GUIDELINES FOR THE MANAGEMENT OF HYPERGLYCEMIC HYPEROSMOLAR STATE (HHS)

(non-ketotic hyperosmolar coma)[1-5]
Updated 3/05/05

Table 1.

Typical laboratory values in a patient with HHS
Effective serum osmolality > 320 mOsm/kg
Glucose > 600 mg/dL
Serum bicarbonate > 15 mmol/L
Serum ketones none or trace
Urine ketones none or trace
PH>7.27 VBG or >7.3 ABG

Effective osmolality: 2 x ([Na] + [K]) + glucose (mg/dL)/18

*Since urea is freely diffusible across cell membranes, it does not alter the effective serum osmolality, which is the clinically important factor to consider in HHS.

IV fluids

- Assume 10-15% dehydration (about 7-12 L in an adolescent)
- Give 10-20 cc/kg/hr of 0.9% NaCl (normal saline = isotonic saline) (usually 1-1.5 L over 1-2 hours in an adolescent) or more if a patient is hemodynamically unstable
- Do not exceed 50 ml/kg over the first 4 h of therapy
- Do not give insulin bolus
- Subtract boluses from the total fluid deficit and replace the fluid deficit evenly over 48 hours plus maintenance

  e.g. For a 70 kg patient
  10.5 L water deficit – 2 L boluses = 8.5 L deficit
  8.5 L divided by 48 hours = 177 cc/hr to correct deficit
  Plus maintenance 104 cc/hr
  Total rate 177 cc + 104 cc = 281 cc/hr

- After initial bolus/boluses of NS, use 0.45%-0.9% NaCl. The goal is to lower serum osmolality very slowly. Even NS is hypotonic relative to serum in patients with HHS (Table 2).
- Add 5% or 10% dextrose to control decrease in blood glucose (BG) of 50-100 mg/dL/hr after the initial bolus (usually D5 is started when BG < 350, and D10 when BG < 250). NaCl should be at 0.45% (1/2 NS) once dextrose is added.

Table 2.

Intravenous fluid	Sodium (mEq/L)	Osmolality (mOsm/kg)
NS (0.9% NaCl)	154	300
D5 (5% dextrose in water)	0	252
D5 NS	154	560
D5 1/2NS	77	406

Potassium in IV fluids

- Once renal function is assured and serum K < 5 mEq/L, add 20-30 mEq/L potassium (2/3 KCl and 1/3 KPO_4)
- If K < 2.5 mEq/L, administer 1 mEq/kg of KCl in IV over 1 hour
- If K 2.5-3.5 mEq/L, administer 40-60 mEq/L potassium in Iv solution
- If K 3.5-5.0 mEq/L, administer 30-40 mEq/L potassium in Iv solution

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- If K > 5 mEq/L, do not give potassium

Na bicarbonate

- Only if pH < 7.0 after initial hour of hydration; give $NaHCO_3$ 1-2 mEq/kg over 1 hour, added to NaCl to produce a solution that does not exceed 155 mEq/L of Na.

Insulin drip

- If initial K < 3.5 mEq/L, hold insulin
- Start at 0.05 u/kg/hr after the initial boluses of NS (after the initial 2 hours of hydration)
- Increase to 0.1 u/kg/hr if needed

  *Patients with HHS are more sensitive to insulin than patients in DKA

  *Both glucose and Na determine effective serum osmolality; it may be prudent to lower glucose first, then sodium.

Initial labs

- HgbA1C
- Islet cell antibodies, GAD65 antibodies, Insulin antibodies
- ABG or VBG
- Electrolytes (Na, K, Cl), bicarb, Ca, Mg, P, BUN, creatinine
- Amylase, lipase if the patient has severe abdominal pain
- CPK
- Urine tox screen, urinalysis
- Serum osmolality
- Coags: INR, PTT, fibrinogen activity, D dimer

Follow-up labs during the acute phase of the illness

- ABG or VBG q 3 hours
- Serum osmolality q 2 hours
- Glucose hourly
- Electrolytes, bicarb, BUN, creatinine q 2 hours
- Monitor input/output hourly
- Ca, P, Mg q 4 hours
- Amylase, lipase q 12 hours if the patient is symptomatic
- CPK q 12 hours or if blood is present in the urine
- Coags q 12 hours or more frequently if abnormal at baseline
- Urinalysis q day

Goals of management

- BG decrease by 50-75 mg/dL/hr to a range of 100-180 mg/dL
- Effective serum osmolality decrease by no more than 3 mOsm/kg/hr

Watch for

- Change in mental status (patient may require intubation in case of impending respiratory failure)
- Hyperthermia
- Rhabdomyolysis
- Vascular thrombosis
- Multisystem failure (cardiac failure, pulmonary edema, renal failure)
- Mortality may be as high as 50%

REREFENCES

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