

Diagnosis and Management of Acid-Base Disorders



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KEYWORDS

- Acid-base disorder • Metabolic acidosis • Metabolic alkalosis • Respiratory acidosis
- Respiratory alkalosis

HOSPITAL MEDICINE CLINICS CHECKLIST

1. Mixed acid-base disorders are common in hospitalized patients. A stepwise approach helps clinicians identify mixed acid-base disorders.
2. A compensatory response does not normalize the pH completely. Always calculate the anion gap when the mixed acid-base disorders are suspected.
3. Patients with low albumin levels with a normal uncorrected anion gap (such as patients with end-stage liver disease) could have a high anion gap after correction. The anion gap decreases by 2.5 mEq/L for each 1 g/dL decrement of serum albumin.
4. If the urine anion gap is positive, this is caused by either high unmeasured anions (such as drug anions, toluene poisoning) or low unmeasured cations (such as renal tubular acidosis [RTA] related to a defect in urine ammonium excretion).
5. Milk-alkali syndrome is characterized by hypercalcemia, alkalosis, and renal failure.
 - a. There are 3 types of RTA. The most important clue is to look at the serum potassium level. If the serum potassium level is low, type 1 (distal RTA) and type 2 (proximal RTA) are likely the cause. If the serum potassium level is high, type 4 RTA is likely.

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Disclosures: None.

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Hosp Med Clin 3 (2014) e334–e349

<http://dx.doi.org/10.1016/j.ehmc.2014.04.001>

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- b. Lactic acidosis is one of the most common causes of metabolic acidosis in the hospitalized patient, and sometimes, the first indicator of decreased tissue perfusion. The initial serum lactate level is a predictor of survival in septic shock. It is important to restore tissue perfusion and stop possible offending agents.
- c. Experts suggest that patients with lactic acidosis and pH lower than 7.1 need to be treated with bicarbonate therapy to prevent or treat the possible effects of profound acidemia on hemodynamic instability. It is important to treat the underlying cause of the acidemia.
- d. Venous blood measurements can be a good alternative to arterial blood measurements, but can be misleading when patients are in shock.

How do you diagnose acid-base disorders? What are the steps in making a diagnosis?

- It helps to use a stepwise approach in identifying acid-base disorders (**Box 1**).
- First, consider the clinical settings that are commonly associated with acid-base disorders. Hospitalized patients often have more than 1 acid-base process occurring simultaneously. Pay particular attention if a patient has gastrointestinal (GI) (vomiting, diarrhea), respiratory (hyperventilation, hypoventilation, severe chronic obstructive pulmonary disease [COPD]), or renal (renal failure) problems.
- Second, obtain an analysis of arterial blood gas (ABG) and serum electrolytes. Clinicians could make a wrong diagnosis by determining the acid-base disorder solely based on blood gas. It is easy to miss mixed acid-base disorder when electrolyte values are not taken into consideration.

Box 1**Stepwise approach to acid-base disorder****Step 1: consider clinical settings**

Common settings: gastrointestinal (vomiting, diarrhea), pulmonary (hyperventilation caused by pneumonia/hepatic encephalopathy/sepsis, hypoventilation caused by neuromuscular disorder/central nervous system depression/severe pneumonia, advanced chronic obstructive pulmonary disease), renal (renal failure, rhabdomyolysis), ketoacidosis, toxin, drugs

Step 2: identify primary disorder(s)

Determine primary disorder based on P_{CO_2} and bicarbonate

- a. acidemic ($pH < 7.37$) or alkalemic ($pH > 7.43$)
- b. compare HCO_3^- from blood gas and from serum electrolytes

If difference is greater than 3, repeat laboratory measurements

Step 3: check mixed disorders

Compensation does not normalize pH

- a. If metabolic acidosis, apply the Winter formula or rule of 15 (addition of 15 to $HCO_3^- = P_{CO_2}$ and the last 2 digits of pH) to assess compensation
- b. Calculate anion gap. If greater than 20, metabolic acidosis exists regardless of pH and bicarbonate
- c. Measure $\Delta\Delta$ (>1 [or >2 , practically], superimposed metabolic alkalosis; <1 , superimposed nongap acidosis; 1, simple gap acidosis)

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