

Abstract

Little is known about the role of a strong ions in humans with respiratory abnormalities. In this study, we investigated the associations between partial carbon dioxide pressure ($p\text{CO}_2$) and each of sodium ion (Na^+) concentrations, chloride ion (Cl^-) concentrations and their difference ($\text{SID}_{\text{Na-Cl}}$). Blood gas data were obtained from patients in a teaching hospital intensive care unit between August 2013 and January 2017. The association between $p\text{CO}_2$ and $\text{SID}_{\text{Na-Cl}}$ was defined as the primary outcome. The associations between $p\text{CO}_2$ and $[\text{Cl}^-]$, $[\text{Na}^+]$ and other strong ions were secondary outcomes. $p\text{CO}_2$ was stratified into 10 mmHg-wide bands and treated as a categorical variable for comparison. As a result, we reviewed 115,936 blood gas data points from 3,840 different ICU stays. There were significant differences in $\text{SID}_{\text{Na-Cl}}$, $[\text{Cl}^-]$, and $[\text{Na}^+]$ among all categorized $p\text{CO}_2$ bands. The respective $p\text{CO}_2$ $\text{SID}_{\text{Na-Cl}}$, $[\text{Cl}^-]$, and $[\text{Na}^+]$ correlation coefficients were 0.48, -0.31, and 0.08. $\text{SID}_{\text{Na-Cl}}$ increased and $[\text{Cl}^-]$ decreased with $p\text{CO}_2$, with little relationship between $p\text{CO}_2$ and $[\text{Na}^+]$ across subsets. In conclusion, we found relatively strong correlations between $p\text{CO}_2$ and $\text{SID}_{\text{Na-Cl}}$ in the multiple blood gas

Partial carbon dioxide pressure and strong ions

datasets examined. Correlations between $p\text{CO}_2$ and chloride concentrations, but not sodium concentrations, were further found to be moderate in these ICU data.

Keywords: acid-base phenomena, Stewart approach, strong ion difference, chlorine ion, partial carbon dioxide pressure