

Hyperosmolar Hyperglycemic Non-Ketotic Syndrome (HHNS)

Case Study Instructor Guide – 2007

Review HHNS Order Set:

- IV Fluids-change to D5 _ NS at 250 mg/dL
- Review steps 1 and 2 and algorithms for insulin
- Target range of 250-300 mg/dL
- Decrease blood glucose by 50-70 mg/dl/hr
- Do not start insulin infusion until Serum Potassium level is ≥ 3.3 mEq/L

Gladys is a 71 year old, Caucasian American female, 58 kg, transported to the ED from a long-term care facility where she was placed post hip fracture and ORIF for rehabilitation. The patient displayed altered mental status, dehydration, incontinence, and fever precipitating the transfer. A diagnosis of hyperosmolar hyperglycemic non-ketotic syndrome was made and the patient was admitted to MICU.

Past medical history included Type II Diabetes Mellitus of 17 years duration, treated with medical nutrition therapy and oral hypoglycemic agents; hypertension; hyperlipidemia; and Stage 3 nephropathy.

Following admission to the ICU, it was noted that Gladys seemed to have weakness on her left side, and was having difficulty speaking.

Gladys' assessment:

- Poor skin turgor
- Skin dry and warm
- Decreased alertness, disoriented
- Weakness on left side
- Difficulty speaking, aphasia
- Lungs with rhonchi
- Sinus tachycardia
- Hypotension
- BP 90/58
- HR 128 bpm
- RR 32/minute
- T 102.8 F (oral)

Labs:

Hgb	10.8 gm/dl	Hct	36%
Bicarbonate	19 mEq/L	Creatinine	2.2 mg/dl
Na	122 mmol/L	BUN	39 mg/dl
K	3.9 mmol/L	Glucose	780 mg/dl
Cl	97 mmol/L	A _{1c}	8.2%
Phos	3.3 mmol/L	Serum osmolality	340 mOsm/kg
Ca	8.1 mmol/L		

ABGs on 50% FM

PH	7.5
PaO ₂	100 mm Hg
PaCO ₂	20 mm Hg
HCO ₃	7.7 mmol/L
SaO ₂	98% on 2 L

Urine

Spec grav	1.034
Ketones	4+
Leukocytes	Few
Glucose	4+
RBCs	many

Home medications:

- Metformin 500 mg PO BID
- Rosiglitazone 4 mg PO daily
- Lipitor 10 mg PO at HS
- Lisinopril 10 mg PO daily
- ASA 81 mg PO daily

1. Discuss the physiology of HHNS.

Relative insulin deficiency + increase in insulin antagonist hormones (glucagon, cortisol, catecholamines, growth hormone) + increased insulin resistance leads to:

- Less glucose uptake by cells
- Protein catabolism
- Diuresis
- Mild ketonemia/ketonuria possible

2. List the classic signs and symptoms of HHNS.

- Polyuria
- Polydipsia
- Weakness
- Warm, dry skin
- Rubor
- Hypernea
- Weight loss
- Anorexia
- Visual disturbances
- Tachycardia
- Hypotension
- Dehydration
- Decreased mentation
- Focal neurological signs such as hemisensory deficits, hemiparesis, aphasia and seizures

3. Discuss the lab values:

Chemistry

Hct – elevated from dehydration typically; note this pt has renal disease and a low Hgb

Na – low; overall body depletion

K – in low normal range now; could change rapidly

Cr/BUN – elevated; can be related to profound diuresis and dehydration; need to know patient baseline as she has renal insufficiency

A_{1C} – elevated, less than optimal glycemic control

Glucose – diagnostic range for HHNS

ABGs

Not acidotic; bicarb is very low, related to renal

Urinalysis

Dilute urine

Glucosuria present

Ketones in urine-starvation related, not related to acidosis; need a serum value

RBC's-high; diuresis and renal status

4. What are the potential precipitating factors for HHNS in general and specifically for Gladys?

- Age (71)
- Infections, MI, GI bleeds, uremia, arterial thrombosis (Gladys has rhonchi, need chest film to r/o pneumonia)
- Stress (Recent fracture, surgery, long-term care stay)
- Massive fluid loss from prolonged osmotic diuresis
- Hypertonic feedings such as prolonged parenteral nutrition via IV infusion, high protein or gastric tube feedings
- Pharmacologic agents such as thiazides, propranolol, phenytoin. Steroids, furosemide, and chlorthalidone

5. Utilizing the HHNS protocol, how do you initiate insulin management for Gladys?

Insulin Bolus $0.15 \text{ units} \times 58 \text{ kg} = 8.7 \text{ units of insulin}$

Hour of Infusion	Blood Glucose	Insulin Infusion Rate	Glucose Change
1	780	6 units/hr	
2	741	Move to algorithm 2; 12 units/hr	39 mg/dl
3	718	Move to algorithm 3; 16 units/hr	23 mg/dl
4	659	Move to algorithm 4; 28 units/hr	59 mg/dl
5	590	No change; 28 units/hr	69 mg/dl
6	520	No change; 28 units/hr	70 mg/dl
7	429	No change, but observe closely; significant rate of fall.	91 mg/dl
8	371	No change; still at 28 units/hr in Algorithm 4.	58 mg/dl
11	339	No change; 28 units/hr.	32 mg/dl
12	274	Decrease drip to 20 units/hr; Algorithm 4.	65 mg/dl
13	247	Decrease drip to 16 units/hr, Algorithm 4. IV fluid changed to D5 NS	27 mg/dl
14	258	No change; remain in algorithm 4 as patient was not below 250 mg/dl X 2 consecutively.	11 mg/dl increase

7. Discuss other treatments that would be initiated.
 - Rehydration with IV fluids-expansion of intra and extracellular fluid and restoration of
 - Renal perfusion. NS 1 liter over 1 hour for initial replacement. Fluids then replaced
 - According to hypovolemic shock or mild hypotension, based on serum sodium corrected, as well as on potassium level.
 - Electrolyte replacement
 - Remember insulin drives potassium intracellularly; potassium can be low, then normal or elevated.
 - Treat concurrent illness. If pneumonia confirmed, MD will initiate antibiotic therapy.
8. List the potential complications associated with HHNS.
 - Hypoglycemia
 - Hyperglycemia
 - Hypokalemia
 - Cerebral edema
 - Pulmonary edema