Editorial

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Assessment of body fluid in critically ill patients with acute kidney injury requiring continuous renal replacement therapy

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Previous studies have presented prognostic factors for patients with acute kidney injury (AKI) who require continuous renal replacement therapy (CRRT), including elderly age, systemic inflammation, oliguria, fluid imbalance, comorbidities, and need for mechanical ventilation [1–4]. Nevertheless, prognostic factors that accurately predict outcomes have not been determined. Among the prognostic factors under consideration, there is growing interest in the clinical role of negative or positive fluid balance associated with fluid resuscitation [5]. Most importantly, an ideal method of body fluid assessment should be an easy, objective, and reproducible evaluation, and a treatment plan based on the results should confirm whether it affects the outcomes of the patient.

The pathogenesis of AKI in critical illness is multi-factorial and complex. Therefore, therapeutic interventions for patients with AKI remain heterogeneous. In particular, it can be said that it is representative issues to determine an appropriate fluid administration dose and fluid removal amount, and the timing of renal replacement therapy.

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Fluid overload is strongly associated with adverse clinical outcomes and may contribute to development and persistence of AKI in critically ill patients [5]. Assessment of volume status in patients with AKI requiring renal replacement therapy is important not only for maintaining hemodynamic stability, but also for improving the outcomes of AKI. However, the traditional methods for detecting degree and severity of fluid imbalance have several limitations. Furthermore, there is no clinical gold standard that can be used as a guide for fluid administration to prevent fluid overload in patients with AKI.

Many studies have consistently highlighted the clinical significance of fluid overload in critically ill patients. Jhee et al [6] also showed a relationship between fluid overload and mortality in elderly patients with AKI requiring CRRT. Their multicenter prospective cohort study clearly showed that critically ill patients with positive fluid balance for 72 hours prior to CRRT initiation were associated with higher mortality compared to those without. However, despite such clear results, attention should be paid to important issues in their research.

First, as the researchers noted, it is important to define fluid overload using a decisive rather than arbitrary method. Various methods such as clinical examination, serial weights, cumulative fluid balance (CFB), chest X-ray, lung ultrasound, echocardiography, and bioimpedance analysis can be used to evaluate volume status, but they all have limitations. Therefore, because there is no rapid, objective, non-invasive, and relatively affordable method to quantitatively assess volume status, it is difficult to set a treatment policy for critically ill patients with AKI requiring CRRT. Unlike the study by Jhee et al [6], some have defined the criteria for fluid overload as a

greater than 10% increase in body weight relative to baseline [7,8]. Furthermore, the relationship between fluid overload based on this criterion and clinical outcome has been well elucidated.

Second, the efforts to avoid positive fluid balance in initial treatment of critically ill patients as proposed by Jhee et al [6] may conflict with current intensive care strategies. Since early goal-directed therapy for patients who present to the emergency department with severe sepsis, septic shock, or sepsis syndrome was proposed by Rivers et al [9], clinical therapeutic strategies based on early fluid resuscitation to restore or maintain intravascular volume have been useful [10]. The recently updated version of the Surviving Sepsis Campaign proposes a rapid infusion of crystalloid solution at a minimum dose of 30 mL/kg in the initial critical phase [11]. Although this therapeutic strategy has been recommended mainly in cases of hypotension or lactic acidosis, early fluid resuscitation is currently performed for most critically ill patients.

Third, given that not all patients underwent standardized early fluid resuscitation from treatment initiation, setting the reference point for fluid overload using cumulative fluid data assessed at 72 hours before CRRT initiation is limited, even though the aforementioned CFB is widely accepted as a method to document fluid balance. We cannot rule out the possibility that positive fluid balance might have been the result of early fluid resuscitation due to hemodynamic instability of the critically ill patients in the study. In addition, even though propensity score matching and adjustment for confounding factors were performed, it is unclear whether hemodynamic stability was properly controlled between the two groups because the authors did not provide data on use of inotropic agents or vasoactive agents. Therefore, the association between fluid overload and mortality may largely be secondary.

Fourth, an additional measurement method for determining the appropriate amount of fluid should have been used. This was mentioned as one of the limitations of the study. The definition of CFB is the sum of each day's fluid balance over a period of time. Therefore, it cannot be assumed that a positive fluid balance is accompanied by fluid overload. Furthermore, CFB is often inaccurate, and insensible fluid losses are not reflected. Bioimpedance analysis may be a good replacement, even though it has not been verified in critically ill patients with AKI [12].

In conclusion, the study by Jhee et al [6] is valuable because it supports the existing research that fluid overload is related to poor clinical outcomes in critically ill patients. Preventing fluid overload should accompany accurate assessment of individual volume status. Future studies should provide more scientific and accurate analysis methods, allowing innovation in evaluation of volume status in critically ill patients with AKI.

Conflicts of interest

All authors have no conflicts of interest to declare.

Authors' contributions

Jae Seok Kim provided intellectual content of critical importance to the work. Byoung-Geun Han participated in the conception and wrote the manuscript. All authors read and approved the final manuscript.

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