AJKDblog

Test Your Knowledge: Lactic Acidosis

Acute lactic acidosis is associated with high morbidity and mortality. In a recent Teaching Case published in *AJKD*, Kraut and Madias discuss an interesting case of severe lactic acidosis in a patient with severe sepsis. Test your knowledge on lactic acidosis with the following questions based on their article.

1. A 55-year-old woman with a history of coronary artery disease is admitted with sepsis due to pneumonia. Her hospital course is complicated by cardiorespiratory failure requiring intubation, mechanical ventilation, and three vasopressor agents. She also develops acute ischemic hepatitis and oliguric acute kidney injury due to acute tubular necrosis. Her serum creatinine is 4.5 mg/dL, serum lactate level is 6.0 meq/L, and serum bicarbonate concentration is 14 meq/L with a corresponding arterial pH of 7.25. What would be the best approach to manage her acidemia?

    A. Normal saline solution
    B. Ringer lactate solution
    C. Isotonic sodium bicarbonate solution
    D. Tris-hydroxymethyl aminomethane (THAM)
    E. Renal replacement therapy

2. All of the following are advantages of dialysis as an approach to deliver base in order to manage severe lactic acidosis, EXCEPT:

    A. Dialysis facilitates better volume management
    B. Base can be delivered in large quantities
    C. Dialysis helps in improving survival in patients with severe lactic acidosis
    D. Dialysis facilitates better management of calcium disturbances
    E. Dialysis helps remove toxic substances that can produce severe metabolic acidosis

3. When administering base in a patient with severe acidemia, what blood pH should be targeted?

    A. $\geq$ 7.4
    B. $\geq$ 7.2
    C. $\geq$ 7.0

4. What is the effect of aggressive sodium bicarbonate repletion on calcium level in severe lactic acidosis?
    A. Total calcium concentration decreases
    B. Ionized calcium concentration decreases
    C. Ionized calcium concentration increases
    D. No effect on calcium concentration

5. What is the best modality of extracorporeal treatment of severe metformin associated lactic acidosis (serum lactate >20 meq/L)?
    A. Peritoneal dialysis
    B. Plasma exchange
    C. Intermittent hemodialysis
    D. Continuous renal replacement therapy (CRRT)

*Quiz prepared by **Ritu Soni**, AJKD Blog Contributor*

To view the Kraut and Madias Teaching Case **abstract** or **full-text** (subscription required), please visit **AJKD.org**.

Solutions to *AJKD* Blog's Test Your Knowledge: Lactic Acidosis

1. **E. Renal replacement therapy**

   When sodium bicarbonate is administered rapidly in large amounts in patients with circulatory collapse, it tends to produce an intracellular acidosis. This is because the carbon dioxide (generated when protons are buffered by the base) translocates into the intracellular space. This effect is generally not seen if circulation is only moderately impaired. Normal saline solution can exacerbate acidosis by diluting bicarbonate concentration. THAM is required to be eliminated from the body to generate base, which is typically through the kidneys. Hence, it should be avoided in kidney failure. Ringer lactate solution should be avoided in patients with liver disease as lactate may accumulate due to impaired hepatic metabolism and thereby fail to generate bicarbonate. Additionally, all the other options can lead to volume overload in a patient with already tenuous respiratory status. Renal replacement therapy is the best option in this patient for the aforementioned reasons.

2. **C. Dialysis helps in improving survival in patients with severe lactic acidosis**

   Dialysis is a very effective measure of correcting metabolic acidosis. Large quantities of base can be delivered from dialysate into the bloodstream by diffusion across a semi-permeable filter. In extreme situations, additional base can be administered intravenously alongside dialysis. With dialysis, the rate of ultrafiltration and concentration of dialysate calcium can be adjusted to optimize volume status and calcium abnormalities. Dialysis also facilitates removal of toxic agents like metformin and toxic alcohols which can cause severe metabolic acidosis. A small quantity of lactate is also removed by dialysis but dialysis has not been shown to decrease mortality in patients with severe lactic acidosis.

3. **B. ≥ 7.2**

   It is recommended that clinicians aim for a blood pH of 7.2 when giving base. pH levels less than 7.2 have shown to be associated with depressed cardiac contractility in animals. In humans, pH levels lower than 7.2 lead to suppressed myocardial contraction and is associated with increased mortality.

4. **B. Ionized calcium concentration decrease**

   With administration of sodium bicarbonate and increase in the blood pH, there is increased binding of calcium to circulating proteins resulting in ***decreased*** ionized calcium levels.

5. **C. Intermittent hemodialysis**

   According to the EXTRIP (Extracorporeal Treatments in Poisoning) guidelines for treatment of metformin associated lactic acidosis, intermittent hemodialysis is recommended as the modality of first choice, followed by continuous renal replacement therapy (CRRT) as a second option. Metformin is a small molecule with minimal protein binding; hence, it has good clearance with hemodialysis filters (>200 mL/min with intermittent HD versus 50 mL/min with CRRT). Due to negligible protein binding, plasma exchange is not deemed as effective as hemodialysis in metformin clearance.

   Reference: Shamir et al. Metformin Associated Lactic Acidosis. University of Pittsburgh Medical Center Renal Grand Rounds Fall 2016.

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