

Diabetic Ketoacidosis



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KEYWORDS

• Diabetic ketoacidosis • Hyperglycemic crisis • Ketonemia • Insulin deficiency

HOSPITAL MEDICINE CLINICS CHECKLIST

1. The defining features of diabetic ketoacidosis (DKA) are metabolic acidosis, ketonemia, and hyperglycemia.
2. The most common precipitating factors of DKA are acute medical illness (infection), nonadherence to insulin therapy, new onset diabetes, and medications that interfere with carbohydrate metabolism.
3. DKA can also occur in a subset of patients with ketosis-prone type 2 diabetes.
4. DKA occurs when the combination of insulin deficiency and increase of counterregulatory hormones causes release of free fatty acids from adipose tissue as the body is unable to use glucose. These free fatty acids are subsequently oxidized in the liver to ketone bodies, which results in metabolic acidosis.
5. The diagnostic criteria for DKA include acidosis, low serum bicarbonate, increased anion gap, ketonemia, and ketonuria.
6. Treatment of DKA includes intravenous fluid resuscitation, correction of hyperglycemia and ketoacidosis with insulin, management of electrolyte abnormalities, and the treatment of any precipitating causes of DKA.
7. Implementation of standardized protocols to treat DKA can improve outcomes and potentially reduce hospital length of stay.

DEFINITION

What are the defining clinical features of diabetic ketoacidosis?

The most important clinical features of diabetic ketoacidosis (DKA) are:

- Metabolic acidosis
- Hyperglycemia
- Ketonemia

DKA can range from mild to severe depending on the degree of metabolic acidosis and the presence of altered mental status.^{1,2}

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Hosp Med Clin 3 (2014) 556–566

<http://dx.doi.org/10.1016/j.ehmc.2014.06.007>

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How does DKA differ from hyperglycemic hyperosmolar state?

Both DKA and hyperglycemic hyperosmolar state (HHS) are severe complications of uncontrolled diabetes and are life-threatening. There can be some overlap between these two syndromes in about one-third of patients.³ HHS typically involves a greater severity of hyperglycemia and dehydration than DKA. HHS is defined by the presence of hyperosmolality, altered mental status, and the absence of significant ketosis.¹

EPIDEMIOLOGY

How common is DKA?

The incidence of DKA varies widely worldwide.⁴ In the United States, the number of hospital discharges with DKA listed as the first diagnosis has been trending up. The incidence was reported by the National Diabetes Surveillance Program of the Centers for Disease Control and Prevention as 140,000 in 2009.⁵

PATHOPHYSIOLOGY

What is the mechanism for the development of DKA?

DKA occurs in the setting of reduced or absent insulin concentrations in addition to increased levels of counter-regulatory hormones such as catecholamines, cortisol, glucagon, and growth hormone.³

This imbalance leads to lipolysis, or the release of free fatty acids from adipose tissue. In the setting of impaired carbohydrate use caused by insulin deficiency, the fatty acids are oxidized in the liver into ketone bodies (primarily acetoacetate and beta-hydroxybutyrate), which results in ketonemia and metabolic acidosis.³

Hyperglycemia is caused by increased gluconeogenesis and glycogenolysis and decreased use by peripheral tissues.¹

How does this differ from the development of HHS?

In HHS there is enough insulin present to prevent unrestrained free fatty acid oxidation and thus prevent ketonemia and metabolic acidosis.¹

As glucose levels continue to increase in HHS, there is a marked osmotic diuresis resulting in severe dehydration with typical total body water deficits of 7 to 12 L. Elderly patients with impaired thirst mechanism or reduced access to water are particularly at risk.³

What are the precipitating factors that can lead to DKA?

- Underlying medical illness¹
 - Infection: often pneumonia or urinary tract infection
 - Ischemic events such as myocardial infarction or cerebrovascular accident
 - Acute pancreatitis
- Discontinuation of usual insulin therapy³
 - Noncompliance with medication
 - Poor patient education regarding diabetes management
 - Intentional discontinuation of insulin in patients with eating disorders because insulin causes weight gain¹

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