Diabetic Ketoacidosis Care Presents Real Challenges

In addition to diagnosis and management, look for potential triggers of this acute metabolic disorder.

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STOWE, VT. — Uncertain triggers, therapeutic controversies, and potentially fatal complications can compromise emergency management of diabetic ketoacidosis, according to Steven M. Hulsey, M.D.

Diabetic ketoacidosis (DKA) is a major, acute metabolic complication of diabetes that requires immediate and intensive care.

Although DKA is not a difficult diagnosis per se—particularly in the context of known type 1 diabetes—evaluation and treatment can be challenging, Dr. Hulsey said at an emergency medicine update sponsored by the University of Vermont.

Diagnosis and management of the severe insulin deficiency that sets the ketoacidotic chain in motion are only half the battle. The other half is identifying the event or condition that precipitated the metabolic disorder and addressing it appropriately to restore normal balance and prevent recurrences.

"Initially, you want to make sure that what is causing the ketoacidosis isn't itself a life-threatening condition, such as myocardial infarction or sepsis," said Dr. Hulsey, noting that in some cases, the "trigger" could pose at least as great a threat as the DKA.

Excessive urination, severe thirst, fruity-smelling breath, abdominal pain, nausea, vomiting, fatigue, breathing difficulties, and mental confusion are among the telltale symptoms of DKA.

Blood glucose levels higher than 250 mg/dL, large quantities of ketones in the urine and plasma, low serum bicarbonate (less than 15 mmol/L), elevated anion gap (more than 16 mmol/L), and a blood pH of less than 7.3 confirm a diagnosis of DKA.

Because there is no clinically significant difference between arterial and venous pH estimates in patients with DKA, "go ahead and get the venous sample upon insertion of the IV for fluid resuscitation," Dr. Hulsey recommended. "This spares the patient a painful arterial stick later."

Severe electrolyte disturbances are also characteristic of DKA. The most dangerous of these, total body potassium loss, is difficult to assess, because it is typically not mirrored in serum potassium levels—a factor that must be considered before treatment.

If serum potassium levels are even slightly low on first test, total potassium probably is very low and must be replenished before giving the patient insulin.

Initial blood potassium levels usually are normal to high, despite substantial total body potassium deficits. This is because the acidosis encourages leakage of intracellular potassium.

Treatment with insulin—a cornerstone of DKA therapy—drives potassium back into the cells, and levels may drop very quickly.

For this reason, frequent blood potassium checks are critical during therapy.

"If serum potassium levels are even just slightly low on the first test, that means that total body potassium is probably critically low and must be replenished before giving the patient insulin," Dr. Hulsey said. "If potassium levels are normal, total body potassium is probably low and should be replenished [along with insulin infusion]."

The pillars of DKA treatment include efforts to correct life-threatening dehydration, hyperglycemia, ketonemia and acidemia, and electrolyte disturbances. Toward this end, aggressive fluid resuscitation is warranted unless the patient has signs of any condition, such as congestive heart failure, that might be exacerbated by large volumes of intravenous fluids.

A less aggressive approach is also recommended when treating children and adolescents, who are at greater risk for cerebral edema.

It has been suggested, though not proven, that over-aggressive fluid replacement is linked to this rare, often fatal complication. "But most physicians choose to err on the side of underreplacement in kids," Dr. Hulsey said.

Intravenous insulin is also indicated, although there is ongoing debate about dosing and infusion rates.

In the past, large doses of insulin were recommended early in DKA therapy. Current thinking is that hyperglycemia should be corrected gradually to avoid hypoglycemia, hypokalemia, and cerebral or pulmonary edema, he said. Blood glucose levels should be monitored hourly, and insulin dose should be adjusted accordingly.

There currently is no consensus on the practice of administering an intravenous bolus of regular insulin as a way to jumpstart recovery efforts before low-dose infusion.

"In reality, a bolus dose is not needed [before low-dose infusion] to obtain optimal plasma levels, because the time needed to reach normal glycemic levels is the same," Dr. Hulsey said. "And there is the possibility that a bolus dose may increase the risk for hypokalemia."

A bolus dose should be considered, however, when a substantial delay in treatment is anticipated, he said.

In such circumstances, it is not unreasonable to administer successive small bolus doses, as long as potassium levels are being monitored.

The use of intravenous bicarbonate to reduce the immediate risks of extremely low pH is also a contentious topic.

The theoretical advantages include a reduction in cardiac irritability, respiratory discomfort, and intravenous chloride load, while the theoretical disadvantages include the possibility of hypokalemia and arrhythmia and exacerbated intracellular and intracerebral acidosis.

"In reality, there are some studies that have shown that giving bicarbonate in DKA doesn't make a difference either way, so it should probably be avoided" Dr. Hulsey said. Bicarbonate should not be used in pediatric patients, because of a possible association with cerebral edema, he said.

As noted, replacing potassium deficits should be included in the DKA management strategy. The dose will vary depending on serum levels, which should be measured regularly so that the rate of replacement can be adjusted as needed, Dr. Hulsey noted.

Finally, determine the trigger event and provide patient education as needed to prevent recurrences. Infection, serious illness, trauma, and emotional stress can all lead to the acute diabetic disorder, as can other medications, alcohol, and inappropriate cessation of insulin or reduction of the insulin dosage.

Patients should be made aware of the range of possible precipitating factors. They also should be cognizant of early signs and symptoms that might suggest the need for insulin adjustment, before the situation escalates to an emergency, Dr. Hulsey concluded. ■

PCOS, Pregnancy-Induced HT May Signal Metabolic Syndrome

BY SHARON WORCESTER
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ORLANDO, FLA. — Pregnancy-induced hypertension and polycystic ovarian syndrome may be risk markers for later development of metabolic syndrome, Stephen Franks, M.D., said at an international conference on women, heart disease, and stroke.

The findings are important because they suggest that identification of those at risk for metabolic syndrome, and interventions to reduce that risk, can begin as early as adolescence, when polycystic ovarian syndrome (PCOS) typically emerges, said Dr. Franks of the Imperial College London.

The prevalence of metabolic syndrome in women is "staggeringly high," and the hazard ratio for cardiovascular mortality in women with metabolic syndrome is nearly 2.8. For diabetes, the hazard ratio is 6.3.

"So there is an enormously increased risk of heart disease and diabetes; it would be very useful if we could try to predict [metabolic syndrome] and identify those factors that alert us to the possibility of a high risk for metabolic syndrome," Dr. Franks said.

Several studies show that pregnancy-induced hypertension—including gestational hypertension and preeclampsia—is associated with increased prevalence of markers of metabolic syndrome as well as a higher lifetime risk of heart disease. In one study of nearly 2,700 women with prior gestational hypertension or preeclampsia and an average age of 31 years, the conditions were shown to be associated with increased systolic and diastolic blood pressure, as well as higher body mass index, waist-hip ratio, and other metabolic syndrome markers, compared with a reference population.

PCOS, which affects more than 5% of women of reproductive age, also appears to be associated with risk for metabolic syndrome. Since it presents so early, it may be the first identifiable sign predicting metabolic syndrome, Dr. Franks said.

The definitions of metabolic syndrome vary from study to study, so it is difficult to say just how common metabolic syndrome is in those with PCOS, but one review article suggests the prevalence is about 50% among obese women with PCOS, he said.

Obesity, which is already established as a marker for metabolic syndrome, also appears to act as an amplifier of other etiologic factors, including pregnancy-induced hypertension and PCOS.

Furthermore, at least one study showed that PCOS patients who are obese in their teen years and who remain obese in adulthood have an even greater risk of developing metabolic syndrome.

A fundamental abnormality seen in obese PCOS patients is increased insulin resistance and higher insulin levels, compared with age- and weight-matched controls. In the normal population, as body mass index increases insulin levels also increase, but in PCOS this curve is steeper. In one study of more than 300 women with an average age of 57 years and a history of PCOS, the risk of diabetes was increased nearly threefold compared with controls.

Estimates of PCOS prevalence in young women range from 10% to 40% and the relationship between PCOS and obesity suggests the prevalence is set to increase.

"Adults are getting fatter, children are getting fatter, and obese children become obese adults," Dr. Franks said.

But there is hope, because even modest reductions in weight with caloric restriction and exercise is proven to modify a woman's risk profile, he said.

Young women with PCOS or pregnancy-induced hypertension—particularly those who are obese—should be identified as being at risk for metabolic syndrome, and interventions should be initiated.

"Diet and lifestyle [changes], however difficult they are to implement, undoubtedly work and are the treatment of choice," he said. ■

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