Pediatric readiness program education session

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PEDIATRIC READINESS PROGRAM

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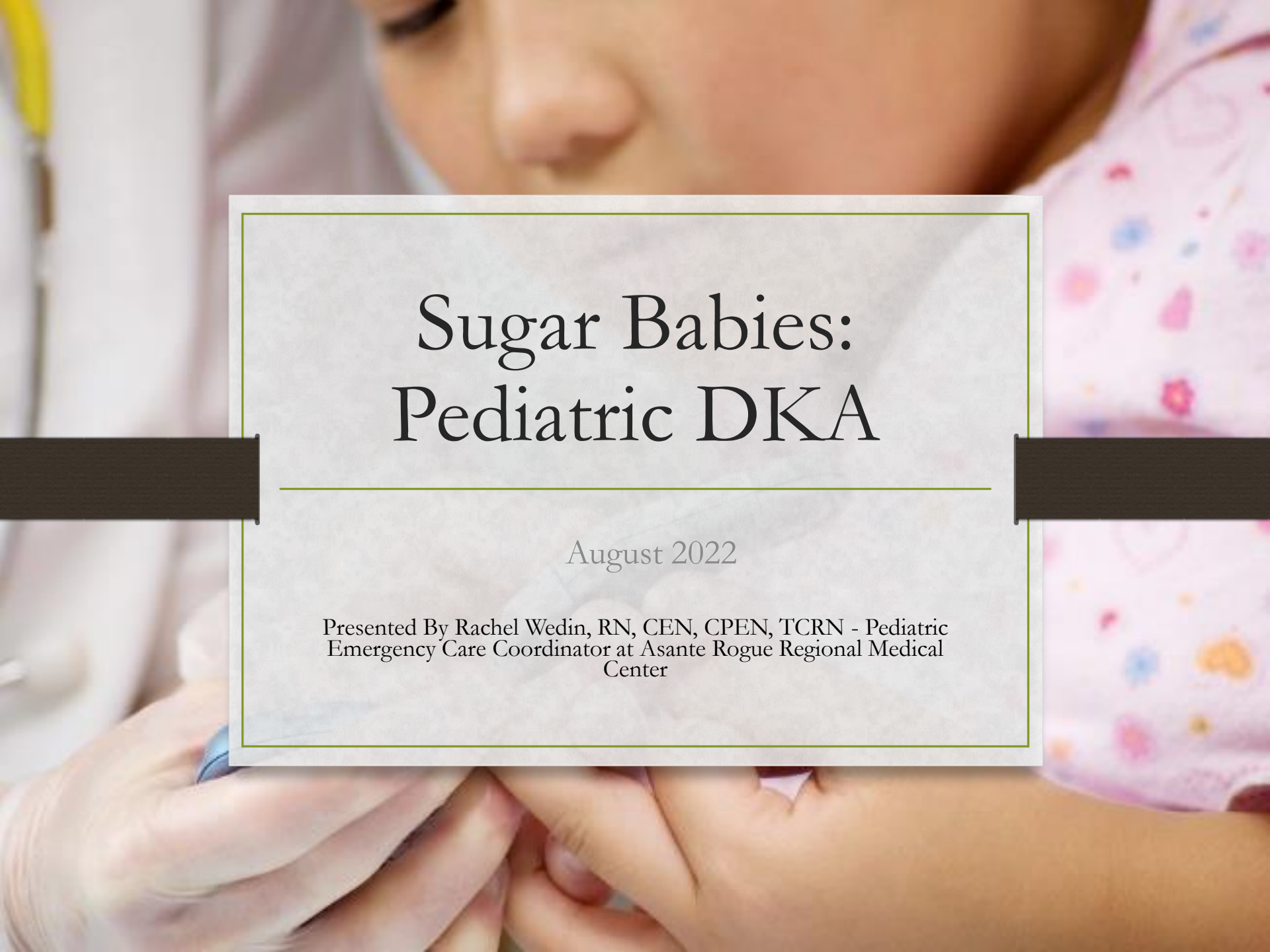


Sugar Babies: Pediatric DKA

August 2022

Presented By Rachel Wedin, RN, CEN, CPEN, TCRN - Pediatric Emergency Care Coordinator at Asante Rogue Regional Medical Center

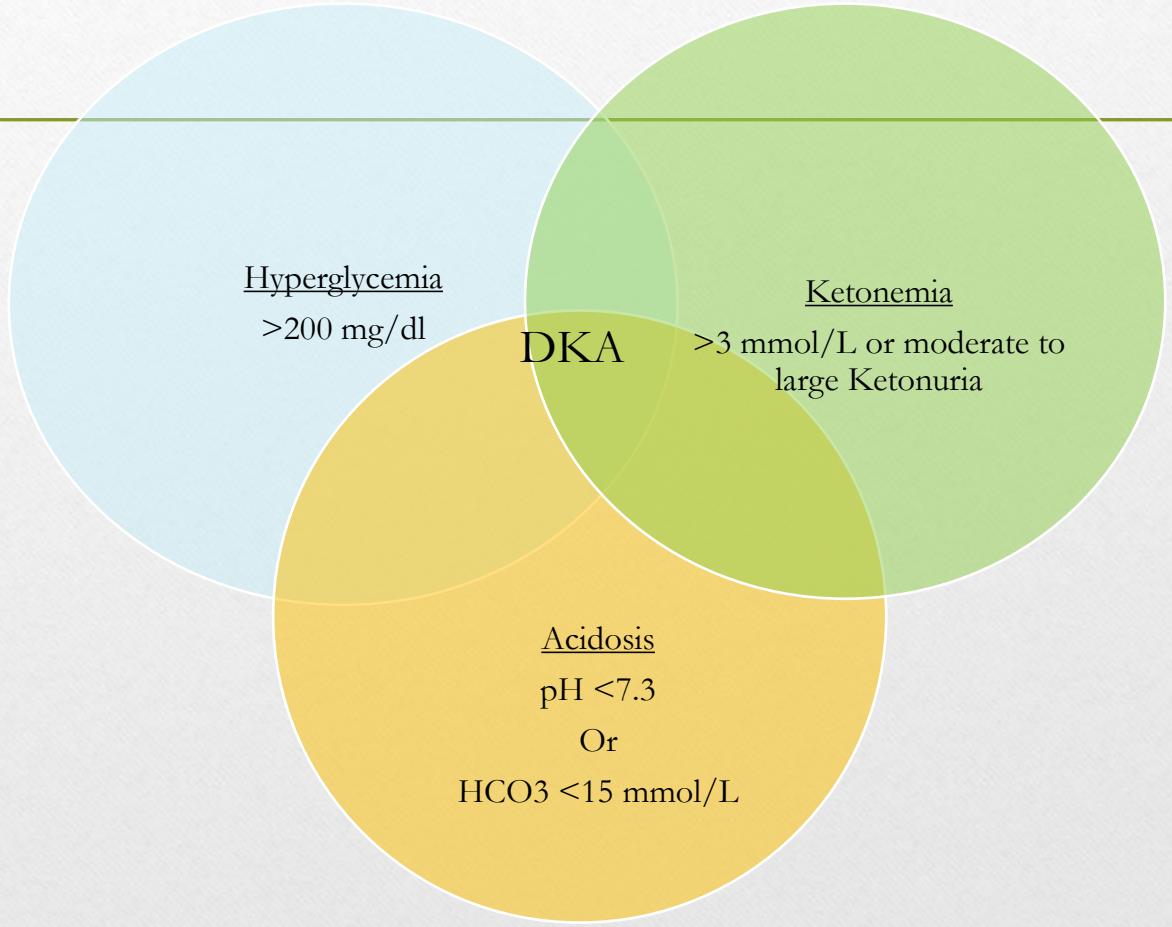
CME Disclosure

None of the planners and faculty for this educational activity have relevant financial relationship(s) to disclose with ineligible companies whose primary business is producing, marketing, selling, reselling, or distributing healthcare products used by or on patients.

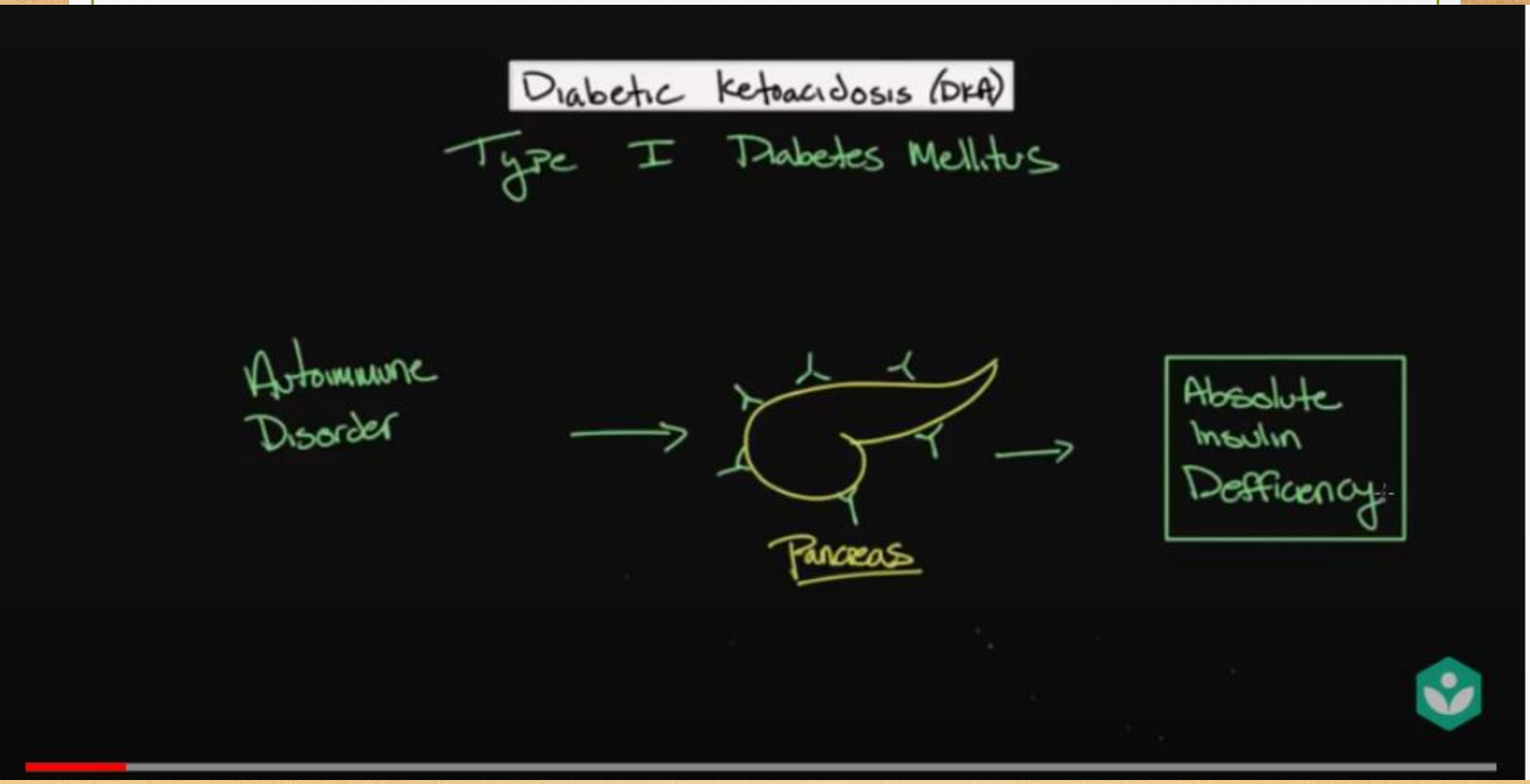
Objectives

- DKA in Kids
  - Definition
  - Pathophysiology
  - Presentation
  - Management in the ER
  - DKA guidelines and hydration chart

What defines DKA in a kid?

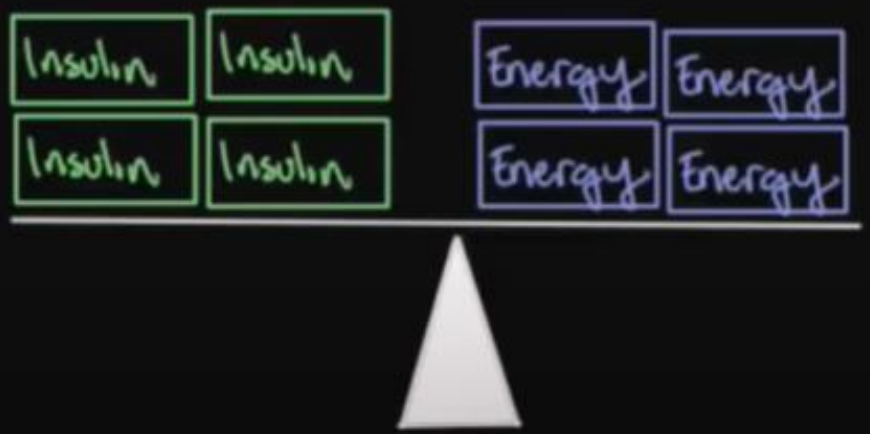


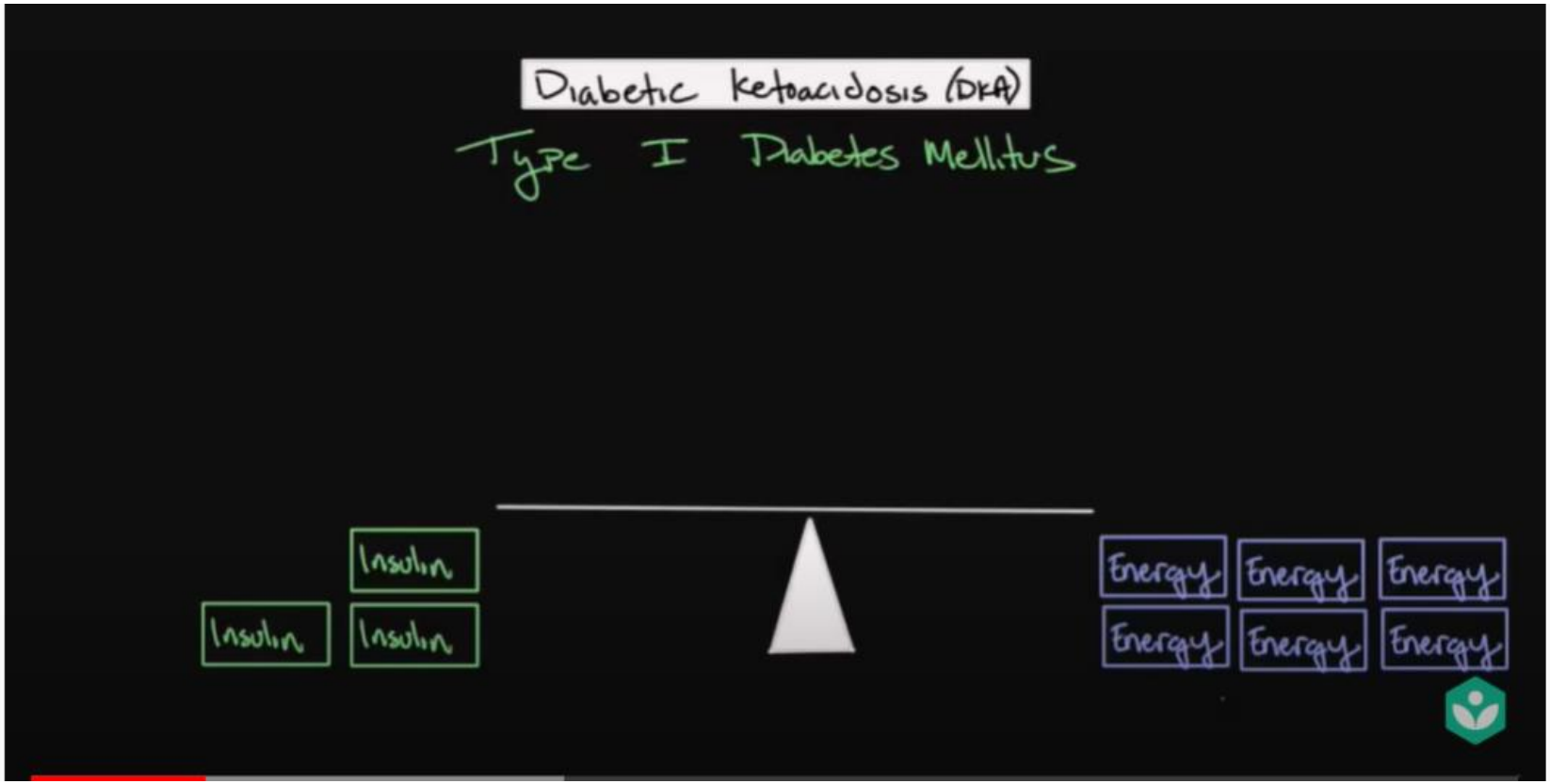
Pathophysiology

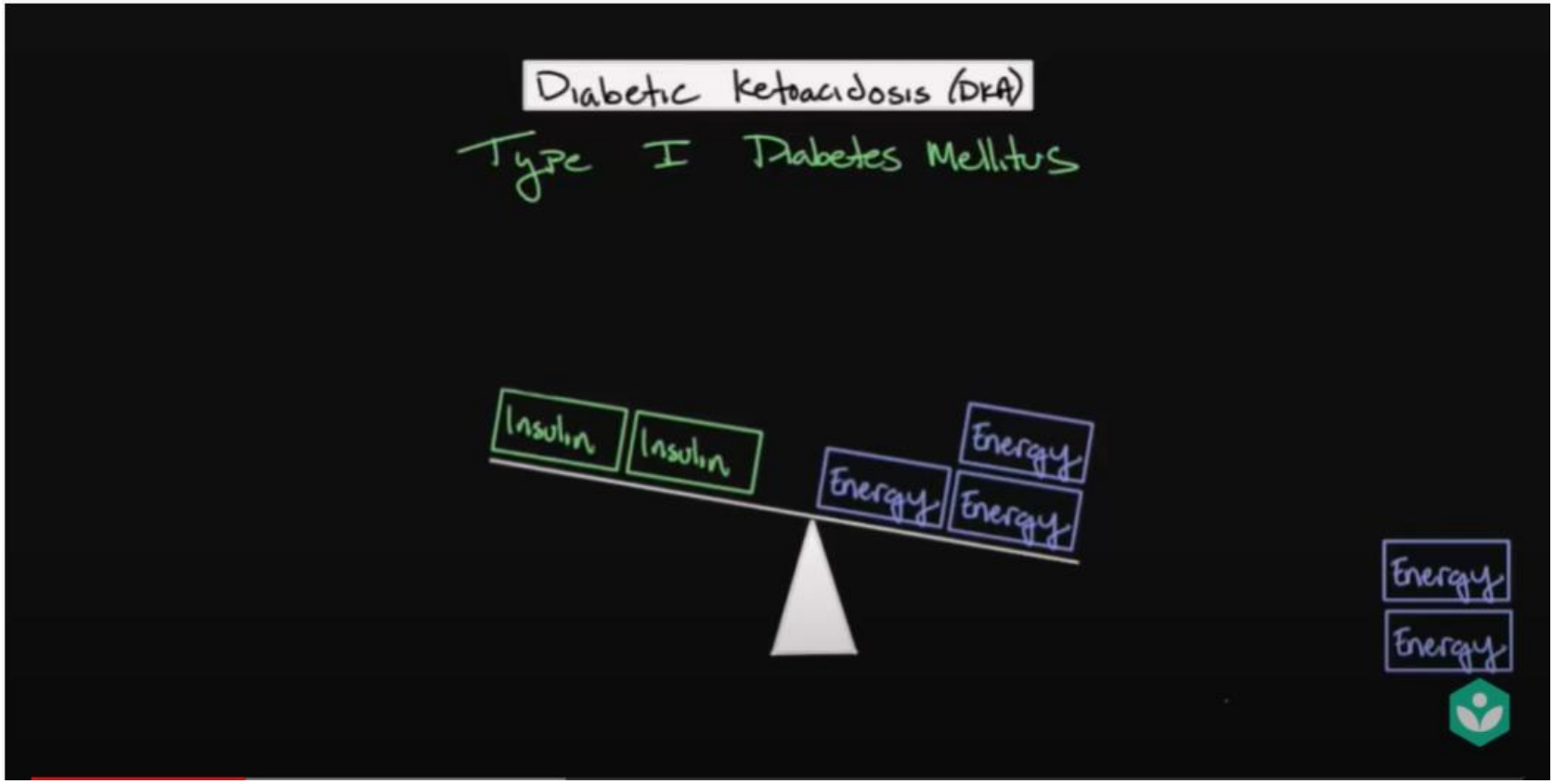


Diabetic ketoacidosis (DKA)

Type I Diabetes Mellitus




Diabetic ketoacidosis (DKA)
Type I Diabetes Mellitus
Insulin
Insulin
Insulin
Energy
Energy
Energy
Energy
Energy
Energy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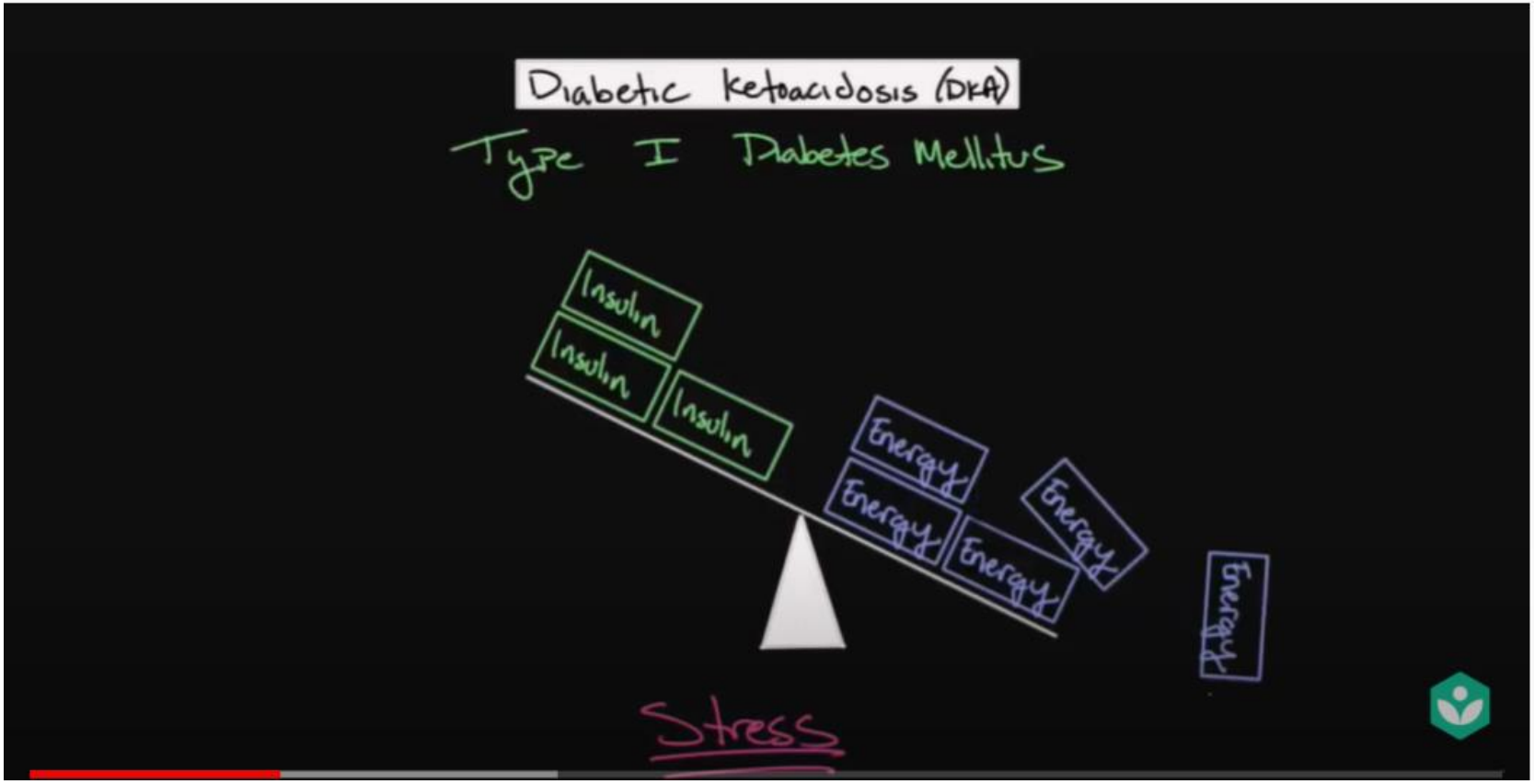
Diabetic ketoacidosis (DKA)
Type I Diabetes Mellitus
Insulin
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Energy
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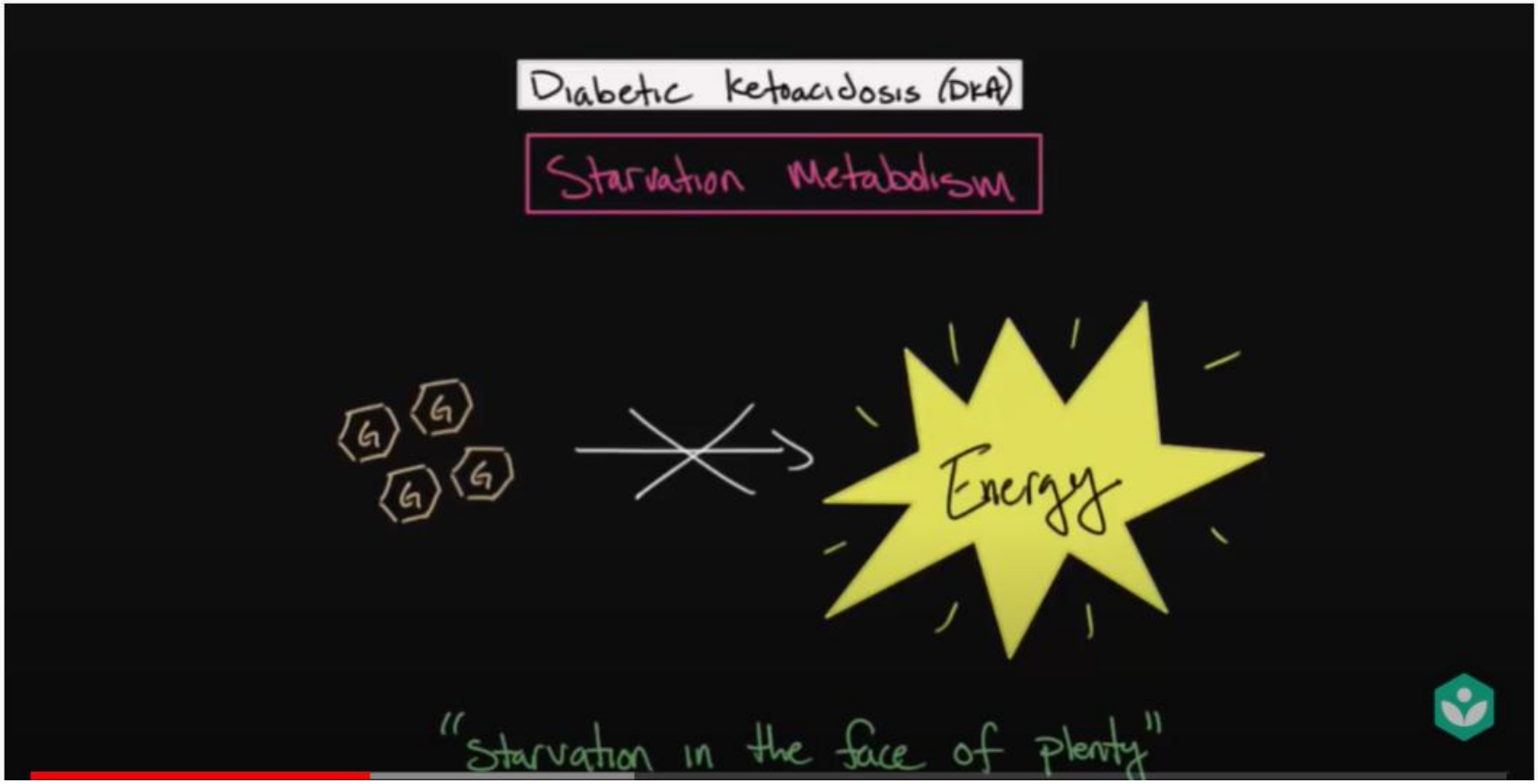
Energy
Stress


Diabetic ketoacidosis (DKA)
Starvation Metabolism
G
G
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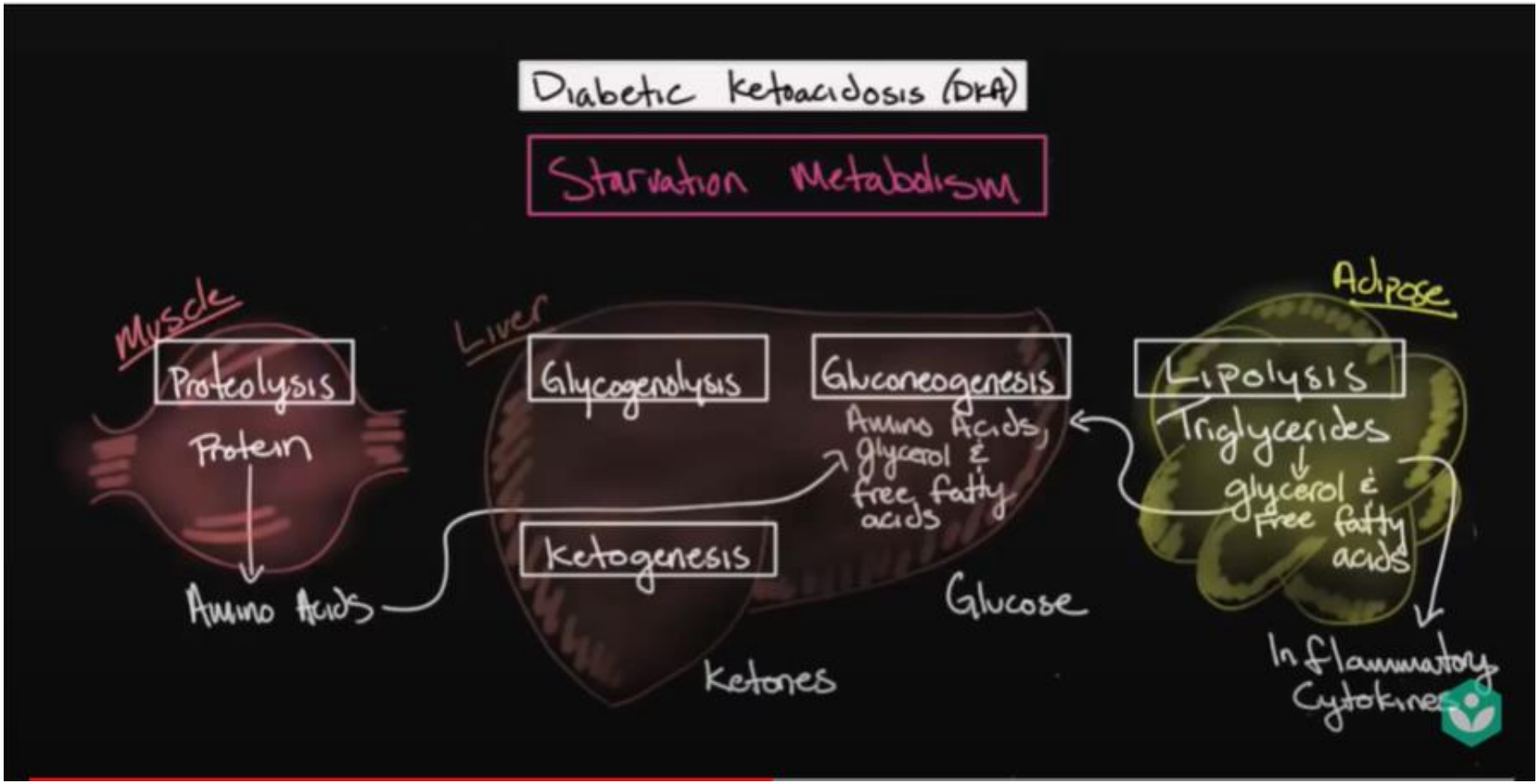
G
Energy
"Starvation in the face of plenty"


Diabetic ketoacidosis (DKA)
Starvation Metabolism
Muscle
Proteolysis
Protein
Liver
Glycogenolysis
Gluconeogenesis
Ketogenesis
Glucose
Ketones
Adipose
Lipolysis
Triglycerides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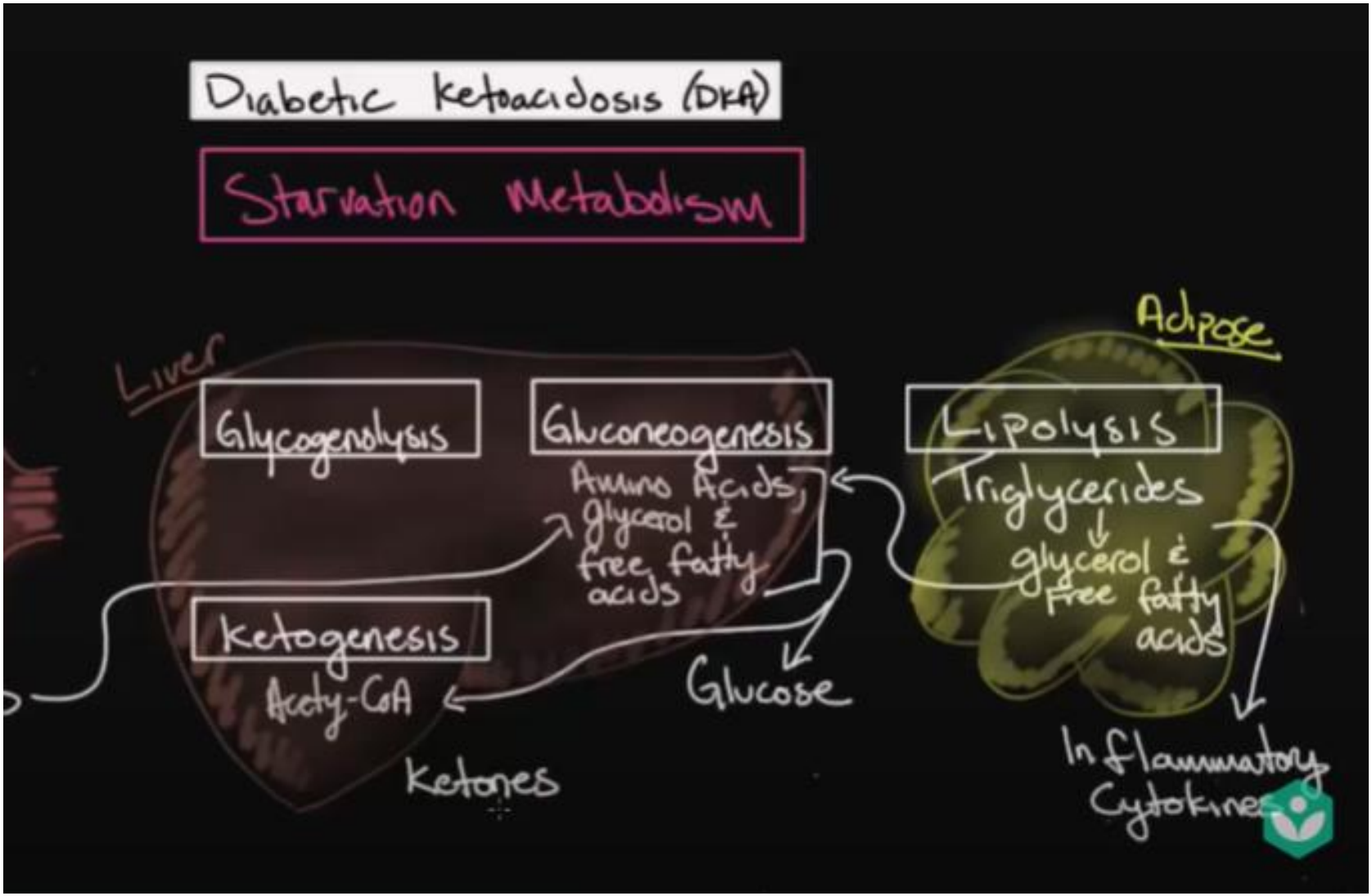
Inflammatory Cytokines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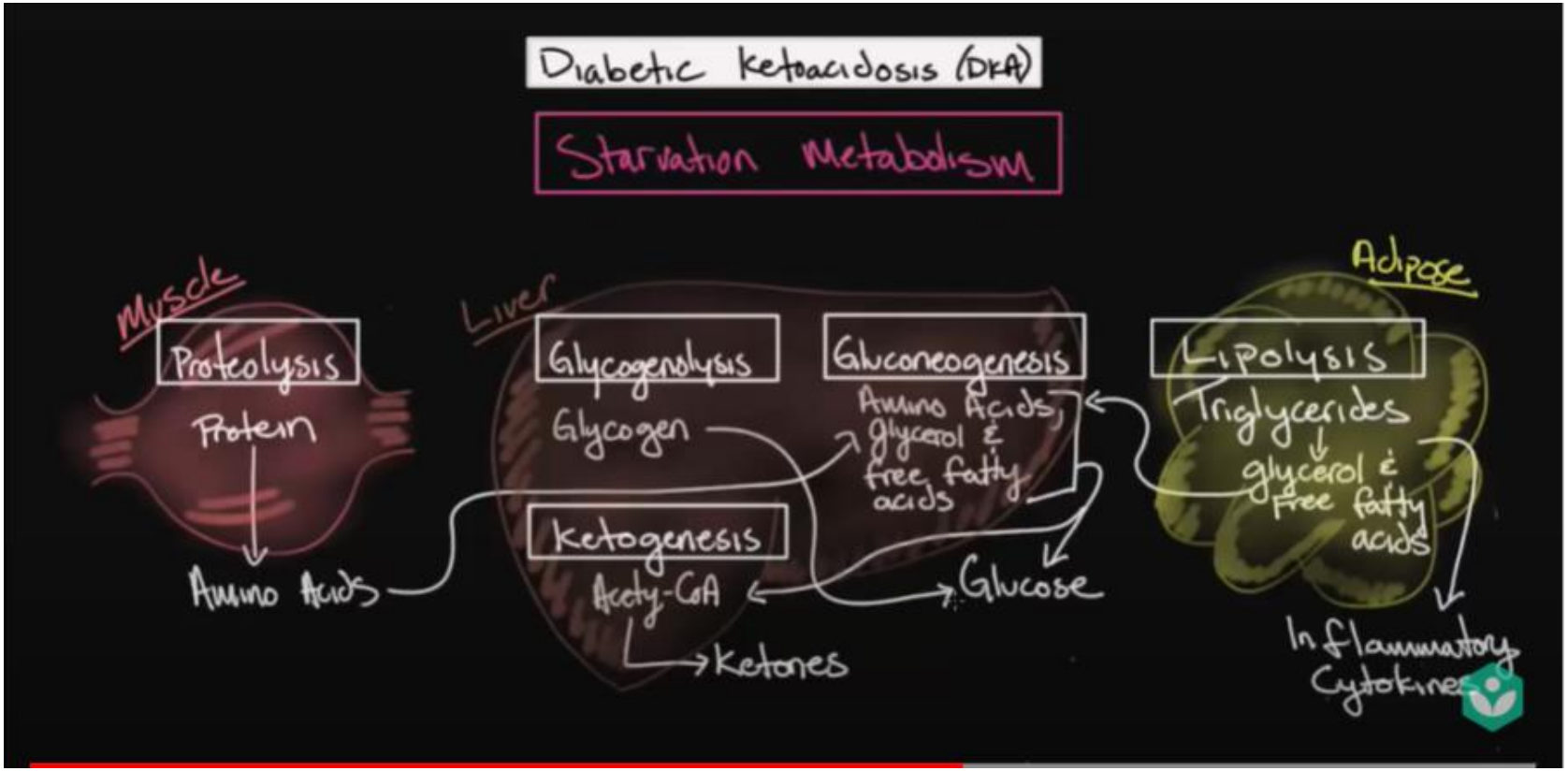
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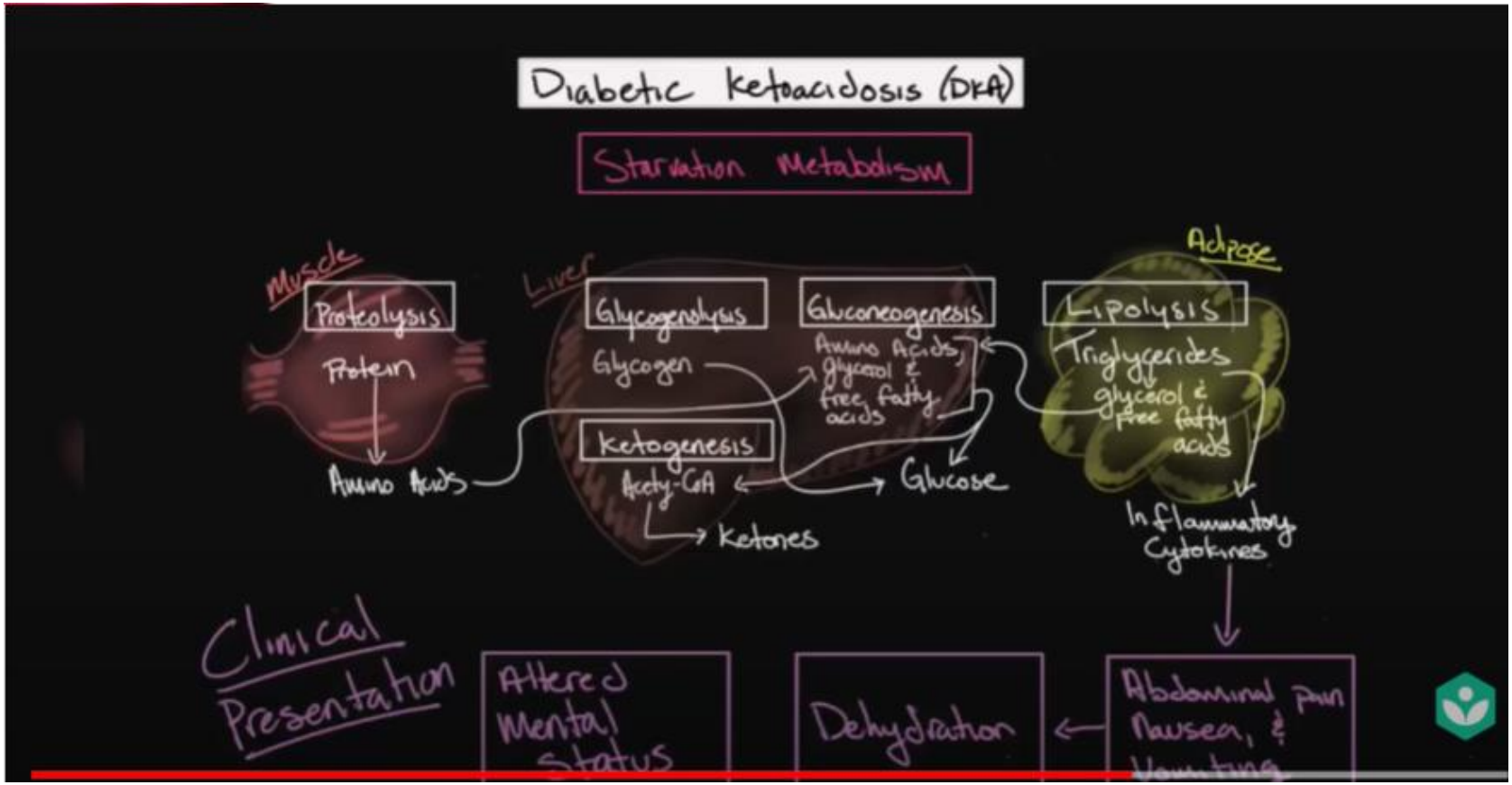
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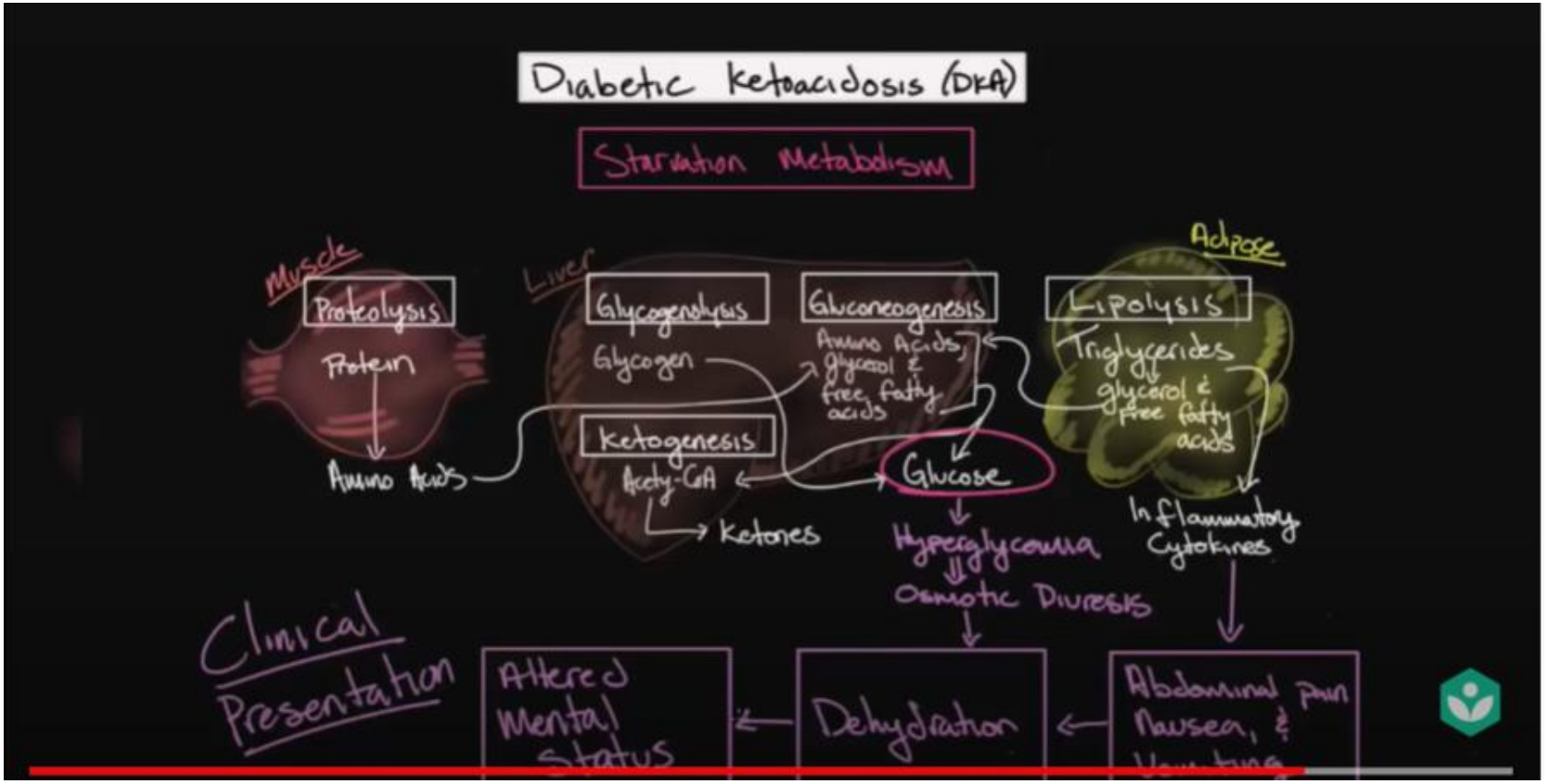
Clinical Presentation
Altered Mental Status
Dehydration
Abdominal pain
Nausea, &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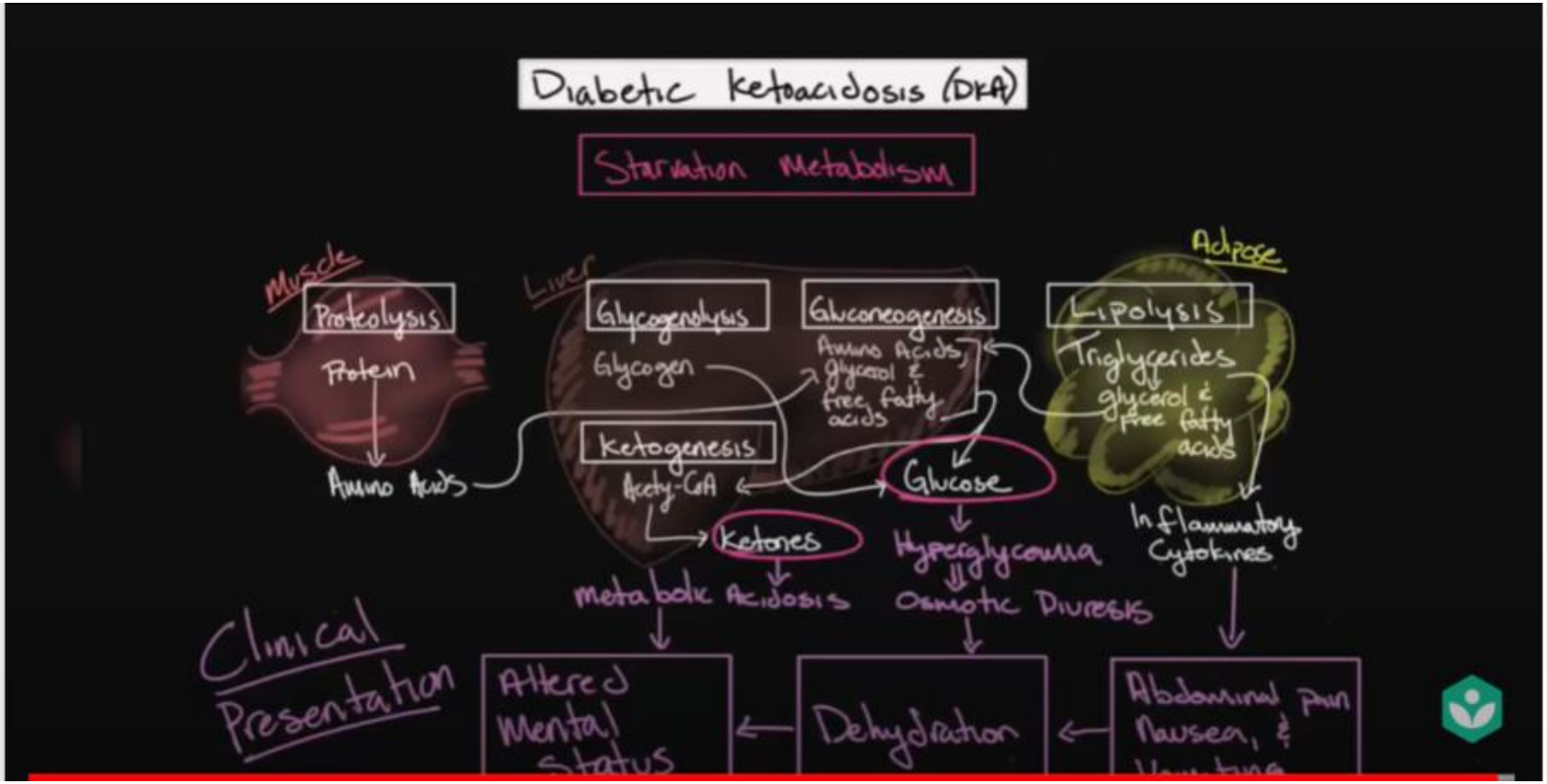
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What does all this cause?

- **Dehydration**
  - Hyperglycemia and fluid shifts
  - Osmotic diuresis
  - Ketone induced nausea and vomiting
- **Electrolyte Abnormalities**
  - Hypokalemia – K+ shifts out of cells. Serum K can be normal, but total body K is low
  - Na, Cl, Phos, Ca and Mg all affected also
- **Altered Mental Status**
  - Low pH (<7.3)
  - Dehydration
  - Cerebral Edema

Presentation

- **New diabetics – takes several days**
  - C/O-Polyuria, polyphagia and polydipsia
  - Abdominal pain, nausea and vomiting
  - Muscle cramping and pain
  - Dehydration (check cap refill), Tachycardia, tachypnea
  - Blurry Vision
- **Established diabetics – quicker**
- **LATE findings**
  - Mental Status changes, headache
  - Kussmaul breathing
  - Ketotic Breath

Big Concern – cerebral edema

- **Indications**
  - Headache-new onset with treatment or worsening HA
  - Mental status changes-irritability, confusion, incontinence
  - Focal neurological deficits
- **Statistics**
  - Among children with cerebral edema 57% recover, 21% survive with neuro deficits and 21% die.
- **Risk factors**
  - Younger age
  - New diagnosis
  - Severity of acidosis
  - Administration of bicarbonate
  - Larger volumes of fluid given in the first 3-4 hours
  - Administration of insulin within the first hour of fluid treatment or an insulin bolus

Cerebral Edema Criteria

- Diagnostic Criteria
  - Abnormal motor or verbal response to pain
  - Decorticate or decerebrate posture
  - Cranial Nerve Palsy
  - Abnormal neurological respiratory pattern
- Major Criteria:
  - Altered mentation/fluctuating level of consciousness
  - HR decels not improved with hydration or sleep
  - Age inappropriate incontinence
- Minor Criteria:
  - Vomiting
  - Headache
  - Lethargy or difficult arousing from sleep
  - DBP > 90
  - Age < 5

Cerebral edema-how to prevent and treat

- **Recommendations:**
  - Avoid **excessive** fluid resuscitation as associated with cerebral edema
    - Estimate degree of dehydration in DKA patients – typically about 7%
  - If clinically dehydrated: **start with a 10 cc/kg NS bolus**
  - Insulin Bolus should not be given and insulin IV should not start until IVF have been running for at least an hour
- **Treatment**
  - Mannitol 1g/kg over 20min-can repeat Q1-2hrs PRN some sources say as soon as 30min
  - Hypertonic Saline 3%- 5-10ml/kg over 15-20min

Our Guideline

- **Establish the diagnosis:**
  - Hyperglycemia >200 mg/dl AND
  - Ketonemia (b-hydroxybutyrate - BOHB) or acetone > 1 mmol/L AND
  - Venous pH <7.3 or HCO3 < 15mEq/L

- **High Risk Cerebral Edema? - YES? OHSU**

(telemedicine?)

  - **-**Age < 24 mo
  - -PCO2 <10
  - -Dev Delay or unable to communicate
  - -GCS <13
  - -Abnl neuro exam after Fluid resuscitation
  - - pH < 7.15
  - -HCO3<5
  - -BUN >30
  - -Organ dysfunction

ER/Initial Treatment

- **Assess cerebral edema risk – if high risk** consult pediatric hospitalist & consider transfer to OHSU

- **Fluid Resuscitation BEFORE insulin**
  - **Moderate dehydration**- 10 ml/kg of 0.9% NS over one hour. Most kids with DKA are ok with gradual rehydration & reduces risk of cerebral edema; we often start with 10/kg and then start continuous fluids; may re-bolus if significant VS/circulation abnormalities.
  - **Severe dehydration**- Repeat bolus (10 cc/kg). Each bolus over 30-60 minutes until normal circulation restored. Max of 30 ml/kg.
  - **Overt shock**- 20 ml/kg NS rapidly. Monitor GCS/exam. Repeat if needed. OHSU consultation for management as high risk for cerebral edema.

ER/Initial Treatment

- **Diagnostic Testing:**
  - VBG, BMP, Mg, Phos, Ketones, Hgb A1C
  - Urine ketones
  - Blood culture and UA (if febrile): 30% have microbial co-morbidity.
- **Nursing:**
  - Secure two peripheral IV lines-
    - 1) fluid resuscitation, maintenance fluids, and insulin; 2) access for frequent blood draws
  - Cardiac monitor, Q15min vitals until stable
  - Q1hr Blood glucose
  - Q1hr GCS

Insulin Drip and Fluids

- **Insulin Drip**
  - 0.05 units/kg. OHSU generally starts at 0.05 units/kg/hr for most patients with DKA regardless of age; if acidosis is not improving, can gradually increase to 0.1 units/kg/hr. If patient has small ketones, pt likely does not have DKA needing an insulin drip (so if pH & HCO3 meet your criteria but ketones are small, would suggest considering other causes of acidosis)
- **Hydration Fluids**
  - Calculate fluid rate (1.5x Maintenance start) – usually consider 7% dehydration
  - NS + 20 mEq KCL+ 20 mEq Kphos (Bag 1)
  - D10 NS + 20 mEq KCL+ 20 mEq Kphos (Bag 2)
  - Titrate the above per Pediatric DKA Hydration Rate Chart
- Start hydration fluids and insulin together

Pediatric Diabetic Ketoacidosis Hydration Rate Chart

Total ml/hr Infusion Rate	To Provide Dextrose Concentration of **D5W**		To Provide Dextrose Concentration of **D7.5W**	
	0.9%NaCl + 20 mEq Kacetate & 13.6 mMol KPO_4	D10 / 0.9% NaCl + 20 mEq KAcetate & 13.6 mMol KPO_4	0.9%NaCl + 20 mEq KAcetate & 13.6 mMol KPO_4	D10 / 0.9% NaCl + 20 mEq KAcetate & 13.6 mMol KPO_4
30 mL/hr	15 mL/hr	15 ml/hr	7.5 ml/hr	22.5 ml/hr
40 ml/hr	20 ml/hr	20 ml/hr	10 ml/hr	30 ml/hr
50 ml/hr	25 ml/hr	25 ml/hr	12.5 ml/hr	37.5 ml/hr
60 ml/hr	30 ml/hr	30 ml/hr	15 ml/hr	45 ml/hr
70 ml/hr	35 ml/hr	35 ml/hr	17.5 ml/hr	52.5 ml/hr
80 ml/hr	40 ml/hr	40 ml/hr	20 ml/hr	60 ml/hr
90 ml/hr	45 ml/hr	45 ml/hr	22.5 ml/hr	67.5 ml/hr
100 ml/hr	50 ml/hr	50 ml/hr	25 ml/hr	75 ml/hr

160 ml/hr	80 ml/hr	80 ml/hr	40 ml/hr	120 ml/hr
170 ml/hr	85 ml/hr	85 ml/hr	42.5 ml/hr	127.5 ml/hr
180 ml/hr	90 ml/hr	90 ml/hr	45 ml/hr	135 ml/hr
190 ml/hr	95 ml/hr	95 ml/hr	47.5 ml/hr	142.5 ml/hr
200 ml/hr	100 ml/hr	100 ml/hr	50 ml/hr	150 ml/hr

IF GLUCOSE:

Greater than 300 mg/dL: USE 0.9% NaCl + 20 mEq KAcetate/L & 13.6 mmol KPO4/L (20 mEq KPO4) (NO DEXTROSE)

200 mg/dL to 300 mg/dL: Use chart to provide dextrose concentrations of D5W

150 mg/dL to 199 mg/dL: Use chart to provide dextrose concentrations of D7.5W

Less than 150 mg/dL: USE D10W / 0.9% NaCl + 20 mEq KAcetate/L & 13.6 mmol KPO4/L (20 mEq KPO4/L)

Pediatric Diabetic Ketoacidosis

- **DKA Labs**
  - POCT Glucose Routine, Every hour
  - CBC with manual differential Once, Starting today For 1 Occurrences
  - Comprehensive metabolic panel Once, Starting today For 1 Occurrences
  - Basic metabolic panel (4 hours after CMP) Magnesium and Phosphorus Q4hrs
  - Glyco Hb (Hba1C Fraction) Once, Starting today For 1 Occurrences
  - IgA Once, Starting today For 1 Occurrences
  - Acetone Every 4 hours
  - Blood Gas-Venous STAT, Every 2 hours (RT)
  - Oxygen Setting (Rm Air, LPM, O2%, FiO2):
  - Urinalysis with microscopic Once, Starting today For 1 Occurrences
  - Urine culture Once, Starting today For 1 Occurrences

Case Study

- 12 mo. new onset DKA
- History- 3 days of polyuria and polydipsia, mom type 1 diabetic so checked sugar at home and read high. Recent RSV infection. Brought pt to ED.

  14:15-Pt triaged

  14:50- Pt receiving 20ml/kg bolus, CBG-598

  1500-VBG resulted pH-7.02 CO2-18 HCO3-4.6, ketones-9.56, no UTI

  16:25- insulin and fluids started

  16:45-1st and only GCS documented

  1700-More labs resulting, CMP showed glucose of 721 (took 2 hrs to result)

  1800-CBG-357- sugars dropped quickly

  18:45- Pt was transported out of ED with PANDA team

Take home points

- We are seeing more and more DKA
- Biggest concern is cerebral edema
  - Higher risk in younger kids and new diagnosis
- Fluid resuscitation – Start small and SLOW
- NO Subcutaneous Insulin or bolus of Insulin
- No insulin until fluids have run for an hour
- Decrease blood sugar slowly 50-100mg/dl an hour
- Monitor mental status closely
- Make sure fluids have dextrose added when CBG is between 200-300

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Questions??

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