BC CHILDREN’S HOSPITAL DIABETIC KETOACIDOSIS PROTOCOL
FOR CHILDREN AGES 1 MONTH TO 19 YEARS

THIS PROTOCOL IS ALSO AVAILABLE IN FILLABLE PDF FORMAT

0. ABCs, vital signs (with BP), neurovitals signs. Place large-bore IV. Draw labs. Confirm DKA: plasma glucose (PG) >11 mmol/L, moderate–large ketonuria or β-hydroxybutyrate ≥3.0 mmol/L, and venous pH <7.3 or serum HCO₃⁻ <15 mmol/L.¹⁰ Consider possibility of an element of hyperglycemic hyperosmolar state.¹⁰

1. Measure body weight (BW) in kilograms ............................................ (1) _______ kg

2. Give 0.9% saline (normal saline, NS) resuscitation bolus¹²
   • recommended amount: 10 mL/kg BW over 30 minutes ......................................... (2) _______ mL

3. Repeat with second bolus of NS if persistent tachycardia, prolonged cap refill (>2 sec), cool extremities:
   • recommended amount: 10 mL/kg BW over 30 minutes ......................................... (3) _______ mL

4. Begin rehydration, calculated for even correction over 36 hours, based on admission BW:¹³
   • 5–10 kg BW: 6.5 mL/kg/h
   • 10–20 kg BW: 6 mL/kg/h
   • 20–40 kg BW: 5 mL/kg/h
   • >40 kg BW: 4 mL/kg/h, maximum 250 mL/h ................................................ (4) _______ mL/kg/h

5. Calculate total hourly fluid rate to be given for 36 hours: multiply (1) and (4) ................ (5) _______ mL/h

6. Use NS with KCl 40 mEq/L (Bag A) as initial rehydration fluid, at rate determined in (5), ensuring that patient has voided and has plasma K⁺ <5 mmol/L before adding potassium to the IV fluids.

7. At 60–120 minutes after starting the first fluid bolus, make up and start a piggyback insulin drip at 0.05–0.1 units/kg BW/h (Bag C):¹⁵
   • 50 units insulin regular (Humulin® R or Novolin® Toronto) in 500 mL NS or D10/NS
   • run at 0.5–1 mL/kg BW/h ..................................................................................... (7) _______ mL/h

8. Begin “2-bag method”¹⁶. Y together (Bag A) NS with 40 mEq/L KCl and (Bag B) D10–D12.5/NS with 40 mEq/L KCl. Decrease replacement fluid rate to adjust for insulin drip rate:
   subtract (7) from (5) ..................................................................................................... (8) _______ mL/h

9. Aim to keep PG ~8–12 mmol/L by titrating the rates of these two solutions, keeping the combined rate at (8)¹⁰. Continue this for the next 6–12 hours, monitoring as below.

10. At 4–6 hours after initial fluids and if corrected plasma Na⁺ is ≥145 mmol/L, stable or increasing, switch Bag A to 0.45% saline w/ 40 mEq/L KCl and Bag B to D10–D12.5/0.45% saline w/ 40 mEq/L KCl at the rate as in (8)¹⁰.

Rationale & Notes:
¹²Please note that this protocol is designed as an algorithm for treating the majority of cases of DKA in infants, children and adolescents. It cannot replace careful clinical observation and judgment in treating this potentially very serious condition. If you have questions or problems related to the management of DKA or diabetes, please feel free to contact the BCCH Pediatric Endocrinologist on call.
¹⁰Hyperglycemic hyperosmolar state (HHS) should be suspected when there is significant hyperglycemia (>33 mmol/L) and hyper-osmolality (>330 mOsm/L) without ketosis or acidosis (bicarbonate >15 mmol/L, venous pH >7.3). A mixed picture of DKA and HHS is possible. Mild hyperglycemia, even with ketones and mild acidosis, can often be managed without IV fluids or IV insulin.
¹⁵Rapid, deep mouth-breathing (Kussmaul respiration) often dries out the oral mucosa, making the child appear more dehydrated than s/he really is. The hematocrit and other clinical signs (decreased capillary refill) are more accurate measures of dehydration.
¹⁶Recent research shows that most children with moderate–severe DKA will require a 20 mL/kg resuscitation fluid bolus to restore perfusion, prior to the rehydration phase.
¹⁷Recent research shows that DKA can be safely corrected over a 24– to 48-h period. This protocol is designed to correct a 10% fluid deficit (100 mL/kg) evenly over 36 h.
¹⁸Insulin boluses are always contraindicated. Insulin given in the first 1–2 h of DKA repair is thought to increase mortality. This insulin rate fully inhibits ketogenesis and gluconeogenesis and should be maintained if possible. If unable to keep PG >8 mmol/L, drop the insulin rate by 25–50%.
11. Re-evaluate appropriateness of replacement fluid type frequently, anticipating the need to add or increase Na⁺, K⁺, dextrose, etc.

- dextrose⁵: aim to keep the PG ~8–12 mmol/L range
- sodium⁴: corrected Na⁺ <145 mmol/L, or falling regardless of level:
  - continue NS
  - corrected Na⁺ ≥145, stable or increasing, switch to ½NS after 4–6 h
- potassium¹: patient urinating and K⁺ remains <5: continue KCl 40 mmol/L may give 50% of K⁺ as acetate or phosphate
- bicarbonate⁶: NaHCO₃ is not generally recommended

12. Children with DKA have high risk for acute kidney injury (AKI). Use Schwartz formula to calculate expected baseline creatinine (EBC).¹

13. Close neurological observation and frequent rousing of the child with finger-pokes to detect any changes consistent with cerebral edema. Follow Glasgow Coma Scale. Severe headache, change in sensorium or BP, dilated pupils, bradycardia, irregular breathing, posturing and incontinence are signs of impending deterioration. Rapid intervention is imperative:

- airway / breathing / circulation
- elevate head of bed
- decrease all fluid bags to 5 mL/h pending physician reassessment
- mannitol 20% (0.5–1 g/kg, 2.5–5 mL/kg IV over 15 min) or NaCl 3% (2.5–5 mL/kg IV over 15 min)⁵
- consider intubation and mild hyperventilation (keep pCO₂ >22 mg Hg) for impending respiratory failure
- arrange CT when stable

14. Follow laboratory parameters (use of a flowsheet is highly recommended):

- follow PG by meter every 30–60 min⁶: does child respond to the poke?
- follow Na⁺, K⁺, Cl⁻, HCO₃⁻, anion gap, urea, creatinine, venous pH every 2–4 hours⁴.¹.⁶.⁷.⁸ and P_i every 2–4 hours if giving phosphate⁹
- follow (preferably) plasma β-hydroxybutyrate every 2–4 hours or urine ketones with each void

15. Re-evaluate appropriateness of replacement fluid type frequently, anticipating the need to increase or decrease Na⁺, K⁺, dextrose, etc.