ECRONICON OPEN ACCESS

EC PULMONOLOGY AND RESPIRATORY MEDICINE
Editorial

# Non-Acidemic Diabetic Ketoacidosis, Clinical Pearls

**Mourad Ismail***

*Assistant Professor of Medicine at New York Medical College and Director, Critical Care Medicine at Saint Joseph's Regional Medical Center, New Jersey, USA*

***Corresponding Author**: Mourad Ismail, Assistant Professor of Medicine at New York Medical College and Director, Critical Care Medicine at Saint Joseph's Regional Medical Center, New Jersey, USA.

**Received:** August 03, 2017; **Published:** August 10, 2017

Diabetic ketoacidosis (DKA) is one of the most common diagnoses that require admission to the intensive care unit (ICU). Absolute or relative lack of insulin production by pancreatic islets, with the resultant inability to metabolize glucose, and production of beta hydroxybutyric acid (β-HBA), is the basic pathophysiology. As a non-measured organic acid (anion), β-HBA leads to a widened anion gap metabolic acidosis (AGMA). Non-complicated DKA is defined as plasma glucose level > 250 mg/dl, arterial pH < 7.3, a serum bicarbonate measure < 18 meq/L, and a wide AGMA. When DKA develops acutely, as in type 1 diabetes mellitus (DM), and in the absence of other metabolic derangements, the classic description of DKA, with low serum bicarbonate, low serum pH, AGMA, and moderately elevated serum glucose, is usually the case. But given the complex nature of DM, the metabolic consequences of macro-vascular complications (i.e. diabetic nephropathy) and the fact that it may have relative, not absolute deficiency of insulin as in type 2 DM, patients may present with a wide spectrum of metabolic patterns. They may present with normal or elevated serum bicarbonate and normal or, on rare occasion, alkalemic pH, this happens when the patient has metabolic alkalosis as well as DKA, which may be the case when patients also have severe vomiting, decreased fluid intake or increased insensible water loss. This usually presents a challenge to clinicians, especially if they don't routinely calculate AG, and base their impression only on serum bicarbonate or pH. Patients with alkalosis and DKA need attention to replace their volume and free water deficit while monitoring serum glucose and AG.

Type 1 DM patients, who usually present shortly after missing 1 or 2 doses of insulin, would have a significantly wider AG as compared to type 2 DM patients, and a lower serum glucose e.g. in 300 to 500 mg/dl range. With the resultant severe acidemia, these patients will present with Kusmaul's breathing pattern and complain of severe cramping abdominal pain caused by splanchnic vasospasm, nausea and vomiting. Their mainstay of therapy after fluid resuscitation is intravenous (IV) insulin which should be continued until the AG resolves, and the serum bicarbonate concentration returns to baseline (i.e. patient's baseline bicarbonate, which might be lower than normal, usually due to type 4 renal tubular acidosis in poorly controlled diabetics).

In type 2 DM patients, DKA may be the presenting clinical picture of DM, usually following a trigger, such as acute coronary syndrome, infection or following a high carbohydrate meal or administration of medications such as high dose steroids. DKA may also be a presentation in established cases of type 2 DM, usually in response to a stressor as mentioned above, or as the end result of a hyperosmolar state. In such cases, the patients will be more dehydrated, with significant volume deficit as well as free water deficit. They will have near normal or alkalemic pH, which will not trigger the chemo-receptor trigger zone to cause kusmaul's breathing to compensate for acidemia. Key points to remember in such cases are as follows. First, start with volume resuscitation using isotonic crystalloids until the patient is adequately volume replete, to ensure adequate perfusion pressure to all vital organs, as well as repleting potassium (K), and phosphorus to ensure K is above 3.3 meq/l, and phosphorus is above 1 meq/l before starting insulin. In the rare occasion where the patient presents with dangerously high K, (i.e. > 6.5 meq/l) one dose of IV insulin may be given during initially resuscitating with fluids. Second, calculation of the free water deficit, and the corrected sodium should be done after volume repletion to be more accurate, since the serum sodium will rise as the patient receives isotonic fluid for volume resuscitation, heralding a final higher free water deficit. Third, when starting insulin

drip, ensure that adequate supplementation of K is provided, to avoid precipitous drop and risk of arrhythmia. Fourth, the calculated dose of IV insulin has to factor in the patients' renal function, (i.e. end stage renal disease (ESRD) on Hemodialysis (HD), or acute kidney injury (AKI) with severe oliguria) as insulin is renally excreted and can accumulate as it gets continuously infused, with a precipitous drop in serum glucose, and serum osmolarity carrying the risk of cerebral edema which can be fatal. Finally, understand that in patients with normal renal function, during the development of hyperosmolar state, and then DKA, the hyperglycemia leads to osmotic fluid shift, from the interstitial to the intravascular space, followed by osmotic diuresis, with a net significant free water loss. This process explains the rise in serum sodium upon resuscitation and insulin therapy. At that time, with the insulin moving glucose intracellularly, the Na-K ATPase pump moves Na extracellularly, there will also be a shift of free water to the extra-vascular space, both intra- and extra-cellular, leading Na to rise intravascularly. Given the relation between Na and glucose in influencing serum osmolarity, for a given serum osmolarity value to remain constant, every drop of serum glucose by 36 mg/dl a rise in serum Na of 1 meq/l has to occur. As such, by allowing glucose to decrease by no more than 75 mg/dl per hour, we avoid risking hypoosmolar cerebral edema.

In conclusion, being alkalemic can coexist with DKA, replacing free water deficit and insulin will gradually correct both. But renal failure patients may require a totally separate protocol in treating DKA. Patients with DKA, especially those with severe contraction alkalosis, may have a misleading presentation that can be easily missed. In the setting of AKI with oliguria or ESRD on HD, the rate of the insulin drip should be halved, to avoid its accumulation with resultant precipitous drop in both serum glucose and osmolarity. This drop may be magnified by the fact that oliguria or anuria prevent the osmotic diuresis, which is the bases for the free water deficit, and the rising sodium, that ultimately balances the effect of dropping glucose in normal kidney function patients. Lastly, we shouldn't be deceived by a normal or even elevated serum bicarbonate level and exclude DKA if we have a reason to suspect it, as AGMA may coexist with respiratory and metabolic alkalosis pathophysiologic processes, and if those processes have a higher impact, the pH will shift in the alkalemic direction.

**Volume 4 Issue 5 August 2017**