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Integration of Acid–Base and Electrolyte Disorders

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TO THE EDITOR

In his review on acid–base disorders, Seifter (Nov. 6 issue)¹ attempts to integrate the “traditional, bicarbonate-centered model” described by Davenport² and Boron³ with Stewart’s strong-ion-difference model⁴:

$$\text{strong ion difference (in mmol per liter)} = [\text{Na}^+] + [\text{K}^+] + [\text{Ca}^{2+}] + [\text{Mg}^{2+}] - [\text{Cl}^-].$$

In unbuffered salt solutions,

$$\text{strong ion difference} = [\text{OH}^-] - [\text{H}^+]$$

and is thus a pH surrogate. However, adding buffers as strong ion salts (e.g., sodium bicarbonate equilibrated with carbon dioxide, or sodium lactate equilibrated with lactic acid) increases the strong ion difference while having variable or even no effects on pH. Thus the strong ion difference does not uniquely define pH. Changes in the strong ion difference are a consequence of adding acids or bases as strong ion salts; they do not cause pH to change. Stewart⁴ makes the fundamental error of mistaking correlation for causation. Proteins are generally sensitive to pH per se, not the strong ion difference. No biologic mechanisms exist for directly sensing or regulating the strong ion difference in cells, blood, or other compartments (e.g., the cerebrospinal fluid) — domains where pH is both sensed and regulated. Seifter advocates the strong ion difference as a diagnostic tool, rather like the anion gap. Although this analysis may indirectly provide information on acid–base control, the strong ion difference offers no new mechanistic insight because it does not have a causal role in pH changes.

References

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No potential conflict of interest relevant to this letter was reported.

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