Urine osmolality predicts worsening renal function and poor prognosis in acute decompensated heart failure


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Background/Purpose: Worsening renal function (WRF) can sometimes occur in the patients with acute decompensated heart failure (ADHF) and increase the risk of morbidity and mortality. In a previous study, it was reported that fractional excretion of sodium (FENa) reflects net sodium reabsorption from nephron segments and predicts WRF during treating ADHF (2). On the other hand, recently the new drugs which approach urine concentration mechanism and affect urine osmolality (U-OSM), such as tolvaptan and sodium-glucose cotransporter-2 inhibitor, have begun to be widely used as treatment of heart failure. Thus, we focused on U-OSM, which reflects not only sodium handling but also water excretion controlled by the collecting duct, and evaluated the association between WRF and U-OSM. Moreover, previous studies have demonstrated that FENa, fractional excretion of urea nitrogen and transtubular potassium concentration gradient are markers for long-term prognosis in patients with ADHF (3–5). Therefore, we also studied whether U-OSM can predict prognosis in ADHF.

Methods: A total of 157 patients admitted to our hospital because of a primary diagnosis of ADHF from February 2020 through July 2021 were retrospectively reviewed. U-OSM in the spot urinary samples were examined within 72 hours after admission. U-OSM was calculated based on the following validated formula (6): U-OSM = 1.07 × (2 × [urine sodium (mEq/L)] + [urine urea nitrogen (mg/dL)]/2.8 + [urine creatinine (mg/dl)] × 2/3) + 16.2. The primary outcome was the occurrence of WRF during hospitalization. WRF was defined as increased serum creatinine ≥0.3 mg/dL from baseline (7). The secondary outcome was the occurrence of ADHF readmission and all-cause death within 180 days after discharge.

Results: Primary Outcome. WRF developed in 46% of all patients. In the patients that developed WRF during hospitalization, U-OSM was significantly lower than in the patients without WRF (366±106 mOsm/L versus 430±128 mOsm/L; P<0.001). Receiver operating characteristic curve analysis revealed the optimal cutoff values of U-OSM was 403 mOsm/L (AUC 0.64; 95% CI: 0.56–0.72; P<0.001) to predict the WRF (Figure 1). On multivariable logistic regression analysis, U-OSM (OR, 1.99, 95% CI: 1.27–3.12; P=0.003) and serum creatinine (OR, 1.00, 95% CI: 0.99–1.00; P=0.009) were independent predictors of WRF.

Secondary Outcome. There were 34 patients (22%) readmitted and 9 patients (6%) died within 180 days after discharge. ROC curve analysis revealed the optimal cutoff values of U-OSM as 349 mOsm/L (C-statistic 0.74; 95% CI: 0.65–0.83; P<0.001) to predict ADHF readmission and all-cause death within 180 days (Figure 2A). On Kaplan-Meier analysis, the secondary outcome was significantly higher in patients with U-OSM≥349 mOsm/L (u-OSM≥349, 57%; U-OSM<349, 43%; HR, 0.99; 95% CI: 0.99–1.00, P<0.001) (Figure 2B).

Conclusion: U-OSM on admission may be a predictor of WRF and a prognostic marker in ADHF patients.