Clinical Practice Guidelines: Management of Type 2 Diabetes Mellitus (5th Edition) 2015

Management of diabetic emergencies: Hyperglycaemic Hyperosmolar State
Hyperglycaemic Hyperosmolar State (HHS)

- Prompt diagnosis is important.

- Intensive management in high-dependency units or equivalent level of care.

- Common presentation in the young adults and elderly with multiple comorbidities.

- Higher mortality than DKA.
Hyperglycaemic Hyperosmolar State (HHS)

- Common: vascular complications such as myocardial infarction, stroke or peripheral arterial thrombosis.
- Uncommon: seizures, cerebral oedema and osmotic demyelination syndrome.
- Rapid changes in osmolality during treatment may also be the precipitant of osmotic demyelination syndrome.
- Progresses over many days → dehydration and metabolic disturbances are more extreme
Diagnostic Criteria of HHS

- Hypovolaemia
- Marked hyperglycaemia (BG >30 mmol/L)
- Osmolality >320 mosmol/kg
Other Important Clinical Features

- There is **NO** significant hyperketonaemia (<3.0 mmol/L) or acidosis (pH >7.3, bicarbonate >15 mmol/L).

- When acidosis is present, causes of acidosis such as lactic acid and toxicology screen need to be investigated.

- The presence of **acute cognitive impairment** may be associated with:
  - cerebral oedema in severe cases or
  - significant electrolyte disturbances,
  - hyperosmolality (>330 mosmol/kg),
  - sudden drop in osmolality,
  - severe dehydration,
  - infection and sepsis,
  - hypoglycaemia during treatment
  - renal failure.
Dehydration in HHS

• Clinical features of dehydration in the patient with HHS can be deceptive and may not be reflective of the seriousness of the fluid depletion.

• This is because hypertonicity leads to preservation of intravascular volume, causing movement of water from intracellular to extracellular space.
Precipitating Factors For HHS

a) Infections and sepsis
b) Thrombotic stroke
c) Intracranial haemorrhage
d) Silent myocardial infarction
e) Pulmonary embolism
Management

The goals of treatment of HHS are to treat the underlying cause as well as to gradually and safely:

• Normalise the osmolality
• Replace fluid and electrolyte losses
• Normalise blood glucose
• Prevention of complications
PROTOCOL FOR MANAGEMENT OF ADULTS PATIENTS WITH HYPERGLYCAEMIC HYPEROSMOLAR STATE (HHS)

**Initial evaluation:** After history and physical examination, obtain arterial or venous blood gases, full blood count, urinalysis, plasma glucose, renal profile, liver profile STAT as well as an ECG. Chest X-ray and cultures as needed. Start IV fl uid: 1000 mL of 0.9% saline per hour initially.

**Diagnostic Criteria:** Blood glucose >33.3 mmol/L, blood pH >7.3, bicarbonate >15 mmol/L, mild ketonuria or ketonaemia and efective serum osmolality >320 mOsm/kg H₂O.*

---

**IV Fluids**

- Determine hydration status
  - Hypovolemic shock
    - Administer 0.9% NaCl (1000 mL/hr) and/or plasma expanders
  - Mild hypotension
  - Cardiogenic shock
  - Haemodynamic Monitoring

- Evaluate Corrected Serum Na**
  - Serum Na high
  - Serum Na normal
  - Serum Na low

- 0.45% saline (4-14 mL/kg/hr) depending on state of hydration, 0.9% saline (4-14 mL/kg/hr) depending on state of hydration

- When serum glucose reaches 14.0 mmol/L
  - Change to 5% dextrose and decrease insulin to 0.05 U/kg/hr or 10% dextrose with insulin rate of 0.1 U/kg/hr to maintain serum glucose between 8-12 mmol/L

**Insulin**

- 0.05 U/kg/hour IV insulin infusion
  - Check serum glucose hourly. If serum glucose does not fall by at least 3.0 mmol/L in first hour, double insulin dose hourly until glucose falls at a steady hourly rate of 3-4 mmol/L.

**Potassium**

- If serum K is <3.5 mmol/L, give 40 mEq K/hr until K ≥3.3 mmol/L.

- If serum K ≥5.0 mmol/L, do not give K but check potassium q2h.

- If serum K ≥3.3 but <5.0 mmol/L, give 20-30 mmol/L K in each litre of IV fluid to keep serum K at 4–5 mmol/L.

---

* Effective serum osmolality (SI units) = 2Na⁺ + 2K⁺ + Glucose + Urea (all in mmol/L)

** Serum Na⁺ should be corrected for hyperglycaemia. Corrected serum Na⁺ (SI units) = Measured serum Na⁺ + [(Glucose measured - 5.6) / 5.6] x 2.4 (all in mmol/L)
What is the immediate management?

- **Hydration:** Intravenous (IV) 0.9% saline solution.

- Monitor serum osmolality regularly - prevent harmful rapid changes in osmolality.

- The rate of rehydration - assessing the combination of initial severity and any pre-existing comorbidities. Rapid rehydration - heart failure. Insufficient rehydration - fail to reverse acute kidney injury.

- An initial rise in sodium is expected and is not in itself an indication for hypotonic fluids. Thereafter, the rate of fall of plasma sodium should not exceed 10 mmol/L in 24 hours.
What is the immediate management?

• The fall in blood glucose should be no more than 5 mmol/L/hr.

• Low dose IV insulin (0.05 units/kg/hr) commenced once blood glucose is no longer falling with IV fluids alone or immediately if there is significant ketonaemia (β-hydroxy butyrate >3 mmol/L).

• Prophylactic low molecular weight heparin (LMWH) is recommended unless contraindicated.

• Electrolytes: Hyperkalaemia, hypokalaemia, hypophosphataemia and hypomagnesaemia are common and should be corrected accordingly.
What is the immediate management?

• In acutely ill patients, pyrexia may not be present. If sepsis is highly suspicious, the source of infection should be sought and treated.

• Discharge planning includes diabetes education, dietitian referral, education on medication and insulin administration (if patient is on insulin) to reduce the risk of recurrence and prevent long-term complications.