NHS Children's Acute Transport Service

Clinical Guidelines

Diabetic Ketoacidosis

Document Control Information

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Document Version	Version 3	**Replaces Version**	June 2013
First Introduced		**Review Schedule**	2 Yearly
Active Date	January 2016	**Next Review**	January 2018
CATS Document Number			
Applicable to	**All CATS employees**		

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
- Usual insulin regimen (if known diabetes)
- Any triggers (eg. Infections, stress)

1.2 Clinical

- Acidotic breathing pattern
- Abdominal pain / vomiting
- Level of consciousness
    - Assess the GCS
    - Institute hourly neurological observations whether drowsy on admission or not
- Assess & record level of dehydration so that comparison can be made by others later.

o Mild/Moderate 5%	pH >7.1 Dry mucous membranes, reduced skin turgor.
o Severe, 10%	pH <7.1 As above + sunken eyes.
o SHOCKED	Rapid thready pulse +/- hypotension.

Do not use capillary refill time alone as an indicator of shock (hypocarbia will cause prolonged capillary refill).

Give a maximum 10ml/kg bolus before discussing with senior doctor. **Give an absolute maximum of 30mls/kg. Over estimation of degree of dehydration is dangerous.** Most improve with administration of insulin.

1.3 Examination

Look particularly for evidence of

- Infection
- Ileus
- **Cerebral oedema**
    - Headache / Irritability
    - Reduced level of consciousness
    - 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 (see later)

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

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 patency
- 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
- Ensure full cardiac monitoring (look for 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, discuss with senior doctor if considering further fluid bolus - **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 0.05 - 0.1 units/kg/hr 1 hour after starting IV fluids.
- Aim to reduce the blood glucose no faster than 5mmols/hr.
- 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%.
- Insulin infusion rate can be temporarily reduced (for 1hr) but should be continued at 0.05 - 0.1 units/kg/hr to switch off ketogenesis.

3.2 Fluids

Requirement = (Maintenance + Deficit (replace over 48hrs)) – any bolus fluid given over the first 20ml/kg

Maintenance requirements (reduced in the August 2015 BSPED guidance)

Weight (kg)	Rate (ml/kg/ 24hrs)
<10 kg	2ml/kg/hour
10-40 kg	1ml/kg/hour
>40kg	40ml per hour

Neonates may require larger volumes.

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

Hourly rate = <u>48 hr maintenance + deficit – resuscitation fluids given over the first 20ml/kg</u>

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<u>Examples</u>

6yr child weighing 20kg, assessed as moderate DKA with pH 7.15, therefore 5% dehydration who received no saline boluses for resuscitation.

Deficit 5% x 20 kg x10	= 1000ml
Divide over 48 hours	= 21ml/hr
Add maintenance at 1ml/kg/hr	= 20ml/hr
Total	**= 41ml/hr**

16 yr child 60kg, assessed as severe DKA, pH 6.9, therefore 10% dehydration with circulatory collapse and received 30ml/kg 0.9% sodium chloride boluses.

Deficit 10% x 60kg x 10	= 6000 ml
Subtract resus fluid over 20ml/kg (10ml/kg)	= -600ml
Divide over 48 hours	= 112.5 ml/hr
Add maintenance at 40ml/hr	= 40 ml/hr
Total	**= 152.5 ml/hr**

3.3 Type of fluid

- 0.9% saline + 20mmol KCL per 500ml (once urine output confirmed).

- Once blood glucose is < 14mmol/l change to glucose containing fluid.

4. Observations

- Strict fluid balance (catheterise younger patients or those with low GCS)
- Hourly capillary blood glucose measurement
- Hourly BP, HR
- Continuous ECG monitoring
- Half hourly (or more frequently) neurological assessment
- 1-2 hourly capillary blood ketones
- 2 – 4 hourly capillary blood gas & U&Es
- Twice daily weights

5. Troubleshooting

Acidosis:

If acidosis is not correcting, consider:

- Inadequate fluid resuscitation
- Insufficient insulin to switch off ketogenesis
- Hyperchloraemic acidosis
    - If Cl is >80% of Na
    - Base excess due to Cl = Na - Cl - 32

Corrected sodium:

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

- Ventilatory failure
- Loss of airway
- Decompensated shock

Intubation & ventilation poses a significant risk with worsening acidosis due an abrupt rise in pCO_2

On ventilation avoid sudden increase in pCO2

7. Main Bibliography

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