**Diabetic Ketoacidosis (DKA) Emergency Department 2 Bag System Care Guideline**

**Inclusion Criteria (Definition of DKA):**
- Blood glucose (BG) > 200 mg/dl
- Acidosis (bicarbonate < 15 or blood gas pH < 7.3)
- Associated glycosuria, ketonuria & ketonemia

**Requires Critical Care level of care**

**Initial Evaluation**

**Assessment:** VS, weight, severity of dehydration, level of consciousness, acute trigger for DKA (e.g. infection, trauma, failure to take insulin, pump failure)

**Laboratory:** Stat bedside BG, BMP, phosphorous, magnesium, venous pH, pCO2, pO2, CBC, UA, appropriate cultures if infection suspected. (HbA1c only if new onset DM/DKA)

**Give 10-20 mL/kg of 0.9% normal saline (NS), administer over one hour**

For overt shock – consider giving up to 40mL/kg

**Insulin Drip**

Ensure K level WNL prior to starting insulin drip
Starting dose 0.05 to 0.1 units/kg/hr
Titrate insulin by 0.01 units/kg/hr to keep Blood Glucose between 150-300

**Ongoing Monitoring**
- BP, HR, RR
- Neuro checks every hour
- Bedside BG every hour
- BMP every 2 hours X 3 then every 4 hours if improving

**Neuro checks for S/S of cerebral edema every hour**

**Cerebral Edema Signs and Symptoms**
- Headache
- Altered or fluctuating level of consciousness
- Sustained heart rate deceleration
- Abnormal and deteriorating neurological exam
- Abnormal respiratory pattern
- Recurrent vomiting
- Rising blood pressure
- Decreased oxygen saturation
- Change in neuro status
- Restlessness

**Cerebral Edema Treatment**
- Give mannitol 0.5 gm/kg may be repeated X 1 for a total max of 50 gm
- Ensure adequate circulation but if possible reduce fluid rate by one third
- Avoid maneuvers and drugs likely to increase intracranial pressure
- If intubation is necessary consider neurosurgery consult for intracranial pressure monitoring
- Treat suspected cerebral edema based on clinical criteria immediately. Do not delay treatment to obtain confirmatory CT scan.

**Progress to 2 Bag System Starting with Phase 1**

On page 2

**Recommendations/Considerations**
- The severity of DKA is defined by the degree of acidosis: mild – pH 7.2 – 7.3; moderate – pH 7.1 – 7.2; severe pH < 7.1
- Goal decrease in glucose no more than 100 mg/dl per hour
- If glucose decreases rapidly this may increase the risk of cerebral edema
- Monitor Na level correction to ensure NA rises as glucose decreases using calculation of corrected Na level

**Severity of dehydration:**
- 5% - reduced skin turgor, dry mucous membranes, tachycardia
- 10% - capillary refill ≥ 3 seconds, sunken eyes
- >10% - weak or impalpable peripheral pulses, hypotension, shock, oliguria

**Calculations:**
- Anion gap = Na – (Cl+HCO3); normal is 12 ± 2 mmol/l
- Corrected sodium = measured Na + 1.6 X [(glucose mg/dl – 100) / 100]
- DKA at diagnosis is more common in children < 5 yrs of age
- Omission of insulin is the leading cause of recurrent DKA in adolescents

**Causes of Morbidity and Mortality:**
- Cerebral edema, which occurs in 0.5 – 1 % of all episodes of DKA, is the most common cause of mortality in children with DKA, Cerebral edema usually develops 4 – 12 hours into treatment, but it can occur at any time
- Hypokalemia
- Na Bicarb should not be given without discussion with two attending physicians as this increases the risk of cerebral edema.
- For insulin drip, tubing must be manually primed.

**Correction of Dehydration**
- Estimate fluid deficit
- Subtract initial bolus received
- Divide remaining deficit over 48 hours
- Add deficit replacement/hour to normal maintenance/hr = Total fluid rate per hour
- Re-evaluate I/O for excessive ongoing urine loss
- Do not bolus > 40 mL/kg in 4 hours unless hypotensive or has significantly compromised perfusion

**Principals of 2 Bag System**
- Total fluid rate is dependent on amount needed for treatment of dehydration as above (usually around 1.5 X maintenance)
- Using 2 bags allows for change in glucose infusion rate without ordering multiple IV bags
- Insulin drip rate is adjusted to ensure resolution of acidosis – 0.05-0.12 unit/kg/hr
- Do not decrease insulin rate below 0.05 unit/kg/hr without discussion with Endocrinologist on-call

**Patient to be Admitted to PICU**
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Individual rates of Bag 1 and Bag 2 are dependent on glucose level with goal of maintaining glucose of 150-300. Total rate depends on fluid needs.

<table>
<thead>
<tr>
<th>Plasma Glucose</th>
<th>Bag 1</th>
<th>Bag 2</th>
<th>Final Dextrose Concentration %</th>
<th>Final NaCL Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Phase 1</td>
<td>&gt;300</td>
<td>100%</td>
<td>0%</td>
<td>NS</td>
</tr>
<tr>
<td>Once BG &lt;300 Phase 2</td>
<td>225-300</td>
<td>50%</td>
<td>50%</td>
<td>1/4 NS</td>
</tr>
<tr>
<td>Phase 3</td>
<td>150 – 224</td>
<td>25%</td>
<td>75%</td>
<td>2/3 NS</td>
</tr>
<tr>
<td>Phase 4</td>
<td>100 – 149</td>
<td>0%</td>
<td>100%</td>
<td>1/2 NS</td>
</tr>
<tr>
<td>&lt;100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Change to D12.5% with ½ NS + K and hold insulin drip for 30 minutes until BG > 150

**Phase 1 (No added Dextrose)**
- For glucose > 300
- Bag 1: NS + 40mEq K+ at FULL fluid rate
- Recommend Kphos +/- K Acetate instead of KCL
- Order Bag 2 but do not use until Phase 2
- Change to Phase 2 once glucose level is < 300

**Phase 2 (D5 ½ NS)**
- For glucose ≥225
- Bag 1: NS + 40mEq K+ at 50% of total fluid rate
- Bag 2: D10 ½ NS + 40mEq K+ at 50% of total fluid rate
- After starting Phase 2 if the BG is above 300, then increase insulin drip by 0.01 unit/kg/hr to max of 0.12 unit/kg/hr (e.g. 0.05->0.06->0.07 units/kg/hr)
- DO NOT RETURN TO PHASE 1
- Also if CO2 not resolving by 1 mEq/L over 2 hours, increase insulin by 0.01 unit/kg/hr to max of 0.12 unit/kg/hr

**Phase 3 (D7.5 2/3 NS)**
- For glucose 150-224
- Bag 1: NS + 40mEq K+ at 25% of total fluid rate
- Bag 2: D10½ NS + 40mEq K+ at 75% of total fluid rate

**Phase 4 (D10 ½ NS)**
- Once glucose < 150
- Bag 1: NS + 40mEq K+ OFF
- Bag 2: D10½NS + 40mEq K+ at FULL rate of total fluid
- DO NOT RETURN TO PHASE 3
- To resolve acidosis, remain on D10 with goal BG 150-300 with titration of insulin.

If glucose level remains < 150 and persistent acidosis, order new IVF of D12.5 ½ NS + 40mEq K+.

If glucose level remains < 150 and bicarb above 15, then decrease insulin rate by 0.01 unit/kg/hr to minimum of 0.05 units/kg/hr.

If BG under 100, change to D12.5 with ½ NS + K+. Temporarily stop insulin drip to prevent severe hypoglycemia, and retest in 30 minutes. Restart insulin drip once BG > 150; start at minimum 0.05 units/kg/hr.

Recheck BG every 1 hour while in ED

Recheck BMP and Phos every 2-4 hours

Recheck BG every 1 hour while in ED

If NA decreasing by 2 mEq/L in 2 hrs. Assess for Cerebral edema

If K+ > 5.5 Hold K+ in IV fluids

If K+ = 3.6-5.5 Same K+ in IV fluids

If K+ < 3.5 Increase K+ by 20-40 mEq/L in IV fluids up to max of 60 mEq/L

If K+ < 3.0 Give K-rider 0.5 mEq/kg, max 20 mEq
References

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Reviewed by Evidence-Based Medicine Committee - 9/16/2020