METABOLIC ACIDOSIS: ADVANCED TOPICS


Take home points:
1. The initial step in the work-up of a non-gap metabolic acidosis is the urine anion gap
2. Use the delta gap to determine if there is a second metabolic acid-base disorder in your patient with an anion-gap metabolic acidosis
3. Large amounts of normal saline cause a hyperchloremic (non-gap) metabolic acidosis which is due to a rise in chloride relative to sodium, which results in greater amounts of HCl and thus, acidosis.
4. THAM is a non-bicarbonate buffer that can improve pH. Unlike sodium bicarbonate, it doesn’t cause elevated CO₂, so it doesn’t worsen respiratory acidosis.

What is the initial step in working up a non-gap metabolic acidosis?
• Check the urine anion gap (Uₙa + Uₖ – Uₐₜ)
• If urine anion gap is positive, it is a renal cause (e.g. RTA; really only validated for types I, IV)
• If urine anion gap is negative, the cause is extra-renal

What is the delta gap?
• Use this when you have a patient with anion-gap acidosis to see if there is a concomitant non-gap metabolic acidosis or metabolic alkalosis.
• First, calculate the delta gap = patient’s anion gap – normal anion gap = patient’s anion gap – 12
• Then, add the delta gap to the patient’s bicarbonate ➔ if it is < 24, there is a concomitant non-gap metabolic acidosis; if it is > 30, there is a concomitant metabolic alkalosis.

What's the pathophysiology of saline-induced hyperchloremic metabolic acidosis?
• When you give your patient normal saline (a hyperchloremic solution), you are increasing the chloride level significantly and it is the chloride anion that is the ultimate cause of the acidosis.
• When you give NaCl to your patient, it combines with water as follows: NaCl + H₂0 ➔ HCl + NaOH.
• The strong acid (HCl) and the strong base (NaOH) should cancel each other out, with no effect on pH.
• However, because the normal concentrations of Na and Cl in the serum are 140 and 100, respectively, adding saline (154 mEq Na and 154 mEq Cl) causes the chloride to increase a lot more than the sodium.
• This increase in chloride tips the acid-base balance toward HCl, thereby causing the metabolic acidosis.

What are the disadvantages of giving NaHCO₃ in the setting of metabolic acidosis?
• Initial, transient worsening of intracellular acidosis can occur
• Giving NaHCO₃ generates CO₂ ➔ causes respiratory acidosis (especially if the lungs are not working correctly – e.g. ARDS) ➔ further decreases the pH
• Big sodium load

What is THAM?
• THAM is a non-bicarbonate buffer that helps correct pH in the setting of metabolic acidosis.
• Unlike sodium bicarbonate, it doesn’t increase CO₂, so it is doesn't cause respiratory acidosis.
• The ideal setting for THAM is in a patient with metabolic acidosis who has ARDS. The ARDSNet protocol causes “permissive” hypercapnea and respiratory acidosis. If your patient has a metabolic acidosis also, it will be difficult to run ARDSNet protocol. By giving THAM, you are correcting the pH without generating more CO₂.
• Dose: base deficit x weight (kg) = amount of 0.3 M THAM solution to give (in mL)