Comment on “Higher Serum Creatinine Concentrations in Black Patients with Chronic Kidney Disease: Beyond Nutritional Status and Body Composition”

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The accuracy of a BIA method for muscle mass estimation should be evaluated against an accepted reference method (with magnetic resonance imaging [MRI] and computed tomography being the best currently available methods for in vivo estimation of skeletal muscle volume) (4,5). We have determined whole-body muscle volumes in 27 adult maintenance hemodialysis patients by means of whole-body MRI and compared these, in the same patients, with whole-body resistance and reactance measured at 50 kHz, the technique used by Hsu et al. The bioimpedance measurements were performed on the same day as the MRI scans, and both were performed on a regularly scheduled hemodialysis day before initiation of the dialysis procedure. MRI acquisition was done using a 1.5 Tesla scanner (6X Horizon; General Electric, Milwaukee, WI) and typically involved approximately 40 axial images of 10 mm thickness at 40-mm intervals across the whole body. BIA was performed on the non–vascular access side of the body using a Xitron 4200 device (Xitron Technologies, San Diego, CA). This is a multifrequency (i.e., spectroscopy) device, and the 50-kHz single-frequency readings discussed here were extracted from the raw data files. A detailed presentation of all methods mentioned here can be found in the study by Zhu et al. (6). Figure 1 shows the correlation between muscle volume determined by MRI and resistance at 50 kHz ($R^2 = 0.51$). This degree of correlation would not be expected to eliminate muscle-related differences in serum creatinine with adjustment for resistance. Reactance at 50 kHz (Figure 2) practically does not correlate at all with muscle volume measured by MRI ($R^2 = 0.004$). Although this lack of bivariate correlation does not necessarily mean that reactance measured at 50 kHz does not add to the prediction quality of a multiple regression model for estimation of muscle volume, one major flaw remains: Such a model based on single-frequency resistance and reactance still cannot accurately delineate intracellular from extracellular fluid volume. The more uniform the population in terms of hydration status and the more the tested cohort resembles the original individuals with whom the model was developed, the less of a problem this may be, but in individuals with highly varying degrees of fluid status disturbances (e.g., the hemodialysis population), this leads to marked inaccuracies. It is with the use of the $0/\approx$-kHz parallel Cole-Cole model that the most accurate delineation between intra- and extracellular fluid compartments is accomplished.

That aside, even with a precise adjustment for muscle mass, the study design used by Hsu et al. would still have precluded...
the implication that muscle mass does not explain higher serum creatinine levels in black individuals: Predialysis laboratory values, including serum creatinine, were averaged during a period of 3 consecutive months before the BIA. One quarter of 1 yr is enough time for body composition to change significantly. He et al. (7) demonstrated that total body potassium, which has been used as an index of muscle mass in several studies (8–12), declines over time and that it does so more rapidly in black than in white individuals. It is conceivable that such different kinetics in body cell loss could lead to a bias toward higher serum creatinine levels in black individuals despite accurate adjustment for muscle mass (Figure 3). When serum creatinine is being related to muscle mass, both parameters, therefore, should be determined at the same time (or at least, if multiple serum creatinine values per individual are averaged, the time period from which these laboratory values stem should be centered around the time of BIA measurement).

Another question that necessarily arises is how well predialysis serum creatinine levels represent muscle mass. On the basis of current understanding of creatinine metabolism, serum creatinine would certainly be expected to correlate with muscle mass, but it is not the only determining factor. Creatinine distribution volume will directly affect predialysis serum creatinine concentration in hemodialysis patients. This is a point that Hsu et al. did not address in their discussion. For example, in two anuric hemodialysis patients with identical muscle masses (and, hence, identical creatinine generation rates) and identical creatinine elimination rates but different sizes of creatinine distribution volume, interdialytic rise in serum creatinine will be steeper and reach a higher predialysis concentration in the person with the smaller distribution volume when both receive the same Kt/V urea (Figure 4); therefore, higher predialysis serum creatinine levels are not necessarily a reflection of greater muscle mass in hemodialysis patients.

Figure 1. Whole-body resistance measured at 50 kHz with bioelectrical impedance analysis (BIA) in 27 maintenance hemodialysis patients, plotted against whole-body skeletal muscle volume determined by magnetic resonance imaging (MRI). In each individual, BIA and MRI were performed on the same day.

Figure 2. Whole-body reactance measured at 50 kHz with BIA in 27 maintenance hemodialysis patients, plotted against whole-body skeletal muscle volume determined by MRI. In each individual, BIA and MRI were performed on the same day.
The authors’ statement that differences in body composition do not explain racial differences in serum creatinine levels is not supported by the evidence provided.

Disclosures
None.

References