Phase Angle: A New Predictor of Mortality in Critically Ill Patients Measured by Noninvasive Tool, Bioimpedance Vector Analysis (BIVA) (Preliminary Results)

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Background: Bioimpedance vector analysis (BIVA) is a noninvasive and rapid screening tool for estimation of fluid status in different populations. There are scant data in critically ill patients.

Objective: The present study aimed to evaluate the association between clinical outcome and hydration status assessed by BIVA-derived variables, compared to percentage of fluid cumulation (FA), a conventional fluid assessment tool.

Methods: We conducted a prospective observational study in patients admitted to medical ICUs with an expected length of ICU stay of at least 72 hours. We performed BIVA measurements and cumulative fluid balance calculation and recorded physiological variables on day 0, 3, and 7 after ICU admission. BIVA results included percentage of fat free mass hydration (FFMH), and phase angle (PhA). Treating clinicians were blinded to BIVA results. The correlation between BIVA-derived values, FA, and 28-day mortality were analyzed.

Results: Sixty-nine patients were enrolled, with a mean age of 61 ± 21 years, and a mean Acute Physiology and Chronic Health Evaluation II (APACHE II) score of 23 ± 8. The median FA was 7.04%, 9.9%, and 11.48% on day 0, 3, and 7 after ICU admission. Based on BIVA-derived values, the median FFMH was 79.8%, 79.6%, and 79.2%. Median TBW was 66.1%, 65.3%, and 63.0%. Median phase angle was 4.9, 4.9, and 5.1 on the first, day 0, 3, and 7 after ICU admission, respectively. According to 28-d mortality, there were no differences of FA and BIVA-derived, which were measured on day 0 and day 3 after admission, between non-survivors and survivors. The median FA on day 7 was higher in the non-survivors than the survivors. The median PhA on day 7 of the non-survivors was 3.6 (3.2, 4.1), while that of the survivors was 5.5 (4.6, 6.4) (p < 0.001). Whereas, the median FFMH on day 7 of the non-survivors was not statistically different with that of the survivors. Phase angle of < 4.5 on the 7th day after admission could predict 28-d mortality with the OR of 2.1, (95% CI 1.2–3.4, P < 0.001).

Conclusion: A BIVA-derived variable, PhA on the seventh day after admission is associated with 28-d mortality. PhA of less than 4.5 might be used as the cut-off values for guidance of fluid management in critically ill patients.

Keywords: Phase angle, Bioimpedance vector analysis, BIVA, Fluid cumulation, Critically ill, ICU, Mortality