CATS Clinical Guideline

Diabetic ketoacidosis

1. Assessment

Diagnosis requires a combination of hyperglycaemia, acidosis & ketosis. If all three features are not present then an alternative diagnosis should be considered such as: Lactic acidosis, inborn error of metabolism, alcoholic ketoacidosis, salicylate poisoning or sepsis.

1.1 History

• Polyuria
• Polydipsia
• New presentation
• Usual insulin regimen
• Any precipitation causes

1.2 Clinical

• Acidotic breathing pattern
• Assess & record level of dehydration so that comparison can be made by others later.
  o Mild, 3% Only just clinically detectable
  o Moderate, 5% Dry mucous membranes, reduced skin turgor
  o Severe, 8% As above + sunken eyes
  o SHOCKED Rapid thready pulse +/- hypotension.

Only if shocked (poor peripheral pulses, tachycardia +/- hypotension) give 10mls/kg 0.9% saline & reassess. Give an absolute maximum of 30mls/kg. Over estimation of degree of dehydration is dangerous. Most improve with administration of insulin.

• Abdominal pain / vomiting
• Level of consciousness
  o Assess the GCS
  o Institute hourly neurological observations whether drowsy on admission or not

1.3 Examination

Look particularly for evidence of

• Infection
• Ileus
• Cerebral oedema
  o Headache / Irritability
  o Reduced level of consciousness
  o Bradycardia & hypertension
Cerebral oedema is the most common cause of mortality.

Risk factors for cerebral oedema include
- Severe hypocapnoea at presentation (<2kPa)
- Younger age
- First presentation
- Elevated serum urea at presentation
- Bicarbonate administration
- Rapid fall in corrected sodium

If suspected discuss with CATS immediately & give 0.5g/kg Mannitol or 3mls/kg 3% saline over 20 mins.

The aim is to slowly correct metabolic abnormalities

1.4 Indications for discussion with CATS
- pH <7.1 with marked hyperventilation
- Severe dehydration with shock
- Depressed level of consciousness
- Headache
- Age <2yrs

2. Resuscitation
2.1 Airway & Breathing
- Ensure airway patent
- Intubation is rarely necessary. Hyperventilation is a normal compensatory mechanism for metabolic acidosis
- Give 100% oxygen via face mask
- Insert NGT & leave on free drainage

2.2 Circulation
- Insert 2 IV cannulae
- Take blood samples
  - Blood glucose
  - U&Es (can use electrolytes on blood gas until available)
  - Blood gas (venous gives similar values to arterial)
  - Blood ketones if possible (superior to urine ketones)
  - FBC / BC if sepsis suspected
- Cardiac monitor (peaked T waves with hyperkalaemia)
- Do not use capillary refill as an indicator for fluid bolus administration
  - Hypocarbia causes peripheral vasoconstriction
- Only if shocked (tachycardic, poor peripheral pulses +/- hypotension) give 10mls/kg 0.9% saline as a bolus. Assess effect carefully, repeat if indicated - absolute maximum 30ml/kg total bolus
• Over estimation of dehydration is dangerous
• Do not give bicarbonate.

3. Management

3.1 Insulin
• There is some evidence that cerebral oedema is associated with early insulin administration.
• Start insulin at 0.1 units/kg/hr no later than 1hr after starting IV fluids
• Once blood glucose <14mmol/l ADD 5% glucose to IV fluids
• If blood glucose falls to <4mmol/l give 2mls/kg 10% glucose & increase glucose content of IV fluids to 10%.
• Aim to not reduce the blood glucose faster than 5mmols/hr
• Insulin infusion rate can be temporarily reduced (for 1hr) but should be continued at 0.1 units/kg/hr to switch off ketogenesis.
• Once pH >7.3 & blood glucose <14mmol/l infusion rate can be reduced to 0.05 units/kg/hr

3.2 Fluids

Requirement = (Maintenance + Deficit (replace over 48hrs)) – fluid volume already given

Maintenance requirements

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Rate (ml/kg/24hrs)</th>
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<tbody>
<tr>
<td>≤ 12.9</td>
<td>80</td>
</tr>
<tr>
<td>13 – 19.9</td>
<td>65</td>
</tr>
<tr>
<td>20 – 34.9</td>
<td>55</td>
</tr>
<tr>
<td>35 – 59.9</td>
<td>45</td>
</tr>
<tr>
<td>≥ 60</td>
<td>35</td>
</tr>
</tbody>
</table>

Deficit (ml) = % dehydration x body weight (kg) x 10

Hourly rate = 48 hr maintenance + deficit – resuscitation fluids given

Example
6yr child weighing 20kg, assessed as shocked with 8% dehydration who received 10mls/kg saline boluses for resuscitation.

Maintenance = 20 x 55 per 24hr (1100mls)
Deficit = 8 x 20 x 10 (1600mls)
Resus = 20 x 10 (200mls)

Hourly rate = \( \frac{(1100 + 1100) + 1600 - 200}{48} \) = 75mls
3.3 Type of fluid
0.9% saline + 20mmol KCL per 500ml
Once blood glucose is < 14mmol/l ADD glucose to this fluid

4. Observations
- Strict fluid balance (catheterize younger patients)
- Hourly capillary blood glucose measurement
- Hourly BP, HR
- Continuous ECG monitoring
- Half hourly (or more frequently) neurological assessment
- 1-2 hrly capillary blood ketones
- 2 – 4hr CBG & U&Es
- Twice daily weights

5. Troubleshooting
If acidosis is not correcting
- Inadequate resuscitation
- Insufficient insulin to switch off ketogenesis
- Hyperchloraemic acidosis
  - If Cl is >80% of Na
  - Base excess due to Cl = Na - Cl – 32
Use corrected sodium to assess adequacy of rehydration.
Corrected Na = Measured Na + (0.4 x serum glucose mmol/l) – 5.5
- If Corrected Na rising >5mmol/l in 4hr – indicates too much fluid loss
  Increase fluid rate by 25%
- If corrected Na falling >5mmol/l in 4hr – indicates too much fluid gain
  Decrease fluid rate by 25%

6. Indication for intubation
- Depressed level of consciousness (assume cerebral oedema) not responding to osmotherapy or if the patient is not protecting their airway.

Intubation & ventilation poses a significant risk with worsening acidosis due an abrupt rise in pCO₂
Ventilate to pre-intubation pCO₂ – this will require sedation & muscle relaxation. Obtain central & arterial access.