKI groups consisted of 181 (44.3%) and 228 (55.7%) respectively. The AKI group was also classified according to RIFLE[7] as follow: Risk (n = 40, 9.8%) injury (n = 66, 16.1%) and failure (n = 64, 15.6%) and reminders were in loss (n = 7, 1.71%) and end stage renal disease (n = 4, 0.98%). In the 1st day of admission, the total and non-renal APACHE II and SOFA scores compared with max RIFLE. The maximum RIFLE means the criteria evaluation based on the worst GFR or the least urine output during admission. The scores of patients in class F and class I were significantly higher than patients in class R and non-AKI groups in all classifications ($P < 0.05$) [Tables 1 and 2]. We found similar results in comparison total and non-renal APACHE II and SOFA with max RIFLE at the time of discharge as well ($P < 0.05$) [Tables 1 and 2]. The overall hospital mortality rate of the ICU patients was 49.70%. Although the mortality rate in patients without renal injury was 31.3% (72 in 233), in patients with renal disease mortality rate was significantly higher 67.23% (119 in 177) ($P < 0.001$).

DISCUSSION

We conducted a single-center study with 409 ICU patients to characterize AKI, defined by RIFLE classification. In this study, AKI was occurred in 44.3% in ICU patients. This result is similar to result of Park *et al.* study.[8] Although there are other reports such as study of Bellomo *et al.* that found a higher incidence of AKI in their results.[6,10] These differences may be due to the difference in type of ICU admissions (surgery, internal) and age of patients. In comparison of different methods of evaluation of ICU patients, there are significant correlation between class I and F in max RIFLE classification with total and non-renal APACHE II and SOFA scores. It means that based on RIFLE criteria, we are able to recognize patients with severe illnesses as well as APACHE II and SOFA criteria. This relation hasn't been found between classes R with other classifications. May be this result is showing stronger ability of RIFLE criteria for detection of high risk patients to APACHE II and SOFA. Not surprisingly, the occurrence of AKI was associated with higher mortality rate in our patients even in patients in class R that were only at risk for AKI [Figure 1]. In our study, the ICU mortality rate based on different classes of RIFLE criteria was similar to other reports, such as studies of Park *et al*. and Hoste *et al*. results.[1,8]

Table 1: Comparison of the assessment scores of APACHE II* with RIFLE on admission

	R class score	I class score	F class score
Total APACHE II in 1st day			
≤15	4	4	8
16-20	11	13	12
21-29	19	30	29
≥30	6	18	14
Total	40	65	63
P value	0.188	0.000	0.032
Total APACHE II at discharge			
≤11	14	14	8
12-16	6	8	4
17-26	9	7	10
≥27	9	35	41
Total	38	64	63
P value	0.254	0.000	0.000

APACHE=Acute physiology and chronic health evaluation; RIFLE=Risk, injury, failure, loss of kidney function, and end-stage kidney disease

CONCLUSION

In our ICU, the RIFLE classification can be used as non-invasive, quick, and available method to predict the outcome of patients.

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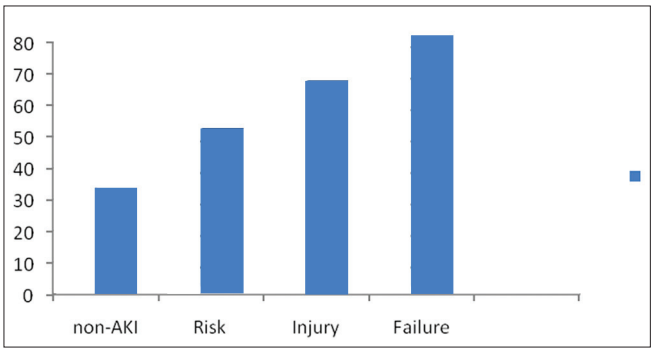

Figure 1: Hospital mortality rates for ICU patients without acute kidney injury and ICU patients with increasing risk, injury, failure

Table 2: Comparison of the assessment scores of SOFA with RIFLE

RIFLE at 1st day	Total SOFA in 1st day	Total SOFA at discharge	Non-renal SOFA at 1st day	Non-renal SOFA at discharge
R class (*n*=40)	7.88±3.12	7.4±5.67	6.58±3.31	5.98±5.2
I class (*n*=66)	8.89±3.77	9.47±5.57	7.55±3.28	7.73±5.1
F class (*n*=63)	8.43±3.75	12.7±5.65	7.11±3.38	9.95±5.05

SOFA=Sequential organ failure assessment; RIFLE=Risk, Injury, failure, Loss of kidney function, and end-stage kidney disease

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