The Shrewsbury and Telford Hospital NHS Trust

Management of Hyperglycaemic Hyperosmolar State (Previously known as HONK – Hyperglycaemiac Hyperosmolar Non Ketotic Coma)

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Definition and Diagnosis

HHS is a diabetic emergency less common but potentially more severe than DKA (diabetic keto-acidosis) with a mortality of 15-20%. HHS and DKA are different conditions and their management is different. They can coexist; if this happens the treatment pathway followed should be the one for the condition which dominates clinically.

The characteristic features of HHS are:

(1) dehydration with hypovolaemia

(2) hyperglycaemia (usually 30 mmol/L or more) without significant hyperketonaemia (capillary ketones usually <3.0 mmol/L, urinary ketones ++ or less) and without significant acidosis (pH>7.3, bicarbonate>15 mmol/L)

(3) high osmolality, usually 320 molsm/L or more

Clinical features

HHS occurs typically in the elderly but it is increasingly occurring in young adults and teenagers.

HHS can be the initial presentation of type 2 diabetes.

The onset of HHS is insidious over days.

HHS can be precipitated by sepsis, myocardial infarction and any other acute illness.

Patients can have acute impairment in cognitive function but this is not specific for HHS and is not necessarily present. Severe, life-threatening metabolic disturbances can be seen in patients with relatively normal cognitive function.

On examination, the patients may not look as dehydrated as they are because the hypertonicity leads to preservation of intravascular volume and water is lost mainly from the intracellular compartment.

HHS is associated with an increased risk of venous and arterial thromboembolism (including myocardial infarction and stroke) which can persist for up to 3 months after discharge.

HHS can be complicated by seizures, cerebral oedema and central pontine myelinolysis. These are probably due to rapid changes in osmolality during treatment.

Goals of Treatment

(1) Treat the underlying cause
(2) Gradually and safely
normalise osmolality
replace fluid and electrolyte losses
normalise blood glucose
(3) Prevent:
arterial and venous thrombosis
cerebral oedema/central pontine myelinolysis
foot ulcers

Management

REFER TO THE DIABETES TEAM AS SOON AS PRACTICALLY POSSIBLE

Patients with HHS are complex and require frequent monitoring; admission to HDU should be considered in all cases.

INITIAL INVESTIGATIONS:
- capillary glucose and ketones
- urine dipstick and culture if indicated
- venous blood gas for electrolytes, pH, bicarbonate and lactate
- venous blood for glucose, urea and electrolytes, CRP, osmolality, full blood count and blood cultures
- ECG
- CXR

Calculate osmolality based on the formula
Osm = 2Na + Glucose + urea

INITIAL MANAGEMENT

(1) Fluids

Start iv 0.9% NaCl solution, 1 litre over 1 hour
faster if SBP<90 mmol/l
slower if there is a risk of precipitating heart failure (be particularly careful in the elderly)

An initial rise in Na is expected and is not in itself an indication for hypotonic fluids as long as the osmolality is declining. If the osmolality is not declining, check the fluid balance and if the balance is not positive, increase the rate of the iv 0.9% NaCl solution. If the osmolality is still not declining, change to 0.45% NaCl solution

(2) Glucose

With the iv fluid replacement, glucose is expected to fall and it is essential to start iv fluids as soon as possible.

Start iv insulin at 0.05 IU/kg/hr (half the rate used in DKA) as soon as the iv fluids are running. For example, in a 60kg adult, the correct insulin starting dose is 3 units/hour and in a 100kg adult the rate should be 5 units/hour. If unsure about the weight of the patient, do not delay starting the insulin and start at 3 units/hour.

Aim for a fall in glucose of a maximum of 5 mmol/L/hr.

Monitor the capillary glucose hourly.

(3) Potassium replacement

- if K>5.5 mmol/L, do not add any potassium to the iv fluids
- if K is 3.5 to 5.5 mmol/l add 40 mmol KCl/L iv fluid given
- if K<3.5 senior review as additional K required

(4) Prevention of venous thromboembolism

Start subcutaneous low molecular weight heparin (unless clearly contraindicated) in the standard VTE prevention dose straightaway.

These patients have a high thromboembolic risk, therefore if there is clinical suspicion of venous thromboembolism or of acute coronary syndrome, start therapeutic dose low molecular weight heparin straightaway.

MONITORING AND FURTHER MANAGEMENT

Use existing trust fluid balance charts and the chart attached at the end of this document to monitor Na, glucose and osmolality.

(1) Fluid balance

Insert urinary catheter and monitor hourly urine output - aim for a minimum output of 0.5 mls/kg/hr.

Continue to give 0.5-1 litres fluid per hour depending on response. Aim for a positive fluid balance of 2-3 litres by 6 hours and a positive balance of 3-6 litres by 12 hours.

Total fluid deficit in patients with HHS is usually estimated at 100-200 mls/kg (which means 6-12 litres in a 60 kg patient or 10-20 litres in a 100kg patient). The aim is to achieve an adequate fluid balance by 24-72 hours.

(2) Osmolality

Aim for a decline of 3-8 mosm/kg/hr.

If rate of decline is lower than this, check fluid balance. If positive balance inadequate, increase the rate of the infusion. If positive balance adequate, consider changing to 0.45% NaCl solution at the same rate.

If rate of decline is above 8 mosm/kg/hr, consider reducing the infusion rate of iv fluids and of insulin.

Repeat laboratory urea and electrolyte levels every 4-6 hours in the first 24 hours.

(3) Sodium

Monitor hourly in the first 6 hours (you can use the blood gas analyser for this). Afterwards, if the patient is improving, monitoring can be decreased to every two hours and later to every 4 hours.

Aim for a maximum drop of 10 mEq/l Na over 24 hours.

Remember that the profound metabolic abnormalities have developed over days and normalisation of electrolytes and, in particular, sodium and osmolarity, will also take days.

(4) Glucose

Aim for a fall in glucose of a maximum of 5 mmol/L/hr. Aim for a glucose of 10-15 mmol/L in the first 24 hours

If blood glucose not falling, check fluid balance
- if positive balance inadequate, increase the rate of 0.9% NaCl
- if positive balance adequate, increase the rate of insulin by 1 unit/hour

Adjust iv insulin rate in 1unit/hr increments and decrements as necessary

If glucose falls below 14 mmol/L, change the iv fluids to 4%Dextrose with 0.18% NaCl (dextrose-saline solution)

(5) Potassium

- if K>5.5 mmol/L, do not add any potassium to the iv fluids
- if K is 3.5 to 5.5 mmol/l ad 40 mmol KCl/L iv fluid given
- if K <3.5 senior review as additional K may be required

Remember that the maximum rate of hourly iv KCl infusion outside ITU is 10 mmol/hour, which means that a litre of Normal Saline with 40 mmol KCl can only be given over 4 hours. If necessary, run in parallel a bag of Normal Saline with KCl together with a bag of fluids without KCl in order to achieve the desired iv fluid rate.

(6) Foot protection

Assess feet at presentation. These patients are at high risk of ulceration and pressure areas should be protected. Re-examine feet daily.

(7) Long term management

IV insulin should be discontinued and the patient should be started on subcutaneous insulin as soon as the patient is eating and drinking. IV fluids are likely to be required for longer, especially if oral intake is not adequate.

Some patients, particularly those with previously undiagnosed diabetes will eventually be managed by diet or oral hypoglycaemic agents. However, they will need a period of glycaemic stability of weeks or months before this switch is attempted.

REMEMBER TO REFER THE PATIENT TO THE DIABETES TEAM AS SOON AS PRACTICALLY POSSIBLE

HHS monitoring chart for the first 24 hours form initiation of treatment

Remember:
Aim for a **maximum** Na drop of 10 mEq/l in the first 24 hours (mark the target on the chart)
Aim for a fall in glucose of maximum 5 mmol/l/hour
Aim for a decline in osmolality of 3-8 mosm/kg/hour

Calculate osmolality based on the formula:
Osm=2Na+Glucose+urea
Use the most recent urea value available when calculating osmolality

Mark your Na target at 24 hours on the chart