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P351 -Extracellular electrical resistance is inversely associated with tissue ionic sodium status and serum osmolality – implications for bioimpedance-derived hydration status in chronic kidney disease

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Background: Multi-frequency bioimpedance spectroscopy (BIS) is an established method for assessing hydration status in chronic kidney disease (CKD). However, the technique is lacking in predictive value and accuracy. BIS algorithms assume constant tissue resistivity, which may vary with changing tissue ionic sodium concentration (Na). This may introduce significant inaccuracies to BIS outputs.
Methods: To investigate the effects of tissue ionic Na on BIS measurements we used ^{23}Na magnetic resonance imaging (MRI) to measure it concentration in the muscle and subcutaneous tissues of 10 healthy controls (HC) and 20 patients with CKD 5 (not on dialysis). The extracellular (Re) and intracellular (Ri) resistance, tissue capacitance, extracellular (ECW) and total body water (TBW) were measured using BIS. Tissue water content was also assessed using proton density-weighted MRI with fat suppression.
Results: The 2 group of participants were of similar age (HC: 51.6±13.4 yrs, CKD: 53.0±9.3 yrs; p= 0.749). The CKD group had higher comorbidity, prevalence of hypertension, pill burden and deranged biochemistry in keeping with advanced CKD (eGFR 11±2.7 ml/min/1.73 m^2) when compared to HC (86.5±7.4 ml/min/1.73m^2). BIS-derived hydration indices were comparable in the two groups (ECW/TBW: HC 0.45±0.03, CKD 0.47±0.04; p= 0.13). However, CKD patients had higher Na (HC 21.2±3.0, CKD 25.3±7.4 mmol/L; p=0.04) and significantly lower Re (HC 693±93.6, CKD 609±74.3Ohms; p=0.01) but Ri and capacitance did not vary. Both Na (ρ= -0.598, p<0.01) and serum osmolality (sOsm) (r= -0.463, p<0.01) have a significant inverse linear relationship to Re (y) but not Ri (y= -7.39x+814 for Na). Each 20% increase in tissue ionic Na (x) or sOsm is estimated to overestimate ECW between 1.2-2.4 L.
Conclusion: Tissue ionic Na concentration and sOsm have a significant inverse linear relationship to Re. BIS algorithms accounting for this effect could improve prediction accuracy of bioimpedance derived hydration status in CKD.