Summer 2020

Hyperosmolar Hyperglycemic State

Justin Momeyer
Otterbein University, justin.momeyer@otterbein.edu

Hyperosmolar Hyperglycemic State

Justin Momeyer, RN, BSN, CCRN
Otterbein University, Westerville, Ohio

Introduction

Hyperosmolar hyperglycemic state (HHS) is a complication of diabetes. HHS is an insidious pathologic process that can take days to weeks to develop. HHS is life threatening and requires careful management in the acute care setting.

Why HHS?

- Diabetes is highly prevalent disease in the United States, and its complications can lead to life threatening pathologic processes.
- HHS requires early identification in order to prevent worsening patient scenarios.
- There are similarities between HHS and DKA, but both require different levels of treatment.
- It is important to distinguish the differences between DKA and HHS so that nurses and providers can treat appropriately.
- It is crucial to educate patients on appropriate diabetes management to avoid complication such as HHS.
- Without appropriate recognition and management, HHS can lead to complications like hypoglycemia, hypokalemia, cerebral edema, rhabdomyolysis, and even death (Fayfman, 2019)
- Mortality rate ranges from 10% - 50% (much higher than DKA – 1.2%-9%) (Stoner, 2017)

Case Study

A 24-year-old male is brought into the ER for worsening lethargy and polyuria. Lab values for the patient revealed hypernatremia, hyperglycemia (1572 mg/dl), elevated creatinine (5.29 mg/dl), low bicarbonate (13 mmol/L), and elevated anion gap (27 meq/L) indicating anion gap metabolic acidosis. The patient also had a serum osmolality of 395 mmol/kg indicating hyperosmolar hyperglycemic state.

In the ER the patient was aggressively rehydrated with IV fluids and electrolyte replacement. CT scan of the abdomen indicated pancreatitis. The patient was admitted to the ICU and treated with the standard protocol for DKA. Once the patient's acidosis had resolved, and the anion gap had closed the patient was transitioned to a normal insulin scale.

The patient eventually became anuric and his kidney function continued to worsen. The patient required hemodialysis. Eventually a CPK level was sent, which revealed a level of 129,940 IU/L – indicating rhabdomyolysis.

The patient was treated high rates of IV fluids and continued hemodialysis to decrease his CPK level.

The patient would end up requiring 2 months of intermittent hemodialysis and developed chronic kidney disease stage 2.

(Amin, 2018)

Pathophysiology

- Elevated levels of glucagon, catecholamines, cortisol, and growth hormone initiate HHS – leading to hyperglycemia, intracellular water depletion, and osmotic diuresis (Stoner, 2017).
- Glycosuria causes loss of water over sodium, which results in hyperosmolality and dehydration (Stoner, 2017).
- Insulin levels are high enough to prevent lipolysis/ketogenesis (which would be seen in DKA) (Stoner, 2017).

Causes and Risk Factors

HHS can be precipitated by:
- infections, medications, undiagnosed diabetes, and substance abuse.
- Infections are leading cause (57%)

(Stoner, 2017)

Signs and Symptoms

Dehydration signs:
- Poor tissue turgor, sunken eyeballs, cool extremities, cracked/dry lips

Mental State
- Range from lucid to disorientation to coma.
- Seizures can occur

Other
- polyuria, abdominal distension, low grade fever

(Stoner, 2017)

DKA vs HHS

Variables	DKA	HHS
Mental Status	Alert	Stupor, coma
Anion gap	> 12	Variable
Arterial pH	<7.35	>7.30
Serum Osmolality	variable	> 320
Plasma glucose	> 250	> 600
Serum bicarbonate	< 20	> 15
Urine or serum ketones	positive	Trace or negative

(Stoner, 2017)

Insulin production via the pancreas. Retrieved from endocrineweb.com/conditions/type-1-diabetes/what-insulin

Complications

- Acute renal failure
- Rhabdomyolysis
- Coma
- Malignant hyperthermia syndrome (children)

(Stoner, 2017)

Significance of Pathophysiology

- Hyperosmolality in HHS is a contributing factor to decreased LOC (Dhatariya, 2017).
- Lack of ketones in urine or serum is distinguishing factor between DKA and HHS (Dhatariya, 2017)
- Acute dehydration worsens kidney function, leading to acute renal failure, which can further lead to rhabdomyolysis in some patients (Stoner, 2017).
- Patient with HHS have enough insulin production to prevent ketosis and worsening levels of metabolic acidosis compared to DKA (Fayfman, 2017).
- Pathophysiology of DKA vs HHS requires similar but different treatment priorities for each (Fayfman, 2017).

https://www.cartoonstock.com/directory/i/iv.asp

Implications for Nursing Care

- Diagnostic testing with using laboratory blood testing is imperative in determining pathology and distinguishing difference between DKA and HHS. Nurses should understand what lab tests are being ordered and ensure timely blood draws for these patients.
- Nurses should understand treatment protocols to ensure proper patient placement within the hospital (almost always in the intensive care unit).
- Nurses should understand the what kind of treatment is required for patients. IV rehydration, electrolyte management, IV insulin administration, and management of complications are the priority treatment modalities for these patients (Stoner, 2017). If not in place, nurses should be asking questions and advocating for patients.
- These patients require education at discharge, and nurses should understand the complications of diabetes like DKA and HHS – so that they can be explained to patients.

Conclusions

In conclusion, hyperosmolar hyperglycemic state is a high mortality complication of diabetes. The differences between HHS and DKA should be understood by nurses, especially in intensive care units. Early recognition of symptoms, diagnosis, and treatment is required to prevent worsening complications. The similarities between HHS and DKA often are confused, and this poster should help bring to light the differences. Complications of HHS can lead to chronic issues for patients and it is crucial for these patients to be managed appropriately in the acute care setting.

References

OTTERBEIN UNIVERSITY