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Muscle mass measured by multi-frequency bioimpedance and intradialytic hypotension among hemodialysis patients

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Objectives : Assessment of volume status is very important for dialysis patients. With the introduction of bio-impedance devices, more relevant and reproducible assessment have become possible. Aberrant volume status might derive intradialytic hypotension or pulmonary edema, both of which are associated with myocardial ischemia leading to significant morbidity and mortality. A few studies have tried to implement bio-impedance measurement to clinical practice, however, it still need more data to find optimal bio-impedance indices to predict clinical outcomes regarding volume status.

Methods : Multi-center prospective observational study have been performed. Prevalent hemodialysis patients were enrolled in three dialysis units. Clinical indices including modified Charlson score, Tilburg frailty indicator, patient generated subjective global assessment (PG-SGA) were collected prospectively at the baseline enrollment point. Bio-impedance assessment were performed at baseline, at 3 months, and at 6 months. Other than routine monthly examination, physical assessment of volume status (at baseline), arthropometry examination (at baseline), NT-proBNP (at baseline), cardiac indices by chest PA (at baseline, 3 months, 6 months) were checked. Intradialytic hypotension, cardiovascular events, pulmonary edema were reviewed at the end of study periods.

Results : Total 150 patients were enrolled. Mean age was 58.5 ± 14.1 years old. Female were 75 (50%). Dialysis vintages were 5.5 ± 4.5 years old. Diabetic nephropathy (42%) were most common cause of end stage renal disease (ESRD). Modified Charlson comorbidity score, Tilburg frailty score, and PG-SGA were 3.9 ± 1.8, 3.3 ± 2.3, and 3.2 ± 4.2, respectively. Body mass index was 22.6 ± 3.3 kg/m2. Hemoglobin, albumin and NT-proBNP were 10.4 ± 0.9 g/dL, 4.0 ± 0.5 g/dL, and 10099.7 ± 10192.4 (pg/mL), respectively. Among bioimpedance measures, ECW/TBW, phase angle, and skeletal muscle index were 0.395 ± 0.015, 4.913 ± 1.223°, and 8.667 ± 1.181 kg/m2, respectively. ECW/TBW was significantly correlated with cardiac index in positive direction. (spearman's rho 0.351, $p < 0.001$) ECW/TBW also showed significant

correlation with NT-proBNP. (spearman's rho 0.384, $p < 0.001$). However, higher ECW/TBW was reported to be associated with intradialytic hypotension in the multivariable logistic regression models. (Odds ratio (OR) 1.627, 95% confidence interval (C.I.) 0.985 – 2.687, $p = 0.058$) (Figure 1). To understand the opposite impact of ECW/TBW to the intradialytic hypotension, we checked the relationship of ECW/TBW to muscle mass. Skeletal muscle index was negatively associated with ECW/TBW. (spearman's rho −0.416, $p < 0.001$) Skeletal muscle index was better predictor for intradialytic hypotension than NT-proBNP (AUC comparison of NT-proBNP vs. skeletal muscle index; 0.721 vs. 0.506, $p = 0.003$).

Conclusions : To the best of our knowledge, this study is the first to show the association of skeletal muscle mass with intradialytic hypotension. Optimal values of ECW/TBW, as other than index as inversed reflection of muscle mass, still need to be validated with clinical outcomes.

Keywords : Dry weight, Bio-impedance, Hemodialysis, NT-proBNP, Intradialytic hypotension