Hyperglycaemic Hyperosmolar State (HHS) Guidance Document (applicable to A+E and acute assessment units)

AFFIX PATIENT LABEL

Date _____
Time _____
Ward _____

1.Diagnosis

a. Hypovolaemia
b. Osmolality usually greater than 320 mOsm/kg
c. Marked hyperglycaemia (usually greater than 30 mmol/L)
If significant ketosis (capillary greater than 3 mmol/L, urine greater than 2+) or acidosis (H^+ greater than 45 mmol/L; $HCO3^-$ <15 mmol/L) present treat as per the Diabetic Ketoacidosis (DKA) protocol

2. Initial assessment

a. Patients weight (estimated if measurement not possible) _____ Kg
b. Estimate fluid loss = weight (Kg) /10 _____ L
c. Calculate plasma osmolality = (2 x Na^+) + Glucose + Urea _____ mOsmol/kg

3. Key aspects to good care

- Repeated clinical and biochemical assessment is ESSENTIAL
- The patient's ability to tolerate shifts in fluid balance if co-existing cardiac or renal disease must be taken into consideration
- Assess if any markers of severity present (SEE APPENDIX 1).
- INFORM THE ON-CALL DIABETES TEAM (via switchboard)

4. Key treatment goals

- Osmolality reducing by 3-8 mOsm/kg per hour
- Plasma glucose reducing by 1-5 mmol/L per hour aiming for a target range of 10 – 15 mmol/L
- Fluid replacement aims:
  - achieve positive fluid balance of 2 – 3 L by 6 hours
  - achieve positive fluid balance of 50% of the estimated fluid loss within 12 -24hours and 100% estimated fluid loss by 24-48 hrs
  - ALWAYS adapt fluid replacement to clinical assessment and presence of co-morbidities

Hour 1: assessment and treatment

Assessment:

1. Perform clinical assessment and necessary investigations as determined by the clinical picture e.g. ECG/Sepsis screen/foot examination
2. Measure capillary glucose, capillary or urinary ketones, U&Es, venous blood gas, lactate, calculated osmolality
3. Consider catheterisation to allow accurate fluid balance measurement

Treatment:

1. Commence IV 0.9% Sodium Chloride – 1L over 1 hour
2. Commence insulin (Actrapid 0.05 units/kg/hour intravenously) **ONLY IF** significant ketonaemia (plasma ketones greater than 1 mmol/L or urinary ketones greater than 2+)
3. Commence prophylactic LMWH unless contraindicated (patients are at high risk of thromboembolic disease)
4. Treat any identified precipitant – eg infection, stroke, acute coronary syndrome

Hours 1-6 of treatment

Aim for a gradual decline in osmolality (3-8 mOsmol/kg/hour) and achieve positive fluid balance 2 – 3 L by 6 hours

1. Measure glucose, U&Es and calculate osmolality as per timings on flow sheet (page 3)
2. Monitor urine output
3. Adjust fluid administration based on clinical assessment and measurement of osmolality
4. Potassium replacement (SEE APPENDIX 2).

If by 6 hours:

1. Osmolality falling less than desired rate (3-8 mOsmol/kg/hour)
   - If dehydrated clinically increase the IV fluid rate per hour
   - If patient in positive balance of >3L, commence IV insulin (Actrapid)at 0.05 units/kg/hour
2. Glucose falling less than desired rate (1-5 mmol/L per hours) – commence insulin (Actrapid) Aim to keep glucose between 10 – 15 mmol/L
3. Glucose falls below 14 mmol/L - commence 10% dextrose at 125ml/hr in addition to current fluids (ensure that this additional fluid is taken into consideration for other infusion rates)

Aim to achieve positive fluid balance of 50% estimated fluid loss within 12-24 hours & 100% estimated fluid loss by 24-48 hrs

NB Plasma sodium concentration may increase as glucose concentrations fall. Fluid management should be based on change in osmolality not purely on alterations in Sodium concentration.

If sodium level continues to rise despite adequate fluid replacement (as above) call on-call diabetes team for consideration alternative fluid replacement e.g. 0.45% Sodium Chloride

Continuing care

Consider and treat precipitating cause e.g. sepsis, stroke, myocardial infarction, limb ischaemia
Monitor for cerebral oedema
Assess for arterial venous thrombosis/pressure ulcers/ foot ulceration
Continue regular biochemical and clinical evaluation of hydration status

Appendix 1: Markers of severity

If 2 or more present discuss with senior medical staff and if appropriate consider discussion with critical care:

- *Osmolality > 350 mOsmol/kg*
- *H+ > 80 mmol/L*
- *GCS <12*
- *Systolic BP <90 mmHg*
- *Urine output < 0.5ml/kg/hr*
- *Hypothermia*
- *Sodium > 160 mmol/L*
- *Potassium < 3.5 mmol/L or 6.0 mmol/L*
- *Oxygen saturations < 92% (if normal at baseline)*
- *Creatinine > 200 µmol/L*
- *Macrovascular or other serious co-morbidity*

Appendix 2: Potassium (K^+) replacement

If K+ above 5.5 mmol/L - no additional KCL
If K+ between 3.5 and 5.5 mmol/L – prescribe 40 mmol KCL per litre of infusion fluid
If K+ below 3.5 mmol/L - seek senior advice as additional potassium is required

Ensure that the hourly rate of potassium administration is considered with rapid infusion rates

Guidance document prepared by A. Anderson, R. Gifford, S. Ritchie March 2017, review date March 2020
In accordance with guidelines as set out by JBDS *The management of the hyperosmolar hyperglycaemic state (HHS) in adults with diabetes* August 2012

AFFIX PATIENT LABEL

HHS Monitoring chart (admission to 24 hours):
This chart is designed to chart biochemistry and fluid balance to assess the response to treatment and aid ongoing management. There are checkpoints at 6, 12 and 24 hours for medical assessment of the overall clinical picture.

Date / /		Biochemistry					Fluid balance		
Hour	Time	Na^+ (mmol/L)	K^+ (mmol/L)	Glucose (mmol/L)	Urea (mmol/L)	Calculated Osmolality (see foot note below)	Fluid in (ml)	Fluid out (ml)	Fluid balance
0									
1									
2									
3									
4									
6									
Assess patient – Is patient clinically improving? Assess fluid balance – has positive balance of 2-3L been achieved? Assess omolality – is this reducing by 3-8 mOsmol/kg per hour?									
8									
10									
12									
Assess patient – Is patient clinically improving? Assess fluid balance – has desired positive balance been achieved? Assess omolality – is this reducing by 3-8 mOsmol/kg per hour?									
16									
20									
24									

Footnote: Calculated osmolality = (2x Na^+) + glucose + urea