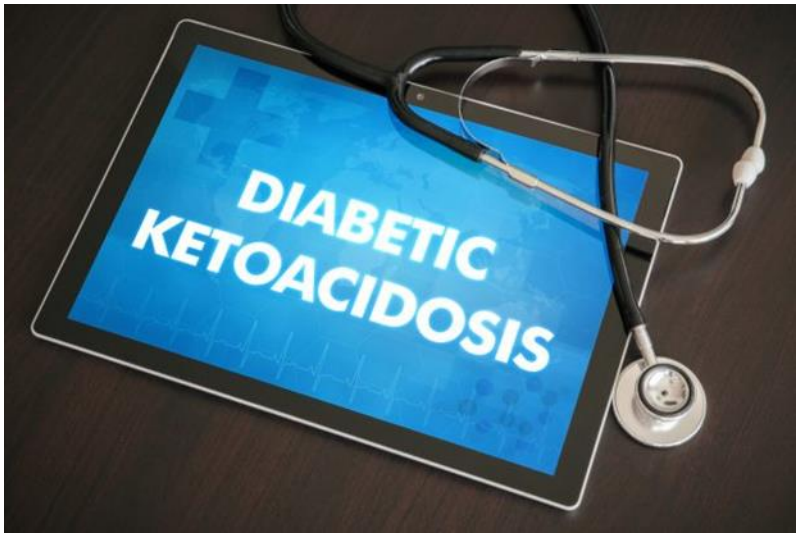


Diabetic Ketoacidosis

Leila Salarian, MD

Pediatric Endocrinology and Metabolism

Shiraz University of Medical Sciences

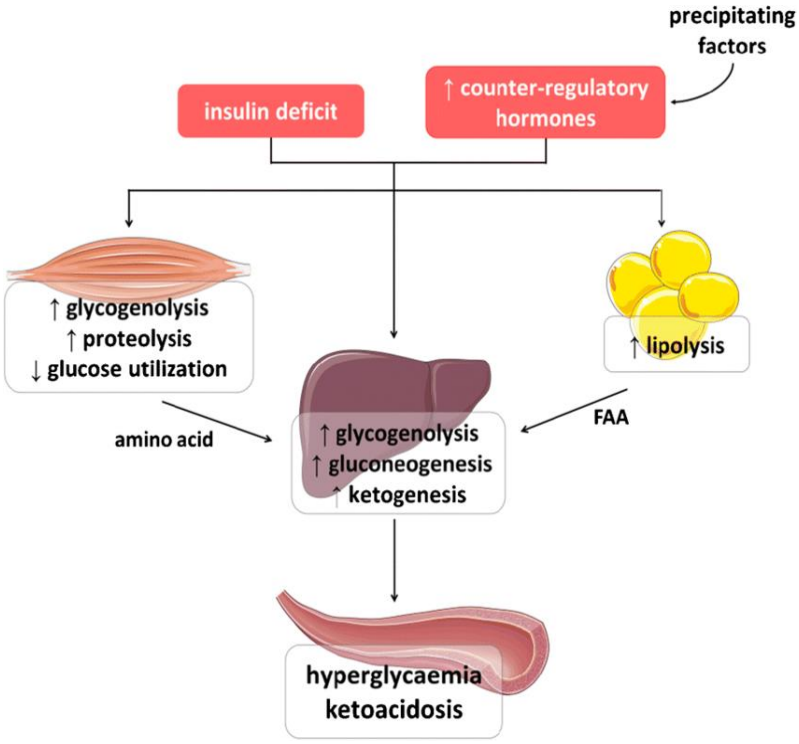
DKA

- **New cases**
- **Known cases**
  - Omitted insulin dose
  - During illness, infection or stress
  - Counter-regulatory hormones:
    - Glucagon
    - Growth hormone
    - Cortisol
    - Cathecholamines

- **Diagnostic Criteria:**
  - Blood sugar > 200mg/dL
  - pH < 7.3
  - HCo3 < 15
  - Elevated serum/ urine ketones

Pathophysiology

- Decreased insulin secretion → partial hepatic oxidation of fatty acids to ketone bodies
- Hyperglycemia → osmotic diuresis & polydypsea
- Worsening hyperglycemia & diuresis → dehydration
- Acidosis → vomiting → dehydration
- Tachypnea → increased insensible water loss → dehydration
- Electrolyte abnormalities



Presentation

- Polyurea (+ Dehydration)
- Polydypsea
- N/V
- Abdominal pain
- Tachypnea & deep (Kussmaul) respiration
- Breath with fruity (acetone) odor
- Altered mental status

Emergency assessment

- Immediate measurement of blood glucose
- Blood or urine ketones
- Serum electrolytes
- Blood gas
- Assessment of severity of dehydration and LOC
- Second peripheral intravenous (IV) line

Unless absolutely necessary, **avoid** placing a central venous catheter (high risk of thrombosis, especialy in very young child)

Laboratory Studies

- Blood sugar > 200mg/dL
- pH < 7.3
- HCo3 < 15
- Na is depressed (due to hyperglycemia)
  - Na corrected = $\left\{\frac{\text{blood sugar } -100 \times 1.6}{100}\right\}$ + Na pt
- BUN
- WBC (Finding etiology of Fever)
- ECG

CLASSIFICATION OF DIABETIC KETOACIDOSIS

	MILD	MODERATE	SEVERE
Serum bicarbonate	**10-15**	**5-10**	**<5**
pH (venous)	**7.2-7.3**	**7.1-7.2**	**<7.1**
Clinical	**Orient, alert but fatigued**	**Kussmaul respirations; orient but sleepy; arousable**	**Kussmaul or depressed respirations; sleepy to depressed sensorium to coma**

Treatment

1. Dehydration
2. Hyperglycemia
3. Acidosis
4. Electrolyte Imbalance

Treatment

1. **Dehydration**
   - Severe → 10% dehydration
   - 20cc/kg Bolus normal saline IV if Severe
   - Deficit + Maintenance fluid during 36-48 hrs
   - If Blood Sugar falls to less than 300, Sugar can be added to the IV fluid

2. **Hyperglycemia**
   - Regular insulin IV infusion : 0.1 U/kg/hr
   - BS should decrease not faster than 100mg/dl/hr
   - If Blood Sugar falls to less than 300, decrease insulin infusion rate and add sugar to IV fluid

Treatment

3. Acidosis

- Insulin therapy:
  - decrease the production of FFAs & protein catabolism
  - Increases tissue glucose usage

- Avoid bicarbonate therapy unless:
  - Severe acidosis (pH< 7) results in hemodynamic instability
  - Symptomatic hyperkalemia
- Potential adverse effects of bicarbonate therapy?
  - Paradoxical CNS acidosis
  - Tissue hypoxia
  - Abrupt osmotic changes
  - Increased risk of cerebral edema

  As acidosis is corrected, urnie ketone concentrations may appear to rise.

  β-hydroxybutyrate….. acetoacetate

Treatment

4. **Electrolyte Imbalance**
   - Total body K depleted
   - When adequate urine output is shown & the ECG is normal, K should be added to the IV fluids (20-40 meq/L)
   - If serum K is > 6 meq/L → No K in IV fluid

Initial laboratory measurements

- Blood sugar
- Sodium
- Potassium
- Chloride
- BUN, creatinine
- Calcium, phosphate, magnesium
- PH
- Bicarbonate
- Urinalysis

Monitoring

- Blood sugar: Q1hr
- Blood gas: Q1-2hr
- Na, K: Q2-3hr
- Calcium, phosphate, and magnesium: Q4-6hr
- Neurologic & mental status: frequently
  - Indicative symptoms of “Brain Edema”:
    - Decreased sensorium
    - Sudden severe headache
    - Vomiting
    - Change in vital signs (bradycardia, hypertention, apnea)
    - Dilated pupils
    - Ophthalmoplegia
    - Seizures

Complications

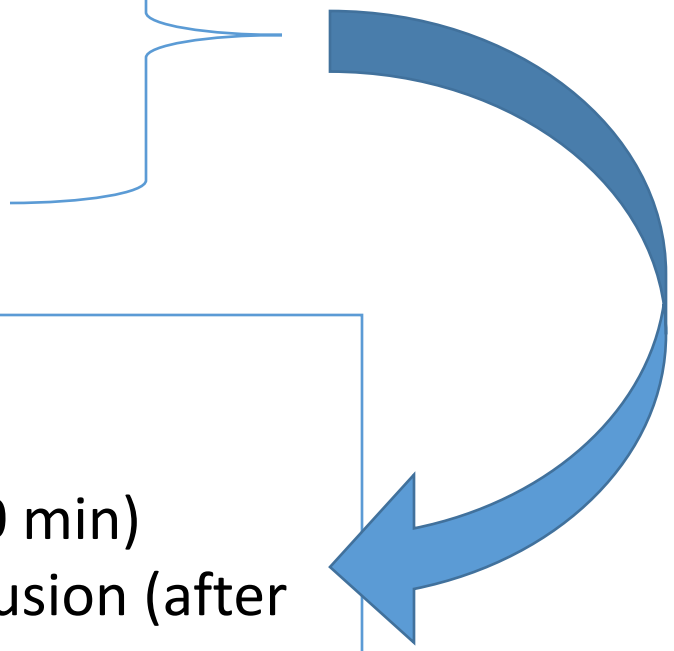
- Clinically apparent **cerebral edema** in 1-5%
- Most serious complication
- Significant mortality rate
- 6-12hrs after beginning therapy
- Often follows a period of clinical improvement
- **Risk factors:**
  - Higher initial BUN
  - Lower initial HCO3
  - Failure of increase in Na as BS decreases
  - Bicarbonate therapy
- **Treatment:**
  - IV mannitol, intubation, hyperventilation,….

Other Complications

- Intracranial thrombosis or infarction
- Acute renal failure & acute tubular necrosis
- Pancreatitis
- Arrhythmias
- Pulmonary edema
- Bowel ischemia

Final Step

- When acidosis has been corrected:
  - pH >7.3
  - HCO3 >15
  - No nausea or vomiting
  - Normal mental status



- Give 0.1 unit/kg regular insulin SQ stat
- Start PO feeding (after 30 min)
- Discontinue IV insulin infusion (after 1hr)
- Start maintenance insulin & check blood sugars accordingly

Maintenance insulin

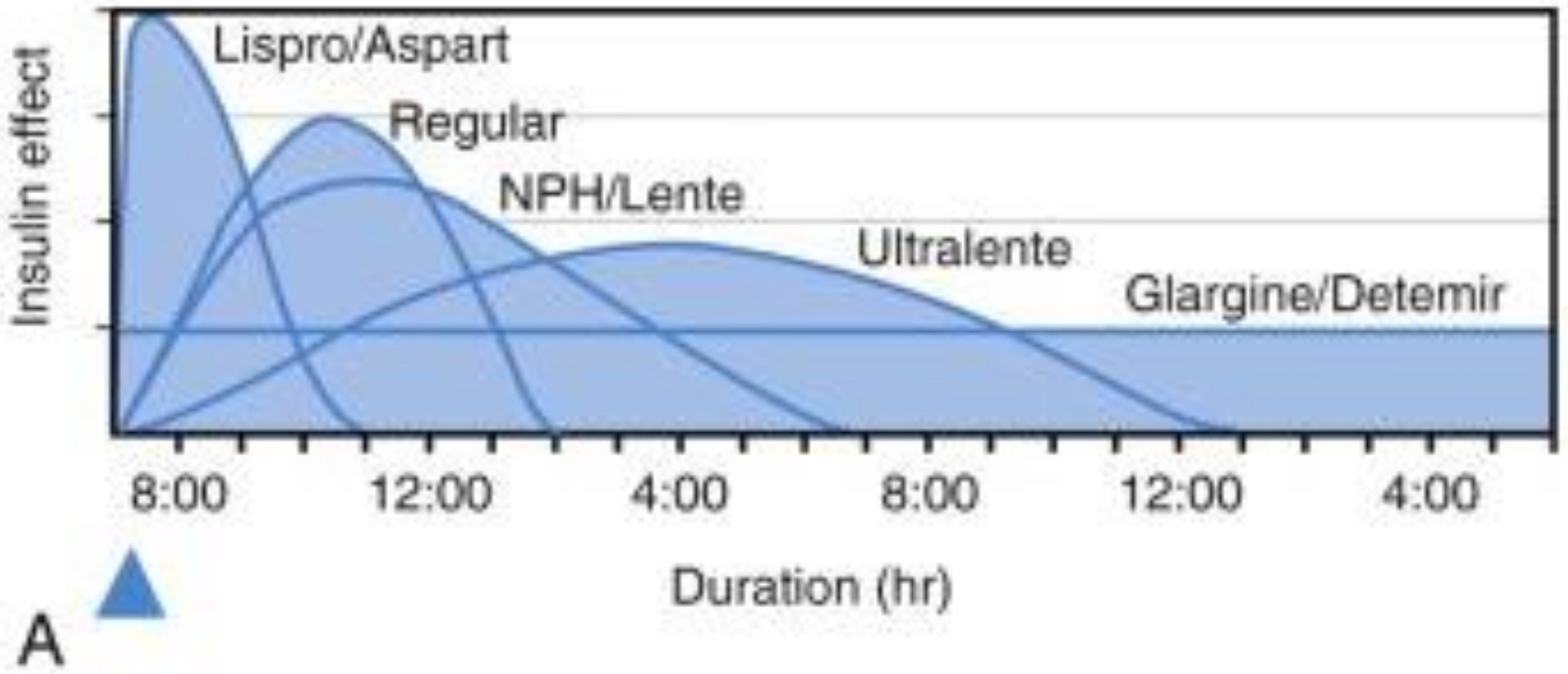
- A known case of T1D: restart on the prior doses if adequate
- New-onset T1D:starting total daily doses

  of 0.5-1 U/kg/day
- Basal and bolus injections
- BS monitoring: Before meals, bedtime, at 2–3 a.m.
- Basal: long-acting insulin at bedtime (glargine, detemir, degludec)
- Bolus: fast-acting insulin with each meal (lispro, aspart, glulisine insulin)
- Externally worn pumps: continuous SC infusion
- of fast-acting insulin (not used at onset of T1D)

Educations

- Patients and their families
- Learn the principles of diabetes care
- Ability to administer insulin injections
- Ability to test BS using a glucose meter
- knowledge of hypoglycemia management
- Meal planning
- Nutrition consult

Insulin Effect

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