The management of the hyperosmolar hyperglycaemic state (HHS) in adults with diabetes

Joint British Diabetes Societies
Inpatient Care Group

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Initial Care Pathway only (pages 25-27)
For use as ESH ED intranet resource
Full text available from
http://www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_HHS_Adults.pdf
HHS care pathway

The Hyperglycaemic Hyperosmolar State (HHS) is a medical emergency. In the UK it is less common than diabetic ketoacidosis (DKA), though in areas with a high proportion of patients of African origin this may not be the case. HHS is associated with a significant morbidity and higher mortality than DKA and must be diagnosed promptly and managed intensively. The diabetes specialist team should be involved as soon as possible after admission.

For young people under the age of 16 years contact your paediatric diabetes service and refer to published paediatric guidelines for the management of HHS such as those by Zeitler (2011).

**Diagnosis**

The characteristic features of a person with HHS are:

- Hypovolaemia
- Marked hyperglycaemia (30 mmol/L or more) without significant hyperketonaemia (less than 3 mmol/L), ketonuria (2+ or less) or acidosis (pH greater than 7.3, bicarbonate greater than 15 mmol/L)
- Osmolality usually 320 mosmol/kg or more

N.B. A mixed picture of HHS and DKA may occur

**Assessment of severity**

Patients with HHS are complex and often have multiple co-morbidities so require intensive monitoring. Consider the need for admission to a high-dependency unit / level 2 environment, when one or more of the following are present:

- Osmolality greater than 350 mosmol/kg
- Sodium above 160 mmol/L
- Venous/arterial pH below 7.1
- Hypokalaemia (less than 3.5 mmol/L) or hyperkalaemia (greater than 6 mmol/L) on admission
- Glasgow Coma Scale (GCS) less than 12 or abnormal
- AVPU (Alert, Voice, Pain, Unresponsive) scale
- Oxygen saturation below 92% on air (assuming normal baseline respiratory function)
- Systolic blood pressure below 90 mmHg
- Pulse over 100 or below 60 bpm
- Urine output less than 0.5 ml/kg/hr
- Serum creatinine >200 μmol/L
- Hypothermia
- Macrovascular event such as myocardial infarction or stroke
- Other serious co-morbidity.
Goals of treatment

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

• normalise the osmolality
• replace fluid and electrolyte losses
• normalise blood glucose.

Other goals include prevention of:

• arterial or venous thrombosis
• other potential complications e.g. cerebral oedema/ central pontine myelinolysis
• foot ulceration.

New principles

• Measure or calculate osmolality (2Na \(^+\) + glucose + urea) frequently to monitor treatment response.

• Use IV 0.9% sodium chloride solution as the principle fluid to restore circulating volume and reverse dehydration. Only switch to 0.45% sodium chloride solution if the osmolality is not declining despite adequate positive fluid balance.

• 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.

• The fall in blood glucose should be no more than 5 mmol/L/hr. Low dose IV insulin (0.05 units/kg/hr) should be commenced once the blood glucose is no longer falling with IV fluids alone OR immediately if there is significant ketonaemia (3-β-hydroxy butyrate greater than 1 mmol/L).

• Assess foot risk score on admission.

A. Hour 1: Immediate management upon diagnosis: 0 to 60 minutes

T=0 at time intravenous fluids are commenced. If there is a problem with intravenous access critical care support should be requested immediately.

• Commence IV 0.9% sodium chloride – 1 litre to run over 1 hour
  o Consider more rapid replacement if SBP below 90 mmHg
  o Caution in the elderly where too rapid rehydration may precipitate heart failure but insufficient may fail to reverse acute kidney injury

• Only commence insulin infusion (0.05 units/kg/hr) IF there is significant ketonaemia (3-β-hydroxy butyrate greater than 1 mmol/L) or ketonuria 2+ or more (i.e. mixed DKA and HHS)

• Clinical assessment of the patient:
  o Does the history suggest sepsis/vascular event or a recent change in medication?
  o Assess the degree of dehydration
  o Examine for a source of sepsis or evidence of vascular event
  o Mental state assessment

Care Pathway hours 0-6 only, Full Text available from http://www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_HHS_Adults.pdf
• Assess foot risk score – assume high risk if patient obtunded or uncooperative
  - Ensure heels are off-loaded
  - Ensure daily foot checks

• Investigations
  - Capillary BG
  - Venous plasma BG
  - Urea and electrolytes
  - Measured or calculated osmolality (2Na+ glucose + urea)
  - Venous blood gas
  - Blood ketones and lactate
  - Full blood count
  - Blood cultures
  - ECG
  - CXR
  - Urinalysis and culture
  - CRP (if indicated)

• Establish monitoring regime appropriate to patient – generally hourly blood glucose (BG), Na+, K+, urea and calculated osmolality (2Na+ glucose + urea) for the first 6 hours then 2 hourly if response satisfactory (a fall of 3-8 mosmol/kg/hr).
  - Chart osmolality / glucose / sodium
  - Continuous pulse oximetry
  - Consider continuous cardiac monitoring

• Insert urinary catheter to monitor hourly urine output and calculate fluid balance.
• Ensure early senior review and/or inform specialist diabetes team
• Commence prophylactic LMWH
• Consider IV antibiotics if sepsis identified or suspected

**B. 60 minutes to 6 hours**

Aims

• To achieve a gradual decline in osmolality (3-8 mosmol/kg/hr)
  - Using 0.9% normal saline aim to give a further 0.5 – 1 L/hr depending on clinical assessment of dehydration / risk of precipitating heart failure and fluid balance (target is to achieve positive fluid balance of 2-3 L by 6 hours)
  - Measure glucose, urea and electrolytes hourly and calculate osmolality (2Na+ glucose + urea)
    n If plasma Na+ increasing but osmolality declining at appropriate rate, continue 0.9% sodium chloride