UNMH Pediatric Diabetic Ketoacidosis Pathway – Starting an Insulin Drip

**Guideline Goals:**
- Rapid diagnosis of DKA
- Appropriate use of insulin drip
- Appropriate disposition
- Avoid bicarbonate

**PKCU Criteria**
- *based on first gas*
  - pH < 7.1
  - K+ < 2.5
  - Age < 2 years
  - Profound shock

- Altered Mental Status
- Dysrhythmia
- Intubation
- Cerebral Edema (See Page 5)

Floor patients must have a bed on PSCU/6-East!

**DKA Triage Screening Tool**
- Known or SUSPECTED Type 1 Diabetes Mellitus

**PLUS ONE OF**
- Abdominal Pain
- Altered Mental Status
- Extreme Thirst
- Fatigue
- Frequent Urination
- Kussmaul Breathing
- Respiratory Distress
- Vomiting
- Weight Loss

**Clinician/RN SWARM**
- POC Glucose > 200 AND SWARM concerning for DKA

**Cerebral Edema? Seizure? Shock?**
Critical care strategies on last page

**Triage Level B**
- pH < 7.3 or CO₂ < 15 AND *Ketonuria or Ketonemia*

**Exit Guideline**
- Diabetic NOT in DKA or Alternate Diagnosis

**Repeat POC glucose after 1 hour NS bolus**

**3-Bag System and Starting Rates**
- Bag 1
- Bag 2
- Bag 3

**Physicians**
- *USE DKA POWERPLAN for insulin drip, labs, and TWO bags of IV fluids!*
  - If initial K+ < 2.5 replete K+ before starting insulin drip
  - If glucose drops > 100 in one hour, start IV fluids with dextrose!
  - If on insulin pump, stop insulin pump

**Nurses**
- Use 3-bag system (on right)
  - Finish 1 hour bolus before starting insulin drip
  - If K+ < 2.5, notify MD and hold insulin drip
  - Q15 Neuro checks for first hour on drip
  - Notify MD if glucose drops > 100/hr

**Fluid Rate (FR) = 1.5 x maintenance**

If glucose drops > 100 in one hour, ↑ proportion of fluids running with dextrose

**Electrolyte Disturbances**
- **Hypernatremia**
  - If corrected sodium > 155, consider treatment for hypernatremia

- **Potassium abnormalities**
  - Total body K+ and Phos deficit, initial K+ often falsely elevated secondary to acidosis
  - If K+ ≥5.5 and/or no UOP → NO K+ in initial IVF until K+ <5.5, consider EKG
  - If K+ <5.5 and +UOP → IVF with 40 meq K+
  - If K+ <2.5 → replete K+ and hold insulin drip until K+ > 3 prior to starting insulin drip, consider EKG, admit to PICU

- **Low bicarbonate**
  - Replacement is not recommended except for treatment of life-threatening hyperkalemia or unusually severe acidosis, often refractory, with evidence of compromised cardiac contractility (cardiogenic shock and/or arrhythmia)

**Labs on Insulin Drip**
- Q1 hour POC glucose
- Q4 hour Chem 10
- VBG PRN after first gas
- Urine Ketones Qvoid or Q2hours
UNMH Pediatric Diabetic Ketoacidosis Pathway – Maintaining and Stopping an Insulin Drip

**GOALS ON INSULIN DRIP:**
- Normalization of electrolytes
- Maintain or regain normal neurologic status
- Timely dose of basal insulin (Glargine) on admission for all new onsets. For known insulin dependent diabetics, give home dose of basal insulin at home dosing time. For < 6 years old, call endocrine for dosing recommendation.
- Do NOT stop insulin drip until acidosis has resolved
- Avoid bicarbonate treatment

**ELECTROLYTE DISTURBANCES**

<table>
<thead>
<tr>
<th>Hypoglycemia (BG &lt;70)</th>
<th>DO NOT STOP INSULIN DRIP UNLESS IT IS AN EMERGENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• If NPO → bolus with dextrose (D10W 5cc/kg) and adjust IVF therapy</td>
<td></td>
</tr>
<tr>
<td>• If not NPO → give 15 grams of carbs (4 ounces of juice) and recheck POC blood glucose in 15 mins</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potassium abnormalities (K &lt;2.5 or &gt; 5.5)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• If K+ &gt;5.5 and/or no UOP → REMOVE K+ in IVF, consider EKG</td>
<td></td>
</tr>
<tr>
<td>• If K+ &lt;2.5 → Notify attending, replete K+, consider EKG &amp; decreasing insulin drip rate</td>
<td></td>
</tr>
</tbody>
</table>

| *Low bicarbonate* | Replacement is not recommended except for treatment of life-threatening hyperkalemia or unusually severe acidosis, often refractory, with evidence of compromised cardiac contractility (cardiogenic shock and/or arrhythmia) |

**TRANSITION TO SUBCUTANEOUS INSULIN**

*Contact Endocrine Prior to Transition*

- Transition to SubQ insulin when acidosis resolves, regardless of time of day:
  - If basal insulin has been administered in the hospital in the last 24 hours, turn off the insulin drip and discontinue dextrose containing IV fluids.
  - If basal insulin has NOT been administered in the hospital in the last 24 hours, give basal insulin 1 hour before turning off the insulin drip and discontinuing dextrose containing IV fluids.
- Once insulin drip is off, allow the patient to eat, dose meal-time insulin, and continue IVFs without dextrose until taking adequate PO

**Expected Management**

- Monitor q1 hr POC glucose and adjust dextrose IVF to prevent dropping glucose > 100/hr
- Avoid and treat hypoglycemia (<70)
- Monitor q4 hr labs for electrolyte disturbances
- Monitor neurologic status for cerebral edema
- Administer basal insulin (Glargine) 0.2 Units/kg on admission for all new onsets. For known insulin dependent diabetics, give home dose of basal insulin at home dosing time. For < 6 years old, call endocrine for dosing recommendation.

**3-Bag System and Starting Rates**

<table>
<thead>
<tr>
<th>Bag 1</th>
<th>Bag 2</th>
<th>Bag 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin</td>
<td>NS +/- additives</td>
<td>D10 ½ NS +/- additives</td>
</tr>
</tbody>
</table>

**Fluid Rate (FR) = 1.5 maintenance**

**Glucose Goals:**

- Glucose ↓ 50-100/hr until 130-200
- Prevent hypoglycemia (<70)

**Labs on Insulin Drip**

- Q1 hour POC glucose
- Q4 hour Chem 10
- VBG PRN after first gas
- Urine Ketones Qvoid or Q2hours

DKA is resolved when serum anion gap < 12 AND serum CO2 >15

- Transition to SubQ insulin when acidosis resolves, regardless of time of day:
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  - If basal insulin has NOT been administered in the hospital in the last 24 hours, give basal insulin 1 hour before turning off the insulin drip and discontinuing dextrose containing IV fluids.
- Once insulin drip is off, allow the patient to eat, dose meal-time insulin, and continue IVFs without dextrose until taking adequate PO
HISTORY AND PHYSICAL

Review of Systems

Polyphagia, Polydipsia, Polyuria, Weight Loss, Anorexia, Vomiting, Fatigue, Malaise
Insulin Use, most recent dose, insulin pump
Home glucose/ketone measurements
Age at dx, prior hospitalizations, previous DKA
Infectious sx, Ingestions, Trauma
Risk of Pregnancy, STI

Known Diabetic

Other Teenage females

Polyphagia, Polydipsia, Polyuria, Weight Loss, Anorexia, Vomiting, Fatigue, Malaise
Insulin Use, most recent dose, insulin pump
Home glucose/ketone measurements
Age at dx, prior hospitalizations, previous DKA
Infectious sx, Ingestions, Trauma
Risk of Pregnancy, STI

Physical Exam

Airway
Breathing: Tachypnea, Kussmaul breathing
Circulation: Capillary refill, pulses
Neuro: Pupils, CN exam, motor, GCS, Mental Status
Vital Signs (including temperature)

Diabetic Ketoacidosis Severity6

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.21 – 7.3</td>
<td>7.11 – 7.2</td>
<td>&lt; 7.1 OR</td>
</tr>
<tr>
<td>OR</td>
<td>CO₂ 11-15</td>
<td>CO₂ 6-10</td>
<td>CO₂ &lt; 5 OR</td>
</tr>
<tr>
<td></td>
<td>Altered Mental Status</td>
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<td></td>
</tr>
</tbody>
</table>

ADDITIONAL TREATMENT

Assure good IV access but avoid central lines due to risk of thrombus
Neurologic assessments every 15 minutes for first hour or until stable
Reeval for need for 2nd bolus
Start 1.5 MIVF NS until 3-bag system ready
Start insulin infusion at least 1 hour AFTER 1st bolus started1,4,6
Add glucose to fluids when blood sugar drops below 300 mg/dL or if dropping > 100/hr
0.2 U/kg Lantus now if new diabetic. Otherwise order their regular home dose at home dosing time.
Do NOT give bicarbonate OR insulin boluses1,4
Add antibiotic coverage if febrile

INITIAL LAB ORDERS

All | If New Onset Diabetes
---|---------------------
VBG (if not already done) | Gad Ab
Chem 7, Mg, Phos | Islet Antigen-2 Antibody
CBC with diff | Islet Ab
Hemoglobin-A1c | Insulin Ab
Ionized Calcium (iCa) | ZnT8
Urinalysis (UA) | When acidosis resolves
Q1 hour POC Glucose | TSH
Gad Ab | Celiac Disease Reflex Panel
Islet Antigen-2 Antibody | Fasting Lipids
Islet Ab | If Severe DKA add a Lactate
Insulin Ab | If Febrile consider cultures + antibiotics
ZnT8

IV FLUID ORDERS1

ALWAYS ORDER a bag WITH AND a bag WITHOUT dextrose!

<table>
<thead>
<tr>
<th>K &gt; 5.5</th>
<th>K &lt; 5.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Saline AND D10 ½ NS</td>
<td>NS + 20 mEq/L KCl + 20 mEq/L KPhos AND D10 + ½ NS + 20 mEq/L KCl + 20 mEq/L KPhos</td>
</tr>
</tbody>
</table>

IF K < 2.5 or > 5.5, consider ordering an EKG

May use K Acetate instead of KCl in the setting hyperchloremia

USE THE FOLLOWING INITIAL RATE

<table>
<thead>
<tr>
<th>POC Glucose</th>
<th>NS +/- additives</th>
<th>D10 ½ NS +/- additives7</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 300</td>
<td>1.5 maintenance</td>
<td>Bag at bedside</td>
</tr>
<tr>
<td>150 - 300</td>
<td>0.75 maintenance</td>
<td>0.75 maintenance</td>
</tr>
<tr>
<td>&lt; 150</td>
<td>Bag at bedside</td>
<td>1.5 maintenance</td>
</tr>
</tbody>
</table>

**Nurses need BOTH IV fluid bags to start insulin drip**
Specialized fluids take time, may start with NS at 1.5 maintenance while waiting for insulin and supplemental fluids

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1, 4, 6 These references are not provided in the image but are typically found in standard medical literature on diabetic ketoacidosis management.

7 The use of half normal saline with additives is a common practice in insulin management, but specific guidelines may vary depending on the institution or local protocols.
## Basal Bolus Insulin Therapy

### Estimate Total Daily Dose of Insulin (TDD)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant (0-2 years)</td>
<td>0.2 units/kg/day</td>
</tr>
<tr>
<td>Early pre-puberty (3-6 years)</td>
<td>0.3-0.4 units/kg/day</td>
</tr>
<tr>
<td>Late pre-puberty (7-13 years)</td>
<td>0.5-0.7 units/kg/day</td>
</tr>
<tr>
<td>Pubertal</td>
<td>0.8-1.0 units/kg/day</td>
</tr>
</tbody>
</table>

**STEP 1:** Calculate total daily dose (TDD) of insulin
- TDD = weight (kg) x age factor

**STEP 2:** Determine basal insulin dose based on TDD
- Typical basal insulin dose is 50% of TDD every 24 hours

**STEP 3:** Determine meal time regimen based on TDD
- Carb Ratio
  - 500/TDD OR
  - If age ≤ 5 or a severely obese adolescent, use Daily g of CHO/(½ TDD)
    - Daily g of CHO = \[\frac{1000+(100 \times \text{year of age})}{\text{max 2500}}\]\\^8
- BG Correction Factor
  - 1800/TDD

### Basal Bolus Calculation Example: 10 yo, 40 kg child

1. Calculate TDD = 0.7 units/kg/day x 40 kg = 28 units/day
2. Calculate basal insulin dose = TDD/2 = 14 units Lantus once a day
3. Calculate carb ratio
   - 500/TDD = 500/28 = 18
   - Or Daily g CHO/(½ TDD) = 250/14 = 18
   - Administer 1 unit of Humalog per 18 grams of carbs with meals (ie 1 unit : 18g CHO)
4. Calculate BG correction factor
   - Correction Factor: 1800/TDD = 1800/28 = 64
   - Administer 1 unit of Humalog to decrease BG by 64 mg/dL above target (ie 1 unit : 64 mg/dL > 120 mg/dL) OR if using a sliding scale 1 unit of Humalog to decrease BG by 64 mg/dL starting at a specified threshed (ie 1 unit : 64 mg/dL starting at a BG of 150 mg/dL)

### Basal Bolus Insulin Orders

Use Peds Insulin (subQ) order set

- **Rapid acting (bolus) Insulin:** Lispro/Humalog
  - If TDD is ≤ 20 = order ½ unit dosing increments

- **Bolus insulin for BG Correction:** Insulin Lispro/Humalog (custom sliding scale)
  - For sliding scale orders *thresholds may be adjusted by endocrine depending on age and TDD
    - Daytime: Start sliding scale at a BG of 150 (threshold)
    - Bedtime and 2AM: Start sliding scale at a BG of 200 (threshold)

- **Bolus insulin for Carb Coverage:** Insulin Lispro/Humalog (nutritional dose)
  - X unit: X grams carbohydrates

- **Long acting (basal) insulin:** Lantus (Glargine)
  - X units at bedtime

**Blood Glucose Monitoring POC:** Before meals, bedtime, 0200, and as needed for symptoms of hypoglycemia

For glucose < 80 during the day, give 4 ounces of juice (15 grams of simple carbs) and recheck BG in 15 min, repeat as needed.

For glucose < 100 at bedtime or overnight, give 4 ounces of juice (15 grams of simple carbs) and recheck BG in 15 min, repeat as needed.

**Urine Ketones:**
- If admitted in DKA, continue urine ketones q void until negative two consecutive times then check urine ketones as needed when BG is > 300
- If admitted not in DKA, urine ketones as needed when BG is > 300

### Insulin Type

<table>
<thead>
<tr>
<th>Insulin Type</th>
<th>Brand Name</th>
<th>Onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Acting</td>
<td>Admelog</td>
<td>15-30 min</td>
</tr>
<tr>
<td></td>
<td>Humalog</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Novolog</td>
<td></td>
</tr>
<tr>
<td>Short Acting</td>
<td>Regular</td>
<td>30-60 min</td>
</tr>
<tr>
<td>Intermediate</td>
<td>NPH</td>
<td>1-4 hrs</td>
</tr>
<tr>
<td>Long Acting</td>
<td>Levemir</td>
<td>1-2 hrs</td>
</tr>
<tr>
<td></td>
<td>Lantus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Semglee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tresiba</td>
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</tbody>
</table>
CRITICAL CARE STRATEGIES

CEREBRAL EDEMA RISK FACTORS³

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Prevention Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 3 years</td>
<td>Bolus Insulin administration</td>
</tr>
<tr>
<td>Prior Hx of DKA</td>
<td>Insulin infusion within 1 hour of 1st fluid bolus</td>
</tr>
<tr>
<td>pH &lt; 7.0</td>
<td>Bicarbonate administration</td>
</tr>
<tr>
<td>Na fails to correct as sugar↓</td>
<td></td>
</tr>
<tr>
<td>Initial glucose &gt; 1000 mg/dL</td>
<td></td>
</tr>
</tbody>
</table>

CEREBRAL EDEMA DIAGNOSIS³ = 1 Major + 2 Minor or 1 Diagnostic + 2 Major

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnl verbal/motor to pain</td>
<td>Altered/fluctuating consciousness (GCS ≤ 13)</td>
</tr>
<tr>
<td>Posturing (e.g. decorticate)</td>
<td>Sustained bradycardia</td>
</tr>
<tr>
<td>CN Palsy (usually III, IV, or VI)</td>
<td>Age-inappropriate incontinence</td>
</tr>
<tr>
<td>Cheyne-Stokes respirations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
</tr>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Age &lt; 5 years</td>
</tr>
<tr>
<td>Does not easily wake</td>
</tr>
<tr>
<td>Diastolic bp &gt; 90 mmHg</td>
</tr>
</tbody>
</table>

Cerebral Edema Treatment:

- Elevate head of bed
- 3% NS over 30 minutes
- Mannitol
- Consider a slower initial insulin drip rate⁴
- Consider head CT AFTER initial treatment
- Call PICU attending if intubation or treatment for cerebral edema is required

Shock Treatment:

- NS or LR boluses until perfusion restored
- 20 mL/kg (up to 3)
- Dopamine (Cold shock)
- Epinephrine (Cold shock)
- Norepinephrine (Warm shock)
- Fever
- See UNMH PED Sepsis Pathway

Diabetic Ketoacidosis Criteria⁶

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<td>pH &lt; 7.1 OR CO₂ &lt; 5 OR Altered Mental Status</td>
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References:


