DKA

1. Insulin
    a. Glucose ⇒ liver ⇒ glycogen
    b. ⇑ Lipogensis
    c. Prevents lypolysis
    d. Inhibits gluconeogenisis
    e. Inhibits glycogenolysis
    f. Increases stores of glycogen
2. Stress Hormones
    a. Cortisol
    b. Catecholamines
    c. Glucagon
    d. Growth Hormone
    e. Somatostatin
3. Metabolic Derangments in DKA
    a. Relative deficiency of insulin
        i. Insulin deficiency → inability for glucose to enter cells → hyperglycemia and cellular starvation
        ii.
    b. Excess stress hormones
        i. Cellular starvation → release of stress hormones → increased gluconeogenesis, glycolysis, lipolysis → further hyperglycemia and increased free fatty acids
        ii. Free fatty acids → ketones (beta hydroxy buterate, acetoacetate
4. Precipitating factors in DKA
    a. Lack of insulin
    b. Infection
    c. AMI
    d. CVA
    e. Trauma
    f. Pregnancy
    g. Hyperthyroidism
    h. Pancreatitis
    i. Emotional upset
    j. Alcohol use
5. Clinical signs related to pathophysiololigcal events
    a. ↑Glucose→ ↑osmotic load → ↓intracellular water → osmotic diuresis → ↓total body water. This results in:
    b. hypotension, tachycardia and dehydration
    c. Decreased serum electrolytes with depletion of
        i. Sodium 1.3-1.6 mEq/L for each 100mg/dL increase in glucose
        ii. Potassium
        iii. Chloride
        iv. Phosphorus
        v. Magnesium

vi. Calcium

d. Insulin lack→ hyperglycemia (glucose cannot enter cells) and cellular starvation → release of stress hormones (especially glucagon) → increased lypolysis → ketogenesis. This results in:
    i. Acidosis with a decrease in sodium bicarbonate
    ii. A fruity breath odor (acetone)
    iii. Hyperventilation (Kussmal respirations)
    iv. Hyperkalemia – Potassium is initially increased because the acidosis causes it to shift out of the cells in exchange for the hydrogen ion. Correction of the acidosis, however, may be associated with a profound hypokalemia

6. Confirmatory Lab Findings
    a. Blood glucose > 350mg/dL
    b. Serum acetone > 2:1 dilution
    c. Serum bicarbonate <10 Eq/L
    d. pH < 7.30
7. Treatment
    a. IV fluids
        i. 1 liter first hour
        ii. 1 liter next 2 hours
        iii. 1 liter next 4 hours
        iv. As much as 5 liters may be needed in first 3-4 hours
        v. If severely dehydrated, use NS for first 2 liters then alternate 0.45NS with NS
        vi. When glucoses is <250 mg/dL then add glucose
        vii. IV #2 is 0.45 NS
            1. Put at TKO till initial K+ is back
            2. If initial K is <3.3 add 40mEq of KCL and run at 250ml/hr and hold insulin drip for 30 minutes
            3. If initial K is normal add 40mEq of KCL and run at 250ml/hr and start insulin drip
            4. If initial K is >5.0 start insulin drip and hold KCL until in normal range.
    b. Insulin
        i. High doses are usually not required to reverse DKA
        ii. Drip of 5-10 U/hr in adults
        iii. Drip of 0.05 – 0.1 U/kg/hr in children
        iv. If no response in 1 hour (should see a drop in at lease 50mg/dL) then double drip and bolus (more likely seen in patients with infection)
        v. Bolus usually not required
    c. Sodium Bicarbonate
        i. Not indicated unless pH is <7.0
        ii. Increases potassium requirement
    d. Early potassium replacement

i. If initial potassium is low, add 20mEq KCL to first liter NS and run in over 1 hour
ii. If initial potassium is normal, add 20-40mEq KCL to 2nd liter of NS and run at 500ml/hr
iii. If oloiguria or abnormal BUN/Creatinine, decrease potassium replacement

e. Phosphate replacement
i. DKA therapy results in phosphate from extracellular to intracellular and hypophosphatemia results in 6-12 hours
ii. Phosphate should never be given in the initial phase of DKA treatment and is not indicated unless the serum PO4 drops below 1mg/dL. A commercial KH2PO4 + K2HPO4 can be used

f. Magnesuim
i. Consider adding 2 gm magnesium to IV #1 in 3rd liter NS

g. Monitoring (every 1-2 hours)
i. Glucose
ii. Acetone
iii. Potassium
iv. Phosphorus
v. CO2
vi. pH
vii. chloride
viii. Continuous ECG monitoring

8. Complications
a. Aspiration
b. DIC
c. Rhabdomyolysis
d. DVT
e. Hypoglycemia
f. Hypokalemia
g. Paradoxical spinal fluid acidosis
h. Cerebral edema
i. Alkalosis (excess bicarb)
j. CHF from overhydration

9. By the numbers
a. 7.0
b. 1.0
c. 1.3-1.6
d. 250
e. 5-10
f. 0.05-0.1
g. 20
h. 350
i. 2:1
j. <10