



Clinical Guidelines

Diabetic Ketoacidosis

Document Control Information

Author	Philip Knight	Author Position	CATS Consultant
Document Owner	M Clement	Document Owner Position	CATS Operational and Nursing Lead
Document Version	Version 5	Replaces Version	Version 4
First Introduced		Review Schedule	2 Yearly
Active Date	2026	Next Review	2028
Applicable to	All CATS employees		



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, hyperosmolar hyperglycaemic state or sepsis. Although blood glucose is usually high (often >11 mmol/L) DKA can occur with normal glucose (euglycaemic DKA), especially in known diabetes.

Definition for DKA

1. Acidosis pH < 7.3 or HCO_3^- <15mmol/l
2. Ketones > 3.0 mmol/l

History

- Polyuria
- Polydipsia
- Usual insulin regimen (if known diabetes)
- Any triggers (e.g., Infections, stress)

Clinical signs

- Acidotic (Kussmaul) breathing pattern
- Abdominal pain / vomiting
- Level of consciousness
 - Assess the GCS
 - Institute hourly neurological observations
- Clinical dehydration:

Mild (5%)	pH 7.2 - 7.29 or HCO_3^- <15mmol/l
Moderate (5%)	pH 7.1 - 7.19 or HCO_3^- <10mmol/l
Severe (10%)	pH < 7.1 or HCO_3^- <5mmol/l

Examination

Look 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 hypocapnia at presentation (<2kPa)
- Younger age
- First presentation
- Elevated serum urea at presentation
- Bicarbonate administration
- Rapid fall in corrected sodium (see corrected sodium section below)

If suspected discuss with CATS immediately and give:

Hypertonic sodium chloride 2.7% 3mls/kg over 10 – 15 mins

Halve maintenance fluid rates and discuss with paediatric consultant and CATS

Indications for discussion with CATS

- pH <7.1 with marked hyperventilation
- Severe dehydration with shock
- Depressed level of consciousness
- Headache
- Age <2yrs

Resuscitation

Airway & Breathing

- Ensure airway patency.
- Intubation is *rarely* necessary. Hyperventilation is a normal compensatory mechanism for metabolic acidosis.

- Insert NGT (if decreased conscious level or recurrent vomiting) and leave on free drainage.

Circulation

- Insert 2 IV cannula.
- Take blood samples.
 - Blood glucose
 - U&Es & CRP (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 / blood cultures if sepsis suspected.
- Initial fluid bolus:

ALL children with mild, moderate, or severe DKA who are *not* shocked and are felt to require IV fluids should receive 10ml/kg of 0.9% sodium chloride or Plasmalyte 148 over 30 mins. This *should* be subtracted from the total calculated fluid deficit.

- **Shocked patients** (tachycardia, poor peripheral pulses, and prolonged *central* capillary refill time and hypotension) require appropriate restoration of their circulating volume.

An initial 10ml/kg bolus of balanced isotonic crystalloid over 15mins and assess for effect. A further 10ml/kg may be given up to a total of 40mls/kg at which stage vasoactive medications should be considered. This resuscitation fluid *should not* be subtracted from the estimated fluid deficit.

- *Do not use capillary refill as an indicator for fluid bolus administration.*
 - Hypocarbia causes peripheral vasoconstriction and prolonged CRT
- *Do not give bicarbonate.*
- Ensure full cardiac monitoring (look for peaked T waves with hyperkalaemia)

The aim is to slowly correct metabolic abnormalities

Management

Insulin

- There is some evidence that cerebral oedema is associated with early insulin administration.
- Start soluble insulin at 0.05 - 0.1 units/kg/hr 1-2 hours *after* starting IV fluids.
 - Start at 0.05units/kg/hr in patients <5 years of age.
- Defer starting insulin until potassium is >3.0 mmol/L
- 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 3mls/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.
- Continue long-acting insulin in patient already on an established insulin regime.
- Consider starting a subcutaneous, long-acting insulin alongside IV insulin in newly diagnosed T1DM.
- For children and young people on *continuous subcutaneous insulin infusion (CSII) pump therapy*, stop the pump when starting intravenous insulin.

Fluids

Requirement = (Deficit + Maintenance -> replaced over 48hrs) – 10mls/kg given to *NON-Shocked* patient.

Resus fluid given to children in shock *should NOT be subtracted*

Maintenance fluids volumes now to be calculated using the traditional Holiday –Segar formula (BSPED Jan 2020 guidance).

Weight (kg)	Rate (ml/kg/day)
1 st 10 kg	100mls/kg/day
10-20 kg	50mls/kg/day
Each additional kg	20mls/kg/day

Maintenance fluids should be calculated to a max weight 75kg or 97th centile for age (whichever is lower).

Neonates may require larger volumes.

Type of fluid

- 0.9% NaCl + 20mmol KCL per 500ml (once urine output confirmed or lab potassium within normal range)
- PlasmaLyte 148 (additional potassium will need to be added as it only contains 5mmol/l potassium)
- Once blood glucose is < 14mmol/l change to glucose containing fluid
- Calculated deficit replacement fluid must be completed - if tolerating oral fluids before the 48-hr rehydration period is complete, ensure IV rehydration rate is reduced accordingly to account for oral intake.

Observations

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

Troubleshooting

Acidosis:

If acidosis is not correcting, consider:

- Adequate administration of insulin
- Check I.V. access/ orientation of three-way tap
- Consider re-making insulin infusion
- 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:

It is recommended the corrected sodium levels are monitored in the management of DKA to assess adequacy of rehydration.

$$\text{Corrected sodium (mmol/l)} = \text{measured sodium} + \frac{(\text{glucose} - 5.6)}{3.5}$$

- If Corrected Na *RISING* >5mmol/l in 4-8 hr – indicates too much fluid *LOSS*
Consider increasing the fluid rate.
- If corrected Na *FALLING* >5mmol/l in 4-8 hr – indicates too much fluid *GAIN*
Consider reducing the fluid rate.

Potassium:

- Add to fluids once UO confirmed or once lab K within normal range
- If potassium is low on presentation (potassium < 3.0 mmol), it is recommended that starting insulin is deferred until potassium is >3.0 mmol.
- Oral potassium supplements should be considered.
- Insulin infusion may be paused if persistent hypokalaemia (potassium < 3.0 mmol).

Phosphate

- Phosphate and hypophosphataemia: Supplements or replacement are not required unless there is severe hypophosphataemia associated with metabolic encephalopathy, reduced myocardial contractility, myopathy, dysphagia or ileus. Be aware that administration of phosphate can precipitate hypocalcaemia.

Indication for intubation

- Ventilatory failure
- Loss of airway
- Decompensated shock

Discuss with CATS consultant prior to intubation.

Intubation & ventilation poses a significant risk with worsening acidosis due an abrupt rise in pCO₂. This is rarely required.

References

1. **National Institute for Health and Care Excellence (NICE).** *Diabetes (type 1 and type 2) in children and young people: diagnosis and management (NG18)*. London: NICE; 2015. DKA fluid therapy recommendations updated December 2020. Surveillance update noting change in shock bolus volume to 10 mL/kg (October 2022). Guideline last updated 11 May 2023. Available at: <https://www.nice.org.uk/guidance/ng18>
2. **British Society for Paediatric Endocrinology and Diabetes (BSPED).** *Guideline for the management of children and young people under the age of 18 years with diabetic ketoacidosis*. 2021 guideline; last updated 26 November 2024. Available at: <https://www.bsped.org.uk/clinical-resources/bsped-dka-guidelines/>