EM Basic- DKA

Diabetic Ketoacidosis (DKA)- mostly a disease of Type 1 Diabetics
Hyperglycemia Hyperosmolar State- mostly a disease of Type 2 Diabetics
HOWEVER- either condition can happen in Type 1 or Type 2 Diabetics

DKA
Definition- Use the abbreviation- DKA

Diabetic- blood sugar over 250
Keto- ketones in the urine or blood
Acidosis- pH of 7.3 or lower

Pathophys- lack of insulin leads to body to burn fat for fuel -> ketone production -> acidosis (ketones disassociate H+ ions at body's normal pH)

PEARL- A high blood sugar alone doesn't make the diagnosis of DKA- they need the ketosis and acidosis as well- process that evolves over hours to days

HHS
Definition- also use the abbreviation- HHS

Hyperglycemic- blood sugar over 800- much higher than DKA
Hyperosmolar- serum osmolarity over 320
State- it's a state (so maybe this one doesn't totally work like DKA does)

No ketones produced in HHS since patient has some circulating insulin
(May have small ketones from vomiting but not large ketones like in DKA)

PEARL- Major difference
DKA- 4 to 6 liters volume down
HHS- 9 to 10 liters volume down, often with altered mental status

Physical exam

Kussmal's respirations- rapid deep breathing without respiratory distress- compensation for acidosis by blowing off CO2

Fruity odor on breath- only in 20-30% of patients, some people are unable to smell this- don't hang your hat on it

History- look for precipitating cause to DKA and treat appropriately- any stressor can cause DKA
7 I's pneumonic

Infection- signs/symptoms of pneumonia, UTI, appendicitis/cholecystitis?
Infarction- CVA or MI
Iatrogenic- change in insulin dose by provider
Incision- surgery can be a precipitating cause
Intoxication- ETOH or illegal drugs
Initial- initial diagnosis of Type 1 DM
Insulin- too little or no insulin being taken by the patient

PEARL- Many patients with DKA will have nausea, vomiting, and abdominal pain. If the abdominal exam is concerning or the pain persists after you have corrected the acidosis, image appropriately for underlying surgical pathology

INITIAL MANGEMENT

Fingerstick glucose, 2 large bore IVs, blood draw for labs and stat VBG

Labs
CBC- high H and H = dehydration
Chem 10- electrolytes are very important in DKA management
VBG- serum pH, CO2, and bicarb measurements are necessary for management
UA- urine ketones and signs of UTI
Serum Ketones- + or -, if urine ketones are absent and you suspect DKA
Serum or urine HCG for females- females = pregnant until proven otherwise
Chest x-ray- + or – if respiratory symptoms suggesting pneumonia

PEARL- Patients may produce both acetoacetate and beta-hydroxybuterate as ketones but only acetoacetate is detected by urine dipstick, order a serum beta-hydroxybuterate if necessary

IV Fluid management- initially much more important than insulin

Patient WITH signs of shock- (tachy, low BP, poor perfusion, altered mental status)- bolus 2-3 liters of normal saline as fast as possible

Patient WITHOUT signs of shock- One liter of normal saline over 1 hour

PEARL- DKA = hypovolemia and hypokalemia who just happens to have a high blood sugar

Potassium management- total body stores of potassium are depleted in DKA- insulin is needed to drive potassium into the cells, without insulin lots of potassium is lost in the urine

PEARL- even if the potassium is normal, in DKA these patients are total body potassium depleted

Potassium replacement- depends on initial K+ level

K+ Below 3.3- add 20-30 meq of K+ per liter of IV fluids
*******DON'T START INSULIN UNTIL K+ IS ABOVE 3.3!*******
(This will push too much potassium into the cells and cause fatal arrhythmia)

K+ 3.3 - 5- add 20-30 meq of K+ per liter of IV fluids, start insulin

K above 5- NO extra K+ to IV fluids, start insulin

Insulin- after K+ level is addressed- next question= to bolus or not to bolus? (Bolusing not proven to add benefit and theorized- but not proven- to increase rate of cerebral edema)

Bolus- 0.1 units/kg regular insulin IV
Drip- 0.1 units/kg/hr regular insulin IV
(Some texts recommend 0.14 units/kg/hr if you don't use a bolus)

Bicarb- controversial and not done by every clinician

Only give bicarb drip if initial pH < 6.9
Bicarb drip- 3 amps of sodium bicarb in one liter of **D5W (NOT NORMAL SALINE!)** (NS + bicarb = precipitation and a very hypertonic solution)
Drip rate- Give 400cc over 2 hours

ONGOING MANAGEMENT

Fluids
After initial IV fluid bolus- recheck serum sodium and correct it for blood sugar
Corrected serum sodium
Measured serum sodium + (((Glucose – 100) *1.6)/100)
Example- Na 125, Glucose 500- 125 + (500-100) *1.6/100 -> 125 + 6.4 = 131.4
If corrected sodium low- Normal saline at 250 – 500 cc/hr
If corrected sodium normal or high- ½ normal saline (0.45%) at 250-500 cc/hr

Once serum glucose <200- switch to D5 ½ normal saline- prevent hypoglycemia
Insulin- once blood sugar <200- reduce insulin drip by ½ to 0.05 units/kg/hr

PEARL- DO NOT STOP INSULIN UNTIL ANION GAP IS NORMAL (CLOSES)
Doing so will send the patient back into DKA
Increase rate of D5 ½ normal saline or give D50 IV if hypoglycemic

Ongoing labs

While in ED- at a minimum- VBG, chem 10, and fingerstick every hour
(If your VBG panel includes sodium, postassium, bicarb, and glucose use that)
Sicker patients may need VBGs every 30 minutes

Pediatric DKA pearls

Limit fluid boluses- limit to one 20 cc/kg bolus in ED, more than 45 cc/kg in first 4 hours increases risk of cerebral edema, shock is rare in pediatric DKA

If the patient was transferred to you- find out exactly how much fluid and how many boluses they got at the transferring hospital

Consult pediatric endocrinology early- they follow these patients closely and want to be involved early

BIG POINTS
DKA- blood sugar >250, ketones in blood or urine, pH 7.3 or less
HHS- blood sugar >800, serum osmolarity over 320
IV fluids- normal saline rapid bolus if in shock, otherwise one liter in first hour
DON'T START INSULIN UNTIL YOU KNOW THE POTASSIUM
Potassium- add K+ to IV fluids as appropriate (see above)
Insulin- + or – bolus 0.1 units/kg regular insulin IV, drip 0.1 units/kg/hr
When blood sugar <200- add dextrose to fluids, reduce insulin drip by 1/2
DON'T STOP INSULIN DRIP UNTIL THE ANION GAP IS NORMAL (CLOSES)
Pediatric DKA- limit fluid boluses to one 20 cc/kg bolus, consul peds endocrine early

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