

Surviving the Impossible, A PH Incompatible with Life

Brittney Grella MD, Alex Gusler MD, Kelly Ussery-Kronhaus MD, Michael Kaufer MD.

Learning Objectives:

1. Present literature search findings on the lowest pH values compatible with life
2. To discuss a life-threatening complication of diabetes with specific focus on pathogenesis and treatment.

Case Summary:

A 66-year-old male with a past medical history of type 1 diabetes mellitus presented to the ER with 1 day of shortness of breath, vomiting, and urinary frequency. The patient stopped using his insulin pump once these symptoms started. On physical examination, the patient was tachycardic (heart rate of 102 beats per minute) and tachypneic (respiratory rate of 30 breaths per minute), using his accessory muscles to breathe. The patient was alert and oriented to person and place but not to time. He was able to answer questions and follow commands. Significant laboratory studies included: glucose 991 mg/dl (70-99 mg/dl), small acetone (negative), sodium 127 mmol/L (136-145 mmol/L), potassium of 7.2 mmol/L (3.5-5.2 mmol/L), creatinine 3.83 mg/dl (0.61-1.24 mg/dl), anion gap greater than 40 mmol/L (5-13 mmol/L), carbon dioxide undetectable (24-31 mmol/L), lactate 12.3 mmol/L (0.5-2.0 mmol/L). His venous blood gas revealed a pH of 6.505 mg/dl (7.35-7.45), pCO₂ of 27 mg/dl (35-45 mmHg), and HCO₃ of 2.1 mg/dl (22-28 mmol/L). His electrocardiogram revealed sinus rhythm with 1st degree atrioventricular block (PR interval of 210 milliseconds). The patient's heart rate decreased from 82 to 40 to 20 beats per minute, his rhythm converted to pulseless electrical activity (PEA) and asystole, and cardiopulmonary resuscitation was started. The patient was given two 1-liter boluses of normal saline, started on an insulin drip and a sodium bicarbonate infusion, and given intravenous pushes of the following: atropine, epinephrine, sodium bicarbonate, amiodarone, and calcium chloride. The patient was intubated for airway protection and the hypothermia protocol was initiated. His blood pressure became unstable and he was started on norepinephrine at 15 mcg/min. Return of spontaneous circulation (ROSC) was achieved after 14 minutes. The patient was admitted to the intensive care unit for further evaluation. His subsequent arterial blood gas improved with a pH of 6.808 mg/dl, PCO₂ of 20.5 mg/dl, and HCO₃ 6.3 mg/dl. The patient improved over the course of his hospitalization and was ultimately extubated with no neurological deficits.

Conclusions:

Diabetic ketoacidosis (DKA) is a fatal hyperglycemia with high rates of morbidity and mortality. The pathogenesis involves insulin deficiency and an increase in counterregulatory hormones ultimately resulting in hyperglycemia, osmotic diuresis, loss of water and electrolytes, impaired renal function, and ketoacidosis. The treatment of DKA involves fluid resuscitation, correction of hyperglycemia, correction of electrolyte abnormalities, and correction of precipitating factors. This patient presented with a pH of 6.505 mg/dl with no neurological sequelae. It is important to recognize that this pH is not usually compatible with life, and this patient is lucky to have survived. This case report also provides us with the opportunity to complete a literature search and discuss the lowest pH values compatible with life.

