Altered mental status and an acid-base disturbance

JANUARY 2017

TABLE 2

'Rules of 5' for acid-base problem-solving

1 Determine the arterial pH status

pH < 7.40 is acidemic, pH > 7.44 is alkalemic
But a normal pH does not rule out an acid-base disorder

2 If the arterial pH is abnormal, determine whether the primary process is respiratory, metabolic, or both

	pH	P_{CO_2}	Bicarbonate
Respiratory acidosis	Low	High	—
Metabolic acidosis	Low	—	Low
Mixed respiratory and metabolic acidosis	Low	High	Low
Respiratory alkalosis	High	Low	—
Metabolic alkalosis	High	—	High
Mixed respiratory and metabolic alkalosis	High	Low	High

3 Calculate the anion gap

Anion gap = sodium – (chloride + bicarbonate)

If serum albumin is low, add 2.5 mmol/L to the anion gap for every 1 g the serum albumin is below normal

An anion gap > 10 mmol/L is elevated

4 Check the degree of compensation (respiratory or metabolic)

P_{CO_2} and bicarbonate should move in the same direction

Nominal normal levels: bicarbonate 25 mmol/L and P_{CO_2} 40 mm Hg

In respiratory acidosis, for every 10-mm Hg increase in P_{CO_2}, bicarbonate should increase by 1 mmol/L in the first 48 hours and 4 mmol/L afterward

In metabolic acidosis, for every 1-mmol/L decrease in bicarbonate, P_{CO_2} should decrease by 1.3 mm Hg

In respiratory alkalosis, for every 10-mm Hg decrease in P_{CO_2}, bicarbonate should decrease by 2 mmol/L in the first 48 hours and by 5 mmol/L afterward

In metabolic alkalosis, for every 1-mmol/L increase in bicarbonate, P_{CO_2} may increase by 0.6 mm Hg

5 If the patient has metabolic acidosis with an elevated anion gap, check whether the bicarbonate level has decreased as much as the anion gap has increased

In metabolic acidosis, the anion gap should increase by the same amount that bicarbonate decreases; a difference in these two changes is called a delta gap

P_{CO_2} = partial pressure of carbon dioxide

Based on information in reference 1

In the article "A patient with altered mental status and an acid-base disturbance" (Mani S, Rutecki GW, Cleve Clin J Med 2017; 84:27–34), 2 errors occurred in Table 2. The corrected table appears at left, with corrections shown in red:

In addition, two sentences in the text regarding the osmol gap should be revised as follows:

On page 31, the last 3 lines should read as follows: "When the anion gap metabolic acidosis is multifactorial, as it was suspected to be in a case reported by Tan et al,[23] the osmol gap may be elevated as a consequence of additional toxic ingestions, as it was in the reported patient."

And on page 33, the last sentence should read as follows: "As reflected in the revisions to MUD PILES and in the newer GOLD MARK acronym, the osmol gap has become more valuable in differential diagnosis of metabolic acidosis with an elevated anion gap consequent to an expanding array of toxic ingestions (methanol, propylene glycol, ethylene glycol, and diethylene glycol), which may accompany pyroglutamic acid-oxoproline."

Cardiopulmonary exercise testing

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In the article, "Cardiopulmonary exercise testing: A contemporary and versatile clinical tool" (Leclerc K, Cleve Clin J Med 2017; 84:161–168), an error occurred in Table 1. Heart rate reserve was defined as maximum heart rate minus resting heart rate. It should be defined as (maximum heart rate minus resting heart rate) divided by (predicted maximum heart rate minus resting heart rate).