LETTER TO THE EDITOR

Is There Any Lower Limit of Serum Bicarbonate in Diabetic Ketoacidosis?

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Abstract

Diabetic ketoacidosis (DKA) is known as one of the most serious complications of diabetes and associated with significant morbidity and mortality. It consists of a triad of uncontrolled hyperglycemia, metabolic acidosis, and increased total body ketone concentration.[1] It leads to high anion gap metabolic acidosis with fall in serum bicarbonate.

Keywords: Diabetic ketoacidosis, High anion gap acidosis, Severe metabolic acidosis.

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Diabetic ketoacidosis (DKA) is one of the most common acute complications of diabetes. Not only it is associated with significant morbidity but also mortality. It manifests as a combination of uncontrolled high blood sugar, metabolic acidosis, and elevated total body ketone concentration.[1] It leads to high anion gap metabolic acidosis with a fall in serum bicarbonate.

A 35-year-old woman presented to the hospital in an unconscious state for the last 2 hours with respiratory distress. She was not known to have diabetes mellitus. She presented in sinus tachycardia, blood pressure (BP) 90/56 mm Hg, respiratory rate 32 per minute, and temperature 36°C. Clinical examination revealed severe dehydration, abdominal distension, and respiratory distress. She required urgent intubation.

Initial blood glucose level was 608 mg/dL, serum beta hydroxybutyrate level 4.8 mmol/L, and high urinary ketone. The arterial blood gas analysis revealed severe metabolic acidosis with a pH of 6.70, bicarbonate of 0.68 mmol/L, pO_2 143 mm Hg on oxygen, and pCO_2 13.9 mm Hg. Other laboratory investigation showed a white blood cell count of 26.5×10^9/L, normal lactate, sodium 134 mmol/L, potassium 3.9 mmol/L, blood urea level of 54 mg/dL, serum creatinine level 0.48 mg/dL, and glycosylated hemoglobin 17.2%.

She was treated for diabetic ketoacidosis. In view of the fact that infection is one of the most common underlying cause that precipitates DKA, all relevant cultures and imaging were done but it did not reveal anything significant. Her clinical status improved gradually over the following days. She was extubated and shifted out of the intensive care unit.

The common causes of DKA precipitation include underlying infection, disruption of insulin treatment, and new onset of diabetes. Biochemically, it is defined as a rise in the serum concentration of ketones greater than 5 mEq/L, a blood glucose level greater than 250 mg/dL, and a blood pH less than 7.3. The characteristic abnormality consists of ketonemia and ketonuria and serum bicarbonate level of 18 mEq/L or less. When serum bicarbonate falls below 5 mEq/L, it indicates severe DKA.

Continuous increase in blood concentration of acidic substances leads to a state of ketonemia initially. When the level of ketones surpasses the body's capacity to extract them, they overflow into the urine. If the situation worsens, the more and more accumulation of acids gives rise to apparent clinical metabolic acidosis, with a substantial drop in pH and serum bicarbonate.

In DKA, low pCO_2 is because of the increase in ventilation. Respiratory compensation has its own limit. When the serum pH is below 7.20, an ongoing reduction in the serum HCO_3^- level may result in a significant drop in pH. This is particularly true when the pCO_2 is near to the lower limit of compensation, which is around 15 mm Hg in an otherwise healthy adult. At this point, even minimal ongoing drop in HCO_3^- is not matched by a corresponding fall in $PaCO_2$ and rapid decompensation can occur.

Serum bicarbonate values below 2 mmol/L in DKA is not reported so far as per our information. Kamarzaman et al. described a case report of DKA patient with an initial pH of 6.27 who made full recovery after cardiac arrest with initial bicarbonate values of 4 mmol/L.[2]

So, with a limit to respiratory compensation in metabolic acidosis, it can be assumed that with the worsening of the underlying disease process in DKA, serum bicarbonate may go to a minimum level, even to zero if a patient is surviving that condition.

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