

# HYPERGLYCAEMIC HYPEROSMOLAR NON-KETOTIC COMA

*HHS (or HONK)* represents a syndrome of acute diabetic decompensation characterised by marked hyperglycaemia, hyperosmolarity & dehydration with associated decreased mental functioning (that can progress to frank coma).

- Ketosis & acidosis are generally minimal or absent.
- Focal neurological signs are common.
- DKA and HHS can occur together.

## Pathophysiology.

The exact pathophysiology will vary from patient to patient, however most HHS patients are elderly & a contributing factor is declining renal function (& associated decreased renal clearance of glucose).

- Decreased insulin action.
  - Gluconeogenesis, glycogenolysis, reduced peripheral glucose uptake.
- Fluid shift (intracellular space --> extracellular space).
- Profound osmotic diuresis.
  - Extremely *hypotonic*.
  - Urine  $\text{Na}^+$  = 50-70mmol/L
- Diuresis leads to profound dehydration.
  - Hyperglycaemia
  - Hypernatraemia (w/ assoc. hypertonicity).
- Compounded by inadequate fluid intake (stroke, Alzheimer's, etc...)
- Ketone formation limited by lower levels of circulating FFA's.

### BOX 124-8 PRECIPITANTS OF HYPERGLYCEMIC HYPEROSMOLAR NONKETOTIC COMA

#### External Insult

Trauma  
Burns  
Dialysis  
Hyperalimentation

#### Disease Process

Cushing's syndrome and other endocrinopathies  
Hemorrhage  
Myocardial infarction  
Renal disease  
Subdural hematoma  
Cerebrovascular accident  
Infection  
Down syndrome

#### Drugs

Antimetabolites  
L-Asparaginase  
Chlorpromazine  
Chlorpropamide  
Cimetidine  
Diazoxide  
Didanosine  
Ethacrynic acid  
Furosemide  
Glucocorticoids  
Immunosuppressants  
Olanzapine and other atypical antipsychotics  
Phenytoin  
Propranolol  
Thiazides

### **Clinical Features.**

The prodrome is significantly longer than for DKA.

Extreme dehydration, hyperosmolality, volume depletion (up to 24% fluid deficit) & CNS findings predominate.

Fever, thirst, polyuria or oliguria are commonly found symptoms.

Up to 20% will have no prior Hx of T2DM.

There may be evidence of the precipitating/underlying cause.

Neurological symptoms are varied & include; seizures (generalised or focal), stroke or hemiplegia, choreoathetosis, ballismus, dysphagia, myoclonus, hemianopsia, nystagmus, visual hallucination & acute quadriplegia.

### **Diagnostic Strategies.**

- Blood Glucose: > 30mmol/L
  - Ketones < 3mmol/L.
  - pH > 7.30 or HCO<sub>3</sub> > 15mmol/L
- Serum Osmolarity: > 320-350 mOsmol/L

$$\text{Calc. Osmolarity} = 2 \times [\text{Na}^+] + \text{urea} + \text{glucose} + \text{EtOH.}$$

- Elevated urea/creatinine.
- Deranged electrolytes (particularly Na<sup>+</sup>).
  - Potassium, phosphate, magnesium (may seem elevated but there is generally a whole body deficit).

$$\text{Corrected Sodium} = \text{measured Na}^+ + [\text{glucose}/3]$$

### **Differential Diagnosis.**

Identical to that of DKA.

- Alcohol vs starvation ketoacidosis.
- DDx of HAGMA & raised osmolar gaps (toxic alcohols).
- Water intoxication w/ dilutional hyponatraemia.
- DDx of stroke/coma/altered mental state.

### ***Characteristic features of a person with HHS:***

Hypovolaemia

+

Marked hyperglycaemia (>30 mmol/L) without significant hyperketonaemia (<3.0 mmol/L) or acidosis (pH>7.3, bicarbonate >15 mmol/L)

+

Osmolality >320 mosmol/kg

## Management.

### General Measures.

- The approach to the patient w/ severe DKA is the same as any patient in extremis.
- ABCD approach.
- Obtunded & vomiting, requires airway protection.
- Hypovolaemic shock requires aggressive fluid resuscitation.
- Identify & treat the precipitating illness.

### Dehydration.

- **GOAL:** Expansion of intravascular volume & extravascular volume, plus restore peripheral perfusion
- **0.9% Saline (or Hartmann's) is appropriate.**
  - Normal Saline is already *hypotonic* relative to patients serum.
  - 1st liter over 1st hour, 2nd liter over next 2-4 hours, as a rough guide.
  - Aim 3-6 liters in first 12 hours.
  - Treat more aggressively if patient is in shock !!
- *Hypotonic fluid (0.45% saline)* may be required if osmolality is not declining despite adequate positive fluid balance.
- **Serum sodium levels *should not fall > 10mmol in 24 hours !!***
- Cautious administration to avoid fluid overload.
- **Glucose should be added to IV fluids when serum levels drop to 15-16mmol/L.**
  - Aim to control glucose drop by < 5mmol/hr.

**Table 1 – Typical fluid and electrolyte losses in HHS (Kitabachi 2009)**

		For 60 kg patient	For 100 kg patient
Water	100-220 ml/kg	6-13 litres	10-22 litres
Na+	5-13 mmol/kg	300-780 mmol	500-1300 mmol
Cl-	5-15 mmol/kg	300-900 mmol	500-1500 mmol
K+	4-6 mmol/kg	240-360 mmol	400-600 mmol

### Electrolytes.

- *as per management for DKA.*

### Insulin.

- *as per DKA management.*
- Start after volume resuscitation commences.
- Infusion @ 0.05 - 0.1 units/kg/hr.
  - May need to increase to 5 units/kg/hr.
- No bolus.

### Other Considerations.

- Vigorous search for underlying precipitant.
- If seizures occur; phenytoin is contraindicated.
  - May impair endogenous insulin release.
- DVT prophylaxis is crucial.
  - Volume depletion, hyperviscosity etc.
- Foot ulcer prevention / Pressure area care.

### Complications.

- Cerebral oedema / pontine myelinolysis.
- Cardiac failure/ischaemia.
- Renal failure.

Identify HHNC, then treatment is the same as initial DKA treatment.

1. Supplement insulin.  
 $\pm$  Bolus: 0.05–0.1 U/kg regular insulin IV  
 Maintenance: 0.05–0.1 U/kg regular insulin IV  
**Caution:** Serum glucose rapidly corrects with fluid administration alone; monitor glucose to avoid hypoglycemia.  
 Change IV solution to D<sub>5</sub>W 0.45% NS when glucose  $\leq$  300 mg/dL.
2. Rehydrate.  
 Rapid administration of 2–3 L NS over first several hours  
 CVP monitoring may be necessary in patients with history of heart disease.  
 Correct one half of fluid deficit in first 8 hours, remainder over 24 hours.
3. Correct electrolyte abnormalities.  
 Sodium  
 Correct with administration of NS and 0.45% NS.  
 Potassium  
 First ensure adequate renal function.  
 Add 20–40 mEq KCl to each liter of fluid.  
 Phosphorus  
 Usually unnecessary to replenish  
 Magnesium  
 Correct with 1–2 g MgSO<sub>4</sub> (in first 2 L if magnesium is low).
4. Correct acidosis.  
 Add 44–88 mEq/L to first liter of IV fluids *only* if pH  $\leq$  7.0.  
 Correct to pH 7.1.
5. Search for and correct underlying precipitant.
6. Monitor progress and keep meticulous flow sheets.  
 Vital signs  
 Fluid intake and urine output  
 Serum glucose, K<sup>+</sup>, Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup>, CO<sub>2</sub>, pH, ketones  
 Amount of insulin administered
7. Admit to hospital or intensive care unit.

### Disposition.

All patients presenting to ED with a diagnosis of HSS/HONK should be admitted for further treatment.

The presence of one or more of the following should indicate admission to HDU.

- Osmolality > 350 mosmol/kg.
- Sodium > 160mmol/L
- pH < 7.10
- Hypokalaemia (< 3.5mmol/L) or Hyperkalaemia (> 6mmol/L)
- GCS < 12.
- Oxygen Saturations < 92% (on room air)
- Systolic BP < 90mmHg.
- Pulse > 100/min or < 60/min.
- Urine Output < 0.5 mL/kg/hr
- Creatinine > 200.
- Hypothermia.
- Macrovascular complication (ACS, CVA)