KSN 2017 Abstract

KSN-17-O050

Excessive fluid balance increases mortality risk in patients undergoing extracorporeal membrane oxygenation treatment

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Objectives : Extracorporeal membrane oxygenation (ECMO) is an extracorporeal technique providing cardiorespiratory support in patients with circulatory or pulmonary failure. Frequently, large volumes of fluid resuscitation are needed to ensure sufficient preload in patients initiating ECMO. However, excessive over-hydration has been found to increase mortality in patients receiving ECMO. Therefore, in order to investigate the sufficient amount of fluid therapy for these patients, the association between cumulative fluid balance (CFB) and outcome was evaluated in patients undergoing ECMO.

Methods : Patients who underwent ECMO in Seoul National University Hospital or Yonsei University Severance Hospital between 2005 and 2016 were recruited. Cumulative fluid balance was calculated as the total fluid input minus total fluid output within the first 72 hours of ECMO initiation. Primary endpoint was mortality within 30 days after ECMO initiation.

Results : A total of 723 patients were enrolled. The mean age was 57.2 years and 66.9 % were male. The most common cause of ECMO was cardiovascular disease (42.2%) and veno-arterial ECMO was applied for 70% of patients. AKI was accompanied in 59.9% and continuous renal replacement therapy (CRRT) was applied in 366 (50.6%) patients. The median CFB of the patients was 57.4 (19.5-145.3) mL/kg. When the patients were divided into quartiles according to CFB, AKI occurred more frequently in highest CFB group ($P < 0.001$). The 30 day mortality rates after ECMO initiation were higher in the groups with higher CFB than those with lower CFB ($P < 0.001$). Multivariable analysis using Cox proportional hazard models revealed that, the risk of 30 day mortality

significantly increased in patient groups with CFB values higher than 57.4 mL/kg compared to patients with patients with lower CFB ($P < 0.001$). This increased risk remained significant even after adjustment were made for propensity score ($P < 0.001$). Cubic spline model showed that mortality risk did not increase in patients with mild CFB increase. However, a significant increase in mortality risk was found in patients with CFB higher than 82.3 mL/kg.

Conclusions : Mortality risk increased in patients undergoing ECMO with excessive CFB. Adequate fluid resuscitation would be important in improving outcome in these patients.

Keywords : Extracorporeal membrane oxygenation, acute kidney injury, fluid balance, continuous renal replacement therapy