

Letter

Renal failure in the intensive care unit: acute kidney injury compared to end-stage renal failureMarlies Ostermann¹ and René Chang², for the Riyadh ICU Program Users Group¹Guy's & St Thomas' Hospital, Departments of Critical Care and Nephrology, London SE1 9RT, UK²St George's Hospital, Department of Nephrology & Transplantation, London SW17 0QT, UKCorresponding author: Marlies Ostermann, Marlies.Ostermann@gstt.nhs.uk

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Patients with advanced acute kidney injury (AKI) and end-stage dialysis dependent renal failure (ESRF) are characterized by loss of renal function as well as significant associated co-morbidities. However, prognosis appears to differ when they are admitted to the intensive care unit (ICU). Patients with advanced AKI have a reported ICU mortality between 25% and 90%, depending on the specific patient population and the definition of AKI [1,2], whereas ICU mortality in ESRF patients has been reported to be 9% to 26% [3-5]. In contrast, Uchino and coworkers [5] found no difference in outcome between 32 ESRF patients in an ICU

and 32 diagnosis and severity score matched patients with AKI treated with renal replacement therapy (RRT).

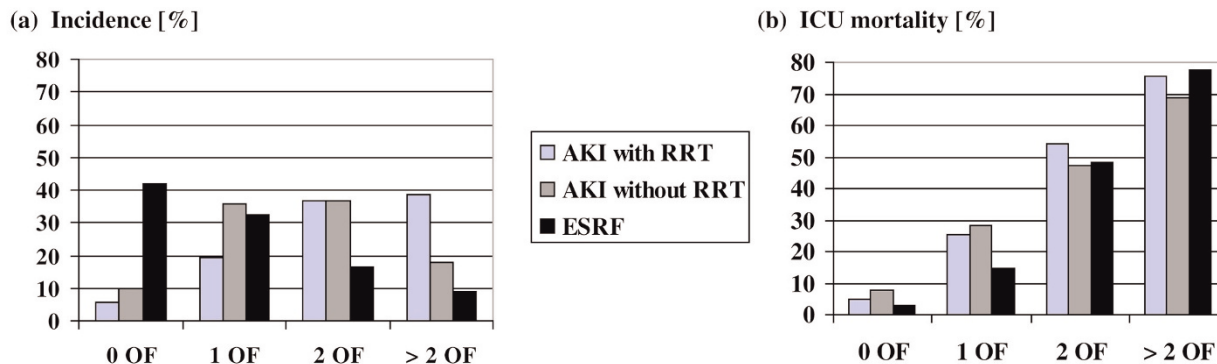
We retrospectively analyzed the Riyadh Intensive Care Program database of 41,972 adult patients admitted to ICUs in 19 hospitals in the UK and three hospitals in Germany between 1989 to 1999, and we compared ESRF patients and patients with advanced AKI (defined by serum creatinine $\geq 354 \mu\text{mol/l}$, treatment with RRT or a rise in serum creatinine by $>300\%$ from baseline). A total of 797 patients had pre-existing ESRF and 2,782 patients had advanced AKI, of

Table 1**Characteristics of patients with AKI and ESRF**

| Factor | Advanced AKI without RRT (n = 935) | AKI on RRT (n = 1,847) | ESRF (n = 797) | P (AKI on RRT versus ESRF) |
|--|------------------------------------|------------------------|-----------------|----------------------------|
| Male sex | 67.2% | 70.6% | 59.6% | 0.0002 |
| Mean age \pm SD (years) | 60.1 \pm 15.7 | 63.1 \pm 15.4 | 55.3 \pm 16.4 | 0.062 |
| SOFA score on admission to ICU (median [range]) | 7 (0 to 17) | 10 (1 to 22) | 8 (1 to 8) | 0.11 |
| Organ failure on admission to ICU ^a (n; median [range]) | 1 (0 to 4) | 2 (0 to 6) | 0 (0 to 4) | <0.0001 |
| Nonsurgical admission | 65.2% | 69% | 54.8% | <0.0001 |
| Emergency surgery | 17.1% | 13.2% | 13.9% | 0.64 |
| Maximum organ failures in ICU ^a (n; median [range]) | 1 (0 to 6) | 2 (0 to 6) | 0 (0 to 5) | <0.0001 |
| Mechanical ventilation | 78% | 91.3% | 60.9% | <0.0001 |
| Haemoglobin ≤ 9 g/dl on admission to ICU | 20.6% | 26.9% | 42.7% | <0.0001 |
| Cardiac surgery | 10.2% | 12.8% | 11.4% | 0.935 |
| ICU mortality | 40.6% | 54.1% | 20.8% | <0.0001 |
| Hospital mortality | 50.5% | 61.6% | 34.5% | <0.0001 |
| Length of stay in ICU (days; median [range]) | 7 (1 to 270) | 10 (1 to 219) | 2 (1 to 64) | <0.0001 |

^aExcluding renal failure. AKI, acute kidney injury; ESRF, end-stage renal failure; ICU, intensive care unit; OR = odds ratio; RRT, renal replacement therapy; SD, standard deviation; SOFA, Sequential Organ Failure Assessment.

Figure 1



Associated maximum organ failure and impact on outcome. Shown are (a) incidence (%) and (b) ICU mortality (%). AKI, acute kidney injury; ESRF, end-stage renal failure; ICU, intensive care unit; OF, maximum associated organ failure during stay in ICU (excluding renal failure); RRT, renal replacement therapy.

whom 66.4% were treated with RRT. ESRF patients had a significantly lower ICU and hospital mortality and shorter stay in ICU compared with patients with advanced AKI (Table 1). In both groups the ICU mortality rate rose with increasing number of associated failed organ systems (Figure 1). However, patients with AKI had significantly more associated organ failures during their stay in the ICU; 75.4% of patients with AKI on RRT and 54.5% of patients with advanced AKI not on RRT had two or more other failed organ systems, in contrast to only 25.6% of ESRF patients. In addition, significantly more patients with AKI on RRT needed mechanical ventilation compared with ESRF patients (91.3% versus 60.9%, $P < 0.0001$).

In a multivariate analysis, mechanical ventilation (odds ratio (OR) = 3.3), maximum number of failed organs (OR = 2.93) and nonsurgical admission (OR = 2.1) were the strongest independent risk factors for ICU mortality, followed by emergency surgery (OR = 1.75), pre-existing chronic disease (OR = 1.2), SOFA score on admission to ICU (OR = 1.05) and age (OR = 1.03).

Our study confirms that patients with ESRF admitted to ICU had a significantly better prognosis than did ICU patients with advanced AKI. The main reasons were due to differences in co-morbid risk factors, in particular need for mechanical ventilation and associated organ failure while in the ICU.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Mr R Chang is in charge of the Riyadh Intensive Care Program database. Both authors extracted the data from the database and performed the analyses. Dr Ostermann wrote the draft and Mr Chang provided critiques. Both authors approved the final manuscript.

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References

1. Mehta RL, Pascual MT, Soroko S, Savage BR, Himmelfarb J, Ikizler A, Paganini EP, Chertow GM, for the Program of Improve Care in Acute Renal Disease: **Spectrum of acute renal failure in the intensive care unit: the PICARD experience.** *Kidney Int* 2004, **66**:1613-1621.
2. Uchino S, Kellum JA, Bellomo R, Doig GS, Morimatsu H, Morgera S, Schetz M, Tan I, Bouman C, Macedo E, Gibney N, Tolwani A, Ronco C, for the Beginning and Ending Supportive Therapy for the Kidney (BEST Kidney) Investigators: **Acute renal failure in critically ill patients: a multinational, multicenter study.** *JAMA* 2005, **294**:813-818.
3. Hutchison CA, Crowe AV, Stevens PE, Harrison DA, Lipkin GW: **Case mix, outcome and activity for patients admitted to intensive care units requiring chronic renal dialysis: a secondary analysis of the ICNARC Case Mix Programme Database.** *Crit Care* 2007, **11**:R50.
4. Dara SI, Afessa B, Bajwa AA, Albright RC: **Outcome of patients with end-stage renal disease admitted to the intensive care unit.** *Mayo Clin Proc* 2004, **79**:1385-1390.
5. Uchino S, Morimatsu H, Bellomo R, Silvester W, Cole L: **End-stage renal failure patients requiring renal replacement therapy in the intensive care unit: incidence, clinical features, and outcome.** *Blood Purif* 2003, **21**:170-175.