

Hyperlipasemia in Diabetic Ketoacidosis

Ajaydas T. Manikkan, MD, MPH

CASE PRESENTATION

A 48-year-old man presented to our institution with intractable nausea and vomiting. His symptoms had evolved over the past 24 hours. He did not complain of fever, abdominal pain, diarrhea, or constipation. His medical history was significant for type 2 diabetes of 5 years' duration. The patient was supposed to be taking NPH/regular insulin, 25 units subcutaneously, twice daily. He was not on any oral antihyperglycemics. He had not been taking his insulin for a week because he ran out of medical insurance coverage. He denied alcohol use.

On admission, he was tachycardic, but his other vital signs were normal. His BMI was 22.6 kg/m². His abdomen was soft, nontender, and nondistended, and there was no evidence of abdominal organomegaly. The remainder of his systemic examination was normal.

Preliminary blood work revealed an elevated white blood cell count of 11,900/mm³ without a left shift. His chemistry panel was significant for a sodium level of 127 mEq/L, potassium level of 2.8 mEq/L, and bicarbonate level of 6 mEq/L. His anion gap was elevated at 24. His blood glucose level was 589 mg/dl, and urine ketones were present (33 mg/dl). His A1C, when checked 2 months before admission, was 9.1%.

Although he had no abdominal pain or tenderness, his lipase level was elevated and peaked at 1,423 U/L (normal range 5–55 U/L). At

this point, it was thought that his diabetic ketoacidosis (DKA) was precipitated by acute pancreatitis and missed insulin doses. He had an undetectable blood alcohol level and normal calcium (8.7 mg/dl), transaminase (aspartate aminotransferase 35 U/L, alanine aminotransferase 42 U/L), and triglyceride levels (142 mg/dl).

An ultrasound of the abdomen did not reveal any gallstones. To further evaluate the hyperlipasemia, the patient had a computed tomography (CT) scan of the abdomen, but it did not show any evidence of pancreatic inflammation.

QUESTIONS

1. What is the mechanism of DKA in acute pancreatitis?
2. Can DKA cause acute pancreatitis?
3. Can lipase levels be elevated in DKA without pancreatitis?

COMMENTARY

DKA is a common complication among patients with diabetes that occurs when there is an absolute or relative deficiency in insulin. It can also be the initial presentation of the disease. Although more common among patients with type 1 diabetes, it can also occur in patients with type 2 diabetes.

Acute pancreatitis can be a precipitating factor for DKA in patients with diabetes. Several hormonal derangements contribute to the hyperglycemia. There is a significant drop in insulin production because

of the pancreatic damage.¹ Acute pancreatitis is associated with an increase in glucagon levels.^{1,2} Finally, the elevated levels of glucose counterregulatory hormones such as cortisol, catecholamines, and growth hormone³ may not be counterbalanced because of the decreased insulin levels. In addition, a state of ketosis is induced by acute pancreatitis.³ Besides the lipolytic effect of decreased insulin,¹ the elevated lipase level causes breakdown of local adipose tissue.³

DKA, on the other hand, has also been reported to cause acute pancreatitis. The exact mechanism is unclear. In a study by Nair et al.,⁴ 11% of the patients with DKA developed acute pancreatitis. Of the 11 patients with acute pancreatitis, 4 had hypertriglyceridemia (triglyceride levels > 500 mg/dl), 4 had no identifiable etiology, and 3 had other causes (alcohol, drugs) more likely to cause acute pancreatitis. Based on their observations, the authors concluded that hypertriglyceridemia induced by the DKA might be responsible for pancreatic inflammation in some cases. The acidotic state itself might contribute to pancreatic cell injury.⁵ In the same study,⁴ acute pancreatitis was more likely to occur among patients with a lower pH and higher anion gap.

Because > 95% of serum lipase comes from the pancreas, as opposed to 40–50% of amylase, lipase is considered a more specific marker for pancreatitis.⁴ Elevation

of lipase to levels more than three times the upper limit of normal is considered diagnostic of acute pancreatitis.⁶ However, in a study by Yadav et al.,⁶ lipase elevations without CT evidence of pancreatitis were noted in 24% (36/150) of DKA cases. Lipase levels were less than three times normal in 15.3% (23/150) of the cases and more than three times normal in 8.7% (13/150) of the cases. Nonspecific elevation of lipase levels was noted to be more common than nonspecific elevation of amylase levels (16.6%) in this study.⁶

The cause for the hyperlipasemia in the setting of DKA is unclear, but some possibilities suggested are its accumulation secondary to suboptimal excretion in the urine,⁷ release of nonpancreatic lipolytic enzymes,⁸ and immunological injury to pancreatic acinar cells.⁹ Hyperlipasemia by itself may not be sufficient for diagnosing acute pancreatitis in this setting.⁶

Back to the presented case, the hyperlipasemia that accompanied the DKA was not secondary to acute pancreatitis. A diagnosis of acute pancreatitis is made based on the presence of abdominal pain, elevation in serum amylase or lipase levels greater than three times normal, and characteristic findings on CT scan.¹⁰

Two out of the three criteria need to be met for diagnosis.¹⁰ Because this patient did not have abdominal pain or CT findings of pancreatitis, the hyperlipasemia was nonspecific and secondary to the DKA. The lipase level declined to normal levels with resolution of the DKA.

CLINICAL PEARLS

- Elevations in amylase and lipase levels greater than three times normal may accompany DKA in 16–25% of cases.
- Hyperlipasemia alone or in combination with hyperamylasemia may not be sufficient to make a diagnosis of acute pancreatitis in patients with DKA.
- DKA causes acute pancreatitis in 10–15% cases. If patients complain of abdominal pain, it should not be assumed that the pain is the result of DKA.

REFERENCES

- ¹Drew SI, Joffe B, Vinik A, Seftel H, Singer F: The first 24 hours of acute pancreatitis: changes in biochemical and endocrine homeostasis in patients with pancreatitis compared with those in control subjects undergoing stress for reasons other than pancreatitis. *Am J Med* 64:795–803, 1978
- ²Donowitz M, Hendler R, Spiro HM, Binder HJ, Felig P: Glucagon secretion in acute and chronic pancreatitis. *Ann Intern Med* 83:778–781, 1975
- ³Kabadi UM: Pancreatic ketoacidosis: ketonemia associated with acute pancreatitis. *Postgrad Med J* 71:32–35, 1995

⁴Nair S, Yadav D, Pitchumoni CS: Association of diabetic ketoacidosis and acute pancreatitis: observations in 100 consecutive episodes of DKA. *Am J Gastroenterol* 95:2795–2800, 2000

⁵Maclean D, Murison J, Griffiths PD: Acute pancreatitis and diabetic ketoacidosis in accidental hypothermia and hypothermic myxoedema. *BMJ* 4:757–761, 1973

⁶Yadav D, Nair S, Norkus EP, Pitchumoni CS: Nonspecific hyperamylasemia and hyperlipasemia in diabetic ketoacidosis: incidence and correlation with biochemical abnormalities. *Am J Gastroenterol* 95:3123–3128, 2000

⁷Owen OE, Licht JH, Sapir DG: Renal function and effects of partial rehydration during diabetic ketoacidosis. *Diabetes* 30:510–518, 1981

⁸Frank B, Gottlieb K: Amylase normal, lipase elevated: is it pancreatitis? *Am J Gastroenterol* 94:463–469, 1999

⁹Semakula C, Vandewalle CL, Van Schravendijk CF, Sodoyez JC, Schuit FC, Foriers A, Falorni A, Craen M, Decraene P, Pipeleers DG, Gorus FK: Abnormal circulating pancreatic enzyme activities in more than twenty five percent of recent-onset insulin-dependent diabetic patients: association of hyperlipasemia with high titre islet-cell antibodies. *Pancreas* 12:321–333, 1996

¹⁰Banks PA, Freeman ML; Practice Parameters Committee of the American College of Gastroenterology: Practice guidelines in acute pancreatitis. *Am J Gastroenterol* 101:2379–2400, 2006

Ajaydas T. Manikkan, MD, MPH, is an attending hospitalist at Delnor Community Hospital in Geneva, Ill. At the time he treated the patient in this case, he was an internal medicine resident at John H. Stroger Hospital of Cook County in Chicago, Ill.