



## **The Value of Osmolality Testing in Emergency Medicine**

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**Abstract:** The purpose of this note is to detail my experience and opinions regarding the utility of osmolality testing in an emergency department setting. I hope to inform practitioners about the uses of this important laboratory test in the emergency management of patients with diabetes, as well as several other conditions.

Osmolality serves as a marker for multiple disease states, notably hyperglycemic, hyperosmolar state (HHS), ingestion of toxic alcohols, and hyponatremia. Typically, when an osmolality test is not ordered, it is because the physician failed to consider these life-threatening conditions, which can lead to errors in patient care.

Early in my career as an emergency physician, I saw an elderly nursing home resident with altered mental status and infected urine; a “bread and butter” case. I admitted her to the inpatient service for IV antibiotics and rehydration, with presumed UTI and encephalopathy. Additionally, she had a serum glucose greater than 800, so I put her on sliding scale insulin. She was not seen again until the following day, when the admitting physician found her in profound septic shock with refractory hypotension. I learned my lesson from this case: she was in HHS secondary to UTI. She should have received aggressive fluid resuscitation (1 liter an hour of NS for 2-4 hours, followed by 500 cc’s an hour). Had I thought of the diagnosis, I would have ordered a serum osmolality, and I would have learned the patient was hyperosmolar, critically ill, and in need of aggressive resuscitation.

The most common reason I order a serum osmolality is for patients with significant hyperglycemia (glucose > 600) and signs of dehydration, to rule out HHS. Another emergent indication to check serum osmolality is in cases of suspected toxic alcohol ingestion (ethanol, methanol, ethylene glycol or polyethylene glycol) in patients with altered mental status and/or lactic acidosis. Hospitals do not have the capability to test emergently for toxic alcohols (using gas chromatography), so it is investigated by measuring the osmolal gap (measured osmolality – calculated osmolality). Elevation means the patient has ingested an osmotically-active toxin. Finally, osmolality can be important in differentiating causes of hyponatremia. Both serum and urine osmolality is used to define hypovolemic hyponatremia (i.e., from dehydration) vs. euvolemic hyponatremia (i.e., SIADH).

The results of osmolality testing are crucial to the management of patients with the above disease entities. In patients with hyperglycemia, HHS is treated with rapid and substantial fluid resuscitation, while DKA (diabetic ketoacidosis) is typically treated with an insulin drip. Left untreated, HHS has a mortality of 20%, 100 times that of DKA. Toxic alcohol ingestion can cause life-threatening multi-organ failure. Serum osmolality is the test of choice, and once evidence of ingestion (by increased osmolal gap) is detected, there is an antidote (Fomepizole) which is 100% effective if given in time. Hypovolemic hyponatremia is typically caused by dehydration, and is treated with IV fluids. Euvolemic and hypervolemic hyponatremia has multiple causes, most commonly SIADH (Serum of Inappropriate ADH secretion) and CHF (Congestive heart failure) and fluid restriction is the mainstay of treatment. The serum and urine osmolality are used to differentiate the various causes of hyponatremia as well.

Typically, if a patient is diagnosed with HHS, it leads to an infectious workup. Approximately 60% of cases are caused by infection. Pneumonia is most common, and UTI’s are also quite frequent. Thus, chest x-ray and urinalysis are important adjunct tests. Serum electrolytes and



renal function play a pivotal role in managing these patients. The fluids given and rate often needs to be adjusted to account for any complex fluid or electrolyte problems. Myocardial schema can also lead to HHS, so an ECG and troponin is useful.

The one thing most of the above patients have in common is altered mental status. In my opinion, most patients with altered mental status of unknown etiology should have a serum osmolality ordered. It serves as a “poor man’s screen” and essentially rules out toxic alcohol ingestion. These ingestions need to be treated urgently, as organ failure is often imminent. It provides a rapid diagnosis of the hyperosmolar hyperglycemic state in diabetic patients. And it provides clues to the underlying diagnosis in patients with severe hyponatremia, who may present with seizures and AMS.

As an emergency practitioner, osmolality is not a lab test I order on every patient, but it is a “can’t miss” test in cases of hyperglycemia, altered mental status, and hyponatremia.

**References:**

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