

Management of Diabetic Ketoacidosis

1) Confirm the diagnosis:

A:History:

History of diabetes mellitus, polyuria, polydipsia, weight loss

B: Physical exam:

Dehydration, decreased level of consciousness, kussmaul respiration, etc.

C: **Biochemical criteria:** BS>200, PH<7/3 or HCO₃<15, ketonemia or ketonuria.

D: **Severity of DKA**

	Mild	Moderate	Severe
PH	7.2-7.3	7.1 -7.2	<7.1
HCO ₃	10-15	5-10	<5

2) Stabilization of the patient:

- **If the patient is in shock state or coma: The patient should be stabilized.**
- Evaluation for infections: oral infection, ENT, vaginal infection, pneumonia, UTI.
- Start antibiotic if clinically suspicious or fever or WBC> 25000.
- **Establish two IV lines**
- **ECG in primary evaluation, then according to needs & cardiorespiratory monitoring**
- **O₂ 2-3lit/min according to the patient's condition**

3) Laboratory assessment:

-VBG, BS, Na, K, BUN, Creatinine

-Evaluation of infection:

-CBC diff, CRP, ESR, UA (evaluation of urine osmolality)

- UC, BC (if suspicious to infection)

-Repeat blood glucose with glucometer Q1h

-Repeat VBG Q2h

-Repeat Na, K Q4h

4. Indications of ICU admission:

A: severe state (PH<7.1, HCO₃<5)

B: Severe loss of consciousness (stupor, coma, seizure)

C: Age <2y/o

D: BS> 700 mg/dl

E: Brain edema

F: Serum Na >150 or decreasing trend of Na during DKA management

G: Serum K<3

5. Principles of water & salt replacement:

A) Fluid resuscitation (Bolus):

- Mild DKA (5% dehydration): Bolus not needed
- Moderate DKA (7% dehydration): Bolus not needed
- Severe DKA (10% dehydration): Bolus Normal Saline **10cc/kg** during one hour (if more bolus volume is needed, please consult the endocrinology fellowship or attending.)
- In shock state: give 20cc/kg normal saline free, then evaluate for repeating bolus if necessary

B) Deficit replacement fluids:

- Mild DKA: dehydration estimate 5%
- Moderate DKA: dehydration estimate 7%
- Severe DKA: dehydration estimate 10 %

C) Maintenance replacement fluids:

The first 10 kg of patient's weight: 100 cc/kg

The second 10 kg of patient's weight: 50 cc/kg

Any 10kg further: 20 cc/kg

D) Formula for rate of IV fluid (cc/h) = $\frac{(2 * \text{maintenance}) + \text{Deficit}}{48}$

Rate of IV fluid should not be changed according to VBG changes during DKA management

E) Type of IV fluid:

If BS>300: NaCL 0.9 %

200 <BS<300: DW 5% + Nacl 77 meq/l

100< BS<200: DW 7.5 % + Nacl 77 meq/l

BS < 100: DW 10% + Nacl 77 meq/l

6. Insulin therapy:

A:

-Insulin infusion should be given only by insulin pump.

- Before starting infusion, serum set should be washed by the prepared insulin solution.

B: Prepare a solution with 50 units **Regular** insulin in **50cc Normal Saline** and start insulin drip according to blood sugar level:

- BS> 300: 0.1 u/kg/h= **0.1cc/kg/h**

- 200 < BS< 300: 0.075 u/kg/h = $\frac{3}{4} * 0.1 \text{ cc/kg/h}$

- 100<BS<200:0.05 u/kg/h = $\frac{1}{2} * 0.1 \text{ cc /kg/h}$

- BS< 100: insulin drip should be hold for 1hour. Then restart infusion according to the BS level.

C: Bolus IV should not contain potassium. Therefore, in severe DKA, start insulin infusion after giving IV bolus.

9) Potassium therapy:

A) Bolus IV does not contain potassium, but at the beginning of DKA management, add **40meq/lit KCL** to maintenance IV unless the patient is anuric or ECG shows findings in favor of hyperkalemia.

B) If serum K>5.5: hold IV KCL

- 5 <K<5.5: 20 meq/lit IV KCL

- 3.5 <K<5: 40 meq/lit IV KCL

- 3 <K<3.5: 50- 60 meq/lit IV KCL in PICU with heart monitoring

- K<3: 60- 80 meq/lit KCL in PICU with heart monitoring

C) If serum K<3 despite high dose potassium replacement, insulin drip rate should be decreased or stopped.

10) Bicarbonate therapy:

A) Indications:

- Refractory metabolic acidosis (PH < 6.9) with unstable hemodynamic state
- Refractory severe hyperkalemia

B) Decision for starting bicarbonate therapy should be made only after consultation with a professor or pediatric endocrinology fellow.

11) Mannitol or hypertonic saline 3% bedside

Administer Mannitol 0.5 – 1 g/kg over 15 min or Hypertonic Saline 3%, 2cc/kg over 15 min for patients clinically suspicious to cerebral edema.

12) Criteria of DKA improvement:

When ketoacidosis has resolved (PH>7.3 & HCO₃ > 15) & oral intake is tolerated:

- Administer SC **Regular** insulin 0.1 u/kg
- Start PO feeding
- Stop insulin infusion 1 hour after regular insulin injection