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Phosphate is a Novel Biomarker of Disease Severity and Predicts Adverse Outcomes in AKI Patients Undergoing Continuous Renal Replacement Therapy

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Objectives : Hyperphosphatemia is associated with mortality in patients with chronic kidney disease. It is also common in critically ill patients with acute kidney injury (AKI). However, clinical implication of hyperphosphatemia is unknown in these patients.

Methods : We conducted an observational study in 1144 patients with AKI who underwent continuous renal replacement therapy (CRRT) between January 2009 and September 2016. Phosphate levels were measured before (0h) and 24 h after the initiation of CRRT. We assessed disease severity by various clinical parameters such as APACHE II score, SOFA score, mean arterial pressure (MAP), and urine output (UO).

Results : The mean age was 63.2 years and 705 (61.6%) were males. Phosphate at 0h positively correlated with APACHE II score ($P < 0.001$) and SOFA score ($P < 0.001$) and inversely with MAP ($P = 0.02$) and UO ($P = 0.01$). In a fully adjusted linear regression analysis for age, gender, Charlson comorbidity index, MAP, and eGFR, higher 0h phosphate level was significantly associated with high APACHE II score ($\beta = 0.05$, $P < 0.001$) and SOFA score ($\beta = 0.04$, $P = 0.04$), suggesting that phosphate represents disease severity. A multivariable Cox model also showed that hyperphosphatemia was significantly associated with an increased 28-day (HR, 95% CI 1.07-1.52, $P = 0.01$) and 90-day (HR, 95% CI 1.05-1.46, $P = 0.01$) mortality. Furthermore, patients with an increase in phosphate level during 24 h were at higher risk of death than those with stable or decreased phosphate levels. Finally, C-statistics significantly increased when phosphate was added to a model that included age, sex, CCI, BMI, eGFR, MAP, hemoglobin, serum albumin, CRP, and APACHE II score.

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Conclusions : This study shows that phosphate is a novel biomarker that can reflect disease severity and predicts mortality in critically ill patients undergoing CRRT.

Keywords : Acute kidney injury, Continuous renal replacement therapy, hyperphosphatemia