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Association between OH/ECW and echocardiographic parameters of CKD patients not undergoing dialysis

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Objectives : Assessment of structural and functional abnormalities of the heart with echocardiography is recommended in dialysis patients in order to prevent adverse events such as sudden cardiac death; however, it has its limitations (high cost of equipment, specialized personnel, etc). Contrary to patients receiving hemodialysis, whose hemodynamic status fluctuates relatively widely, early detection of cardiac abnormalities in patient with CKD is extremely important. Volume overload is a known predictor of poor clinical prognosis, elevating the risk of cardiovascular diseases and increasing the mortality rate. Volume overload induces vascular remodeling, hypertension, left ventricular hypertrophy, heart failure, and vascular events, such as strokes and myocardial infarction.
Therefore, a detection of volume overload prior to its clinical manifestation as edema is imperative, and a more specified, focused therapeutic approach beyond a simple theory of “poor renal function, greater risk of cardiac disease” is necessary.

Methods : We performed echocardiography and bioimpedance spectroscopy (BIS) on stage 5 CKD patients and examined the clinical significance of overhydration (OH/ECW). Furthermore, the association between echocardiographic data and clinical values such as NT-proBNP and OH/ECW was examined. All measurements were performed prior to dialysis.

Results : Among 94 patients who were finally enrolled, 55 were male and 39 were female and 2 patients whose LV ejection fraction (LVEF) was less than 45% were included. The mean age of patients was 59.86±11.04 (range: 31-79) years. 58 patients (61.7%) were diagnosed with diabetes. The mean eGFR of all patients as calculated by CKD-EPI equation was 5.87 ± 2.68 ml/min per 1.73 m2. OH/ECW, which suggests relative fluid overload, was positively associated with TR jet, LA dimension, LAVI, and E/e´ ratio. NT-proBNP were significantly associated with all echocardiographic parameters. Patients were subgrouped according to OH/ECW value: less than 15% (48 patients) and greater than or equal to 15% (46 patients, 48.9%). TR jet, LA dimension, LAVI, and E/e´ ratio were significantly different between the two groups, but LVEDD, LVEDV, LVMI,

LVFS, and LVEF were not. Multivariate logistic regression analysis showed E/e´ ratio, logarithmic value of NT-proBNP, protein, albumin, and TIBC were still significantly associated with OH/ECW after adjustment. Elevated E/e´ ratio and logarithmic value of NT-proBNP was associated with 1.17-fold and 2.65-fold increase in chance of OH/ECW being greater than 15%, while elevated protein, albumin, and TIBC was associated with decreased chance of OH/ECW greater than 15% by the factor of 0.28, 0.12, and 0.98, respectively.

Conclusions : Since OH/ECW measured by BIS is associated with echocardiographic parameters associated with diastolic dysfunction, preliminary screening with laboratory findings, including serum albumin and protein, in conjunction with OH/ECW and NT-proBNP may overcome the shortcomings of echocardiography. Volume is a modifiable risk factor, and biomarkers that detect volume overload at early phase and allow timely intervention are necessary. BIS, which can be measured as outpatient-basis, is a cost-effective, risk-free, reproducible diagnostic tool that can meet the aforementioned needs.

Keywords : CKD, Echocardiography, Impedance, Volume