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Differential Role of Fluid Overload versus Arterial Stiffness on the Development of High Blood Pressure in Patients at Risk of Cardiovascular Disease

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Objectives : Among many factors affecting blood pressure, it is uncertain whether fluid overload itself increases blood pressure. Patients with chronic kidney disease (CKD) are susceptible to fluid overload, which is presumed to affect blood pressure. However, studies that examined the association between fluid status and blood pressure are lacking. In this study, we aimed to clarify differential factors that determine blood pressure in patients with CKD and non-CKD and also explore the relative contribution of fluid overload to blood pressure in these patients.

Methods : The Cardiovascular and Metabolic Disease Etiology Research Center-High Risk (CMERC-HI, NCT02003781) is a prospective observational cohort study in patients at high risk of cardiovascular disease. Between November 2013 and November 2016 a total of 1531 patients were included. Blood pressure and arterial stiffness were measured by ambulatory blood pressure monitoring and brachial artery pulse wave velocity (baPWV), respectively. Volume status were assessed by bioelectrical impedance analysis and presented as extracellular water/total body water (ECW/TBW). Estimated glomerular filtration rate (eGFR) was determined by CKD-EPI equation and CKD was defined as an eGFR of < 60 mL/min per 1.73 m² but not dialysis.

Results : The mean age was 60.4 ± 11.2 years, 843 (55.1%) were men, and the mean eGFR 72.4 ± 28.9 mL/min per 1.73 m². 464 (30.0%) patients were classified as CKD. In CKD patients, multiple linear regression analysis after adjustment of confounders showed that both baPWV and ECW/TBW significantly associated with systolic blood pressure (SBP). The area under the

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receiver operating characteristic curve (ROC) for predicting SBP > 140 mmHg significantly increased after each of baPWV and ECW/TBW was added to a conventional model. This association was further confirmed by the net reclassification and integrated discriminant improvements (NRI/IRI). The predictability for high blood pressure did not differ between baPWV and ECW/TBW in these patients. In contrast, in non-CKD patients, only baPWV significantly associated with an increased blood pressure and increased the area under the ROC curve and the NRI/IRI, whereas ECW/TBW did not.

Conclusions : We demonstrated that fluid overload come into play in the development of high blood pressure as kidney function declines. Arterial stiffness is more important in determining blood pressure in non-CKD patients. Our findings suggest that a stepwise approach is required in the management of hypertension depending on CKD stages.

Keywords : fluid overload, blood pressure, chronic kidney disease