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Use of Different Approaches of Acid-Base Derangement to Predict Mortality in Critically Ill Patients

Ranitha Ratanarat, Chaianan Sodapak, Aekarin Poompichet, Pathiphan Toomthong

Abstract

Background: There have been controversial data regarding the application of acid-base analysis based on Stewart methodology to predict clinical outcome in different populations.

Objective: To compare predictive ability of the physicochemical approach and the traditional bicarbonate approach of acidbase analysis in critically ill patients in relation to 28-days mortality and to evaluate the use of the physico chemical approach determined by the strong ion gap (SIG) in 1) medical compared to surgical critically ill patients; and 2) sepsis compared to non-sepsis patients.

Material and Method: This retrospective cohort study included 410 critically ill patients in the adult medical and surgical intensive care units (ICU) at a tertiary care hospital over a 2-year period. For each patient, values derived from the bicarbonate approaches including anion gap (AG), corrected anion gap (cAG) and lactate and those obtained from the physicochemical approach like SIG were simultaneously computed at ICU admission. The comparison of predictive ability between different approaches was assessed by forward stepwise logistic regression and the area under the receiver operating characteristic (aROC) curves.

Results: Of the 410 patents enrolled, 205 (50%) were admitted in the medical ICU and 226 patients (55%) were male. Overall 28-day mortality was 44.6% (183/410). The comparison between medical and surgical patients showed no difference in age (59 vs. 64 yr), APACHE II score (21 vs. 20), presence of sepsis (71% vs. 70%) and 28-day mortality (45% vs. 44%). Acidbase disturbance in non-survivors (n = 183) and survivors (n = 227) determined by pH (7.39 + 0.04 vs. 7.41 + 0.01), serum bicarbonate (16.0 + 6.1 vs. 17.9 + 7.4) and PaCO₂ (32.4 + 13.4 vs. 29.4 + 8.2) were comparable. However, non-survivors had higher levels of SIG (9.7 + 6.2 vs. 6.4 + 5.2) and cAG (27.5 + 8.8 vs. 20.3 + 8.6) than survivors did. According to a ROC curves, the predictive ability to discriminate between survivors and non-survivors of lactate, cAG, AG and SIG are 0.77, 0.72, 0.68 and 0.67, respectively. Correlations between the SIG and values derived from bicarbonate approach are fair. There was no difference in SIG values between surgical and medical patients with the same severity scores. Sepsis patients (n = 291) had significantly higher SIG than non-sepsis patients (n = 129) did (8.81 + 6.38 vs. 5.74 + 4.14; p = 0.01).

Conclusion: Compared to the traditional approach, an alternative Stewart approach does not provide any greater advantage to predict mortality in the studied population. Because of complex calculation, the usefulness of such approach on the routine clinical practice may be limited.

Keywords: Strong ion gap, Prognostic factor, Acid-base disturbance, ICU, Anion gap, Lactate

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The Medical Association of Thailand

Address: 4th Floor, Royal Golden Jubilee Building, 2 Soi Soonvijai, New Petchburi Road, Bangkok 10310, Thailand

Telephone: 0-2716-6102, 0-2716-6962 press 0 Fax: 0-2314-6305

E-mail: jmedassocthai@yahoo.com, math@loxinfo.co.th 