

Diabetic Ketoacidosis

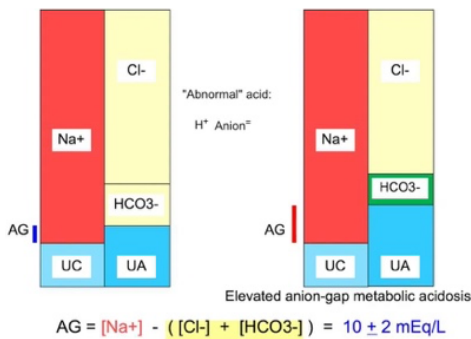
Physical Exam: dehydration, rapid breathing with fruity breath odor (acetone), hypotension, tachycardia, profound fluid & electrolyte depletion.

Labs: BG > 250 mg/dl, K⁺ = 5-8 mEq/L (hyperkalemia), Na⁺ = 130 mEq/L (mild hyponatremia), Phosphate = 6-7 mg/dL (hyperphosphatemia), increased beta-hydroxybutyrate levels (3-8 mmol/L), anion gap > 12, decreased bicarb (5 - 18 mEq/L), and increased BUN & Cr levels.

Diagnostic Criteria for DKA

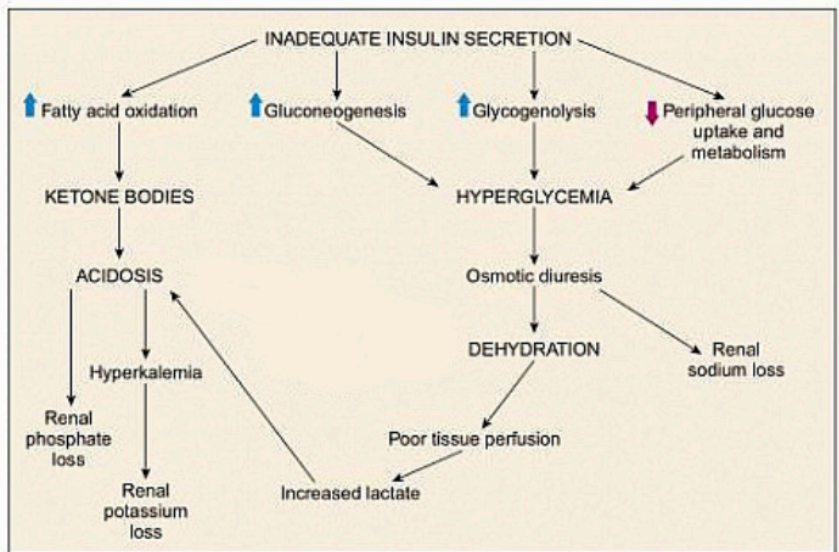
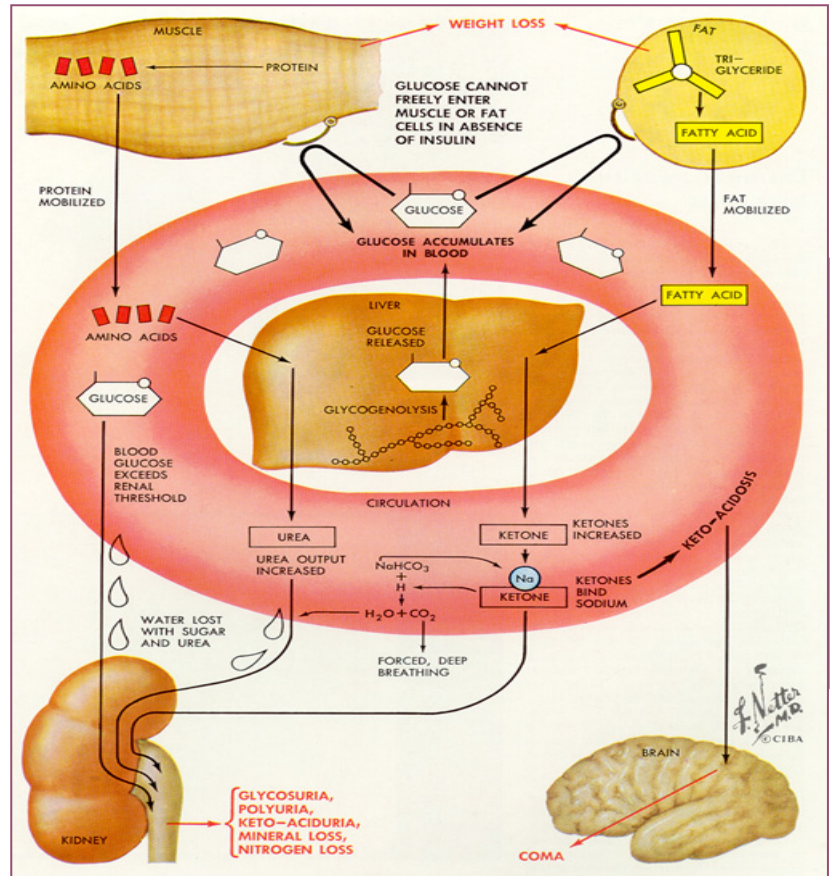
	DKA		
	Mild	Moderate	Severe
Plasma glucose(mg/dl)	More than 250	More than 250	More than 250
Arterial PH	7.25 - 7.30	7.00 - 7.24	Less than 7.00
Serum bicarbonate(mEq/L)	15 - 18	10 - 14	Less than 10
Urine ketones	+ve	+ve	+ve
Serum ketones	+ve	+ve	+ve
Effective serum osmolality(mOsm/kg)	Variable	Variable	Variable
Anion gap	More than 10	More than 12	More than 12
Alteration in sensoria	Alert	Alert / drowsy	Stupor / coma

Anion Gap



Normal Values

- K⁺: 3.5 - 5.2 mEq/L
- Na⁺: 135 - 145 mEq/L
- Phosphate: 2.7 - 4.5 mg/dL
- Magnesium: 1.5 - 2.2 mg/dL
- Anion Gap < 12



- Bicarbonate: 21 - 28 mEq/L
- Beta-hydroxybutyrate < 0.5 mmol/L
- Osmolality: 275-295 mOsm/kg
- Cr: 0.6 - 1.2 mg/dL
- pH: 7.35 - 7.45

Treatment: Fluid Replacement with 0.9%NaCl → 1 liter/hour x 2 hours, then 250 ml/hour

- When BG < 200, switch IVF to Dextrose 5% containing solution to prevent hypoglycemia → D5/0.45% NaCl at 250 ml/hour.

Insulin Replacement: initially 0.1 UNIT/KG IV bolus of Regular Insulin (Humulin R) IV then start insulin infusion (100 UNITS / 100 ml NS) at 0.1 UNIT/KG/HR until BG < 200, and switch to Humalog Sliding Scale regimen (AC&HS) when anion gap closes (i.e., anion gap < 12)



Electrolyte Replacements: Potassium, phosphate, and magnesium Replacement with Basic Metabolic Panel (i.e., serum electrolyte panel) every 2-4 hours.

Treatment Timeline for DKA ...

- Na & Fluid Replacement

- check serum K⁺
- if K < 3.3, hold insulin and replace K⁺

- if pH < 6.9, give 2 amps of NaHCO₃ IV (50 mEq/amp)



- when BG < 200, change IVF to D5/0.45% NaCl prevent hypoglycemia

NOTE: Insulin and NaHCO₃
→ transport K⁺ intracellular
→ may induce hypokalemia

Treatment	Time	Comments
<p>Brief history/examination Monitor, glucose, ECG, urine/serum ketones, VBG IV #1 NS 15-20 ml/kg/hr for first hour #2.45 NS TKO Send lytes, serum osmolarity, CBC, phosphate, calcium, magnesium, VBG, consider blood/urine culture.</p>	0	<p>If D-stick >250 (14mmol/L), urine + ketones, assume DKA Search for precipitant, infection Check ECG for hyperkalemia, infarction Foley catheter as needed</p> <p>Begin flow sheet of vital signs, mental status, glucose, lytes, AG, venous pH, I/O's</p> <p>Perform detailed history and exam</p>
<p>If initial [K⁺] >5.2 initiate regular insulin bolus dose of 0.1 U/kg then a rate of 0.1 U/kg/hr OR 0.14 U/kg/hr without bolus. Repeat [K⁺] STAT in 2 hours</p> <p>If initial [K⁺] is >3.3 <5.2 and urine output, add 20-30 meq of K⁺ to each L of fluid and insulin drip as above</p> <p>If initial [K⁺] is <3.3 hold insulin drip and give K⁺ @20-30 meq/hr until [K⁺] is >3.3 then initiate insulin drip as above</p>	30 min 1 hrs	<p>Initial lytes: check osmolarity, AG, glucose, corrected [Na⁺], K⁺</p> <p>Initial [K⁺] determines further therapy Adequate urine output is essential before initiating K⁺ therapy</p> <p>Repeat glucose, electrolytes, anion gap If anion gap >25 or glucose >800 (44 mmol/L) or significant comorbidity, consider ICU disposition</p>
<p>After NS bolus: Generally for eunatremia or hypernatremia give 0.45 NS @250-500 ml/hr with K⁺ supplement as above. For hyponatremia continue NS at 250-500 ml/hr</p> <p>If pH <6.9 may give 100 mmol NaHCO₃ in 400 ml of water with 20 eq KCL at 200 ml/hr. Repeat every 2 hours until pH >7.0. Check [K⁺] q 2 hrs.</p>	2 hrs	<p>If anion gap <25 and glucose <800 (44 mmol/L) and no significant comorbidity, consider floor or diabetic unit disposition</p> <p>Rate of hydration dependent on hemodynamics, hydration status, urine output</p> <p>Patients with pH >6.9 do not require NaHCO₃</p>
<p>Active Goals:</p> <ul style="list-style-type: none"> -Adequate fluid infusion -Insulin infusing -Maintain [K⁺] 3.3-5.2 -Lower glucose by 75 milligram/dl/hr -Maintain adequate electrolytes (Ca, Mg, Phos) <p>When glucose approaches 200 (11 mmol/L), change IV to D51/2NS with 20-40 meq KCL/L. Decrease insulin rate to 0.02-0.05 U/kg/hr</p>	3-12 hrs	<p>Re-check glucose, lytes, AG, VBG, mental status, I/O's, check results of initial phosphate, magnesium, calcium. Check lytes every 2 hrs initially in ED. Check glucose hourly</p> <p>If glucose does not decrease by 10% after one hour of insulin therapy, give 0.14 U/kg bolus then resume previous rate</p> <p>If glucose decreasing faster than 50-75 milligrams/dl/hr, (2.8-4.2 mmol/L) decrease insulin drip in half. Check glucose hourly</p>
<p>Correct estimated fluid deficits in the first 24-36 hours</p> <p>Maintain serum glucose 180-200 (10-11mmol/L) and continue insulin drip for at least 12 h or until DKA resolves: glucose <200 (11 mmol/L) and Anion Gap normal, pH >7.3 and HCO₃>15</p> <p>Feed patient. Start SC insulin regimen (0.5-0.8 U/kg in insulin naive patients). Continue IV insulin for 1-2 hrs AFTER SC insulin started</p>	12-48 hrs	<p>In young and new onset diabetics avoid excess free water, monitor carefully for development of cerebral edema, and have mannitol at the bedside</p> <p>Re-check lytes, glucose, AG: repeat in 4 hr If taking PO, consider oral K, Phos, Mg replacement as needed</p> <p>Late complications: Refractory acidosis (sepsis) Cerebral edema Vascular thrombosis (rare) ARDS</p>

INSULIN DOSING SCALES

Columnar Insulin Dosing Chart for Titrating Insulin Infusion Rate (EPIC)

DIRECTIONS:		TARGET BG 90-140 (1 ml = 1 unit) Columnar Insulin Dosing Chart*															
Start infusion using the drip rate (ml/hr) in COLUMN No.2 for the current Blood Glucose Tier	Blood Glucose Tiers (mg/dl)	column 1 (ml/hr)	column 2 (ml/hr)	column 3 (ml/hr)	column 4 (ml/hr)	column 5 (ml/hr)	column 6 (ml/hr)	column 7 (ml/hr)	column 8 (ml/hr)	column 9 (ml/hr)	column 10 (ml/hr)	column 11 (ml/hr)	column 12 (ml/hr)	column 13 (ml/hr)	column 14 (ml/hr)	column 15 (ml/hr)	column 16 (ml/hr)
To determine the new drip rate, compare the current BG Tier to the previous BG Tier.	Over 450	4.4	8.8	13.2	17.6	22	26.4	30.8	35.2	39.6	44	48.4	52.8	57.2	61.6	66	70.4
	385-450	3.6	7.2	10.8	14.4	18	21.6	25.2	28.8	32.4	36	39.6	43.2	46.8	50.4	54	57.6
	334-384	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
	290-333	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5	40
If current BG Tier is lower than the previous BG Tier, STAY IN THE SAME COLUMN	251-289	2.1	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21	23.1	25.2	27.3	29.4	31.5	33.6
	217-250	1.7	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17	18.7	20.4	22.1	23.8	25.5	27.2
	188-216	1.4	2.8	4.2	5.6	7	8.4	9.8	11.2	12.6	14	15.4	16.8	18.2	19.6	21	22.4
	163-187	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	10.8	12	13.2	14.4	15.6	16.8	18	19.2
If current BG Tier has not dropped MOVE 1 COLUMN TO THE RIGHT <i>If over 32 columns are needed: 33 = 32 +1, etc.</i>	151-162	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	141-150	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9	9.9	10.8	11.7	12.6	13.5	14.4
	131-140	0.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8	8.8	9.6	10.4	11.2	12	12.8
	121-130	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7	7.7	8.4	9.1	9.8	10.5	11.2
When hourly BG is 90-140, stay in the same column to determine the new drip rate. Do Not Change Columns	111-120	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6	6.6	7.2	7.8	8.4	9	9.6
	106-110	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8
	101-105	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.6	4	4.5	4.9	5.4	5.9	6.4	6.9	7.4
	96-100	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4	4.4	4.8	5.2	5.6	6	6.4
	90-95	0.3	0.7	1	1.4	1.7	2.1	2.4	2.8	3.2	3.5	3.8	4.1	4.4	4.7	5	5.3
When new BG is less than 90, Move 1 Column To The Left and refer to Figure No. 2 for D50 treatment.	80-89	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3	3.3	3.6	3.9	4.2	4.5	4.8
	70-79	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3.0	3.2
	60-69	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	.9	1	1.1	1.2	1.3	1.4	1.5	1.6
	Under 60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

BG	D50W	ACTION (Figure No.2)
80-89	Do Not Give	* If you have not moved 1 column to the left as directed above, do so now
70-79	10 ml IV Push	* If you have not moved 1 column to the left as directed above, do so now
60-69	15 ml IV Push	* Recheck BG in 15 minutes * Repeat as necessary
50-59	20 ml IV Push	* If you have not moved 1 column to the left as directed above, do so now
30-49	25 ml IV Push	* Recheck BG in 15 minutes * Repeat as necessary
Under 30	30 ml IV Push	* Repeat as necessary * Contact physician if BG is under 60 for 2 consecutive BG measurements

NOTIFY PHYSICIAN IF: (Figure No.3)
* BG is less than 60 for 2 consecutive BG measurements
* BG reverts to greater than 200 for 2 consecutive BG measurements
* If an insulin requirement exceeding 24 units/hour does not result in a lower BG Level or if the drip rate (ml/hr) drops to less than 0.5 units/hr
* If the K+ level drops to less than 4
* If continuous enteral feeding, TPN, or IV insulin infusion is stopped

*The Columnar Insulin Dosing Chart and Guideline were designed by the Georgia Hospital Association Research and Education Foundation Partnership for Health and Accountability Diabetes Special Interest Group's Pharmacy representative Lawrence Stockton using studies and work of Drs. Davidson, Steed, Bode, White, Skor, and Santiago, Hawkins, Shipp along with the valuable input and insight of the Diabetes SIG expert panel. PHA Diabetes SIG: All Rights Reserved; Copyright Pending Revised4/06; Reviewed 10/07

Insulin Sliding Scale Regimens

Glucose Level (mg/dL)	Low Dose Regimen (0-6 UNITS) AC & HS	Medium Dose Regimen (0-12 UNITS) AC & HS	High Dose Regimen (0-18 UNITS) AC & HS
< 70	25-50 ml Dextrose 50% IVP		
60 - 150	0	0	0
151 - 199	1	2	4
200 - 249	2	4	6
250 - 299	3	6	8
300 - 349	4	8	12
350 - 399	5	10	14
> 400	6	12	18
	Call MD/PA	Call MD/PA	Call MD/PA

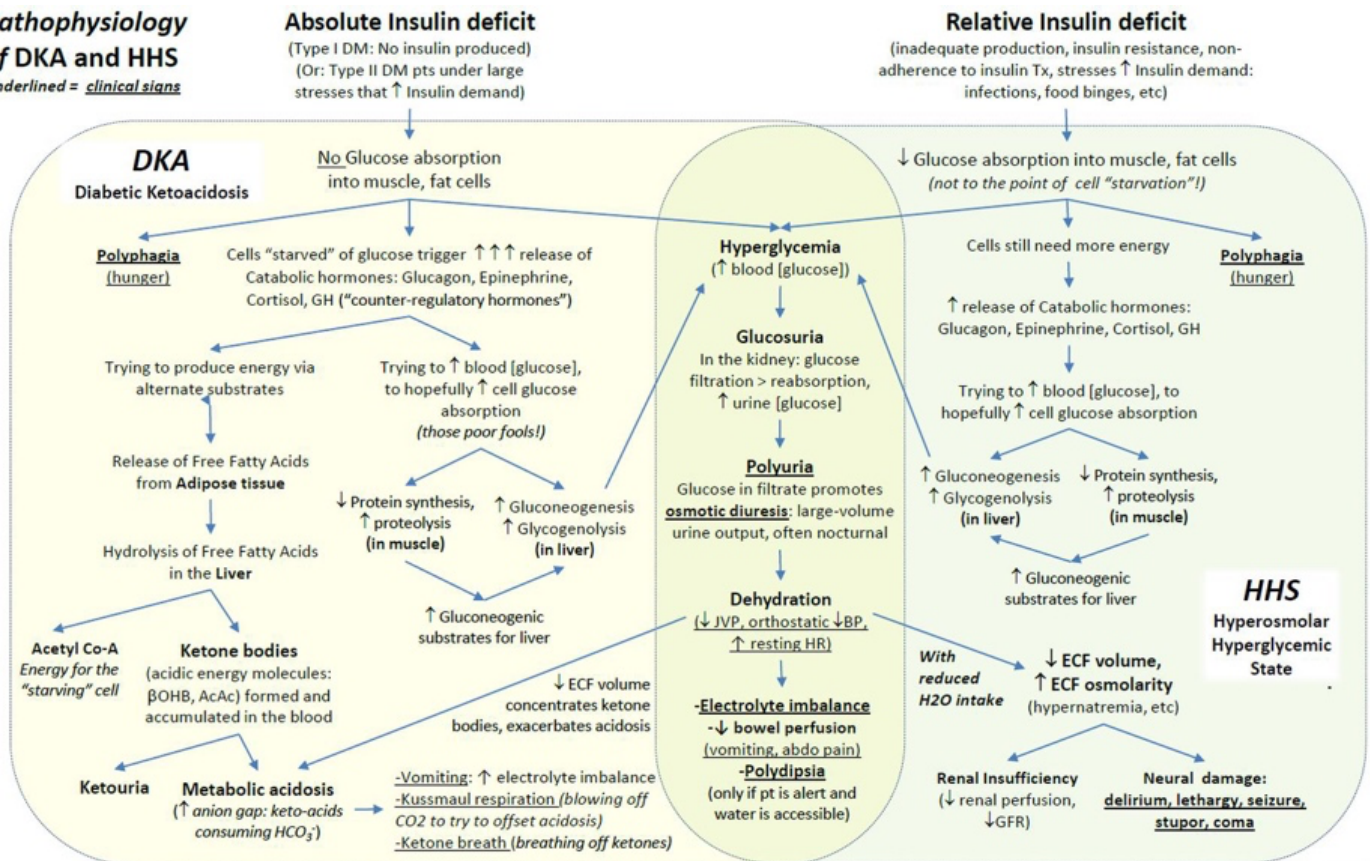
Diagnostic Criteria for DKA & Hyperosmolar Hyperglycemic State (HHS)

Criterion	<u>Diabetic ketoacidosis</u>			<u>Hyperosmolar hyperglycemic state</u>
	Mild (serum glucose > 250 mg per dL [13.88 mmol per L])	Moderate (serum glucose > 250 mg per dL)	Severe (serum glucose > 250 mg per dL)	Serum glucose > 600 mg per dL (33.30 mmol per L)
Anion gap*	> 10 mEq per L (10 mmol per L)	> 12 mEq per L (12 mmol per L)	> 12 mEq per L (12 mmol per L)	Variable
Arterial pH	7.24 to 7.30	7.00 to < 7.24	< 7.00	> 7.30
Effective serum osmolality*	Variable	Variable	Variable	> 320 mOsm per kg (320 mmol per kg)
Mental status	Alert	Alert/drowsy	Stupor/coma	Stupor/coma
Serum bicarbonate	15 to 18 mEq per L (15 to 18 mmol per L)	10 to < 15 mEq per L (10 to < 15 mmol per L)	< 10 mEq per L (10 mmol per L)	> 18 mEq per L (18 mmol per L)
Serum ketone†	Positive	Positive	Positive	Small
Urine ketone†	Positive	Positive	Positive	Small

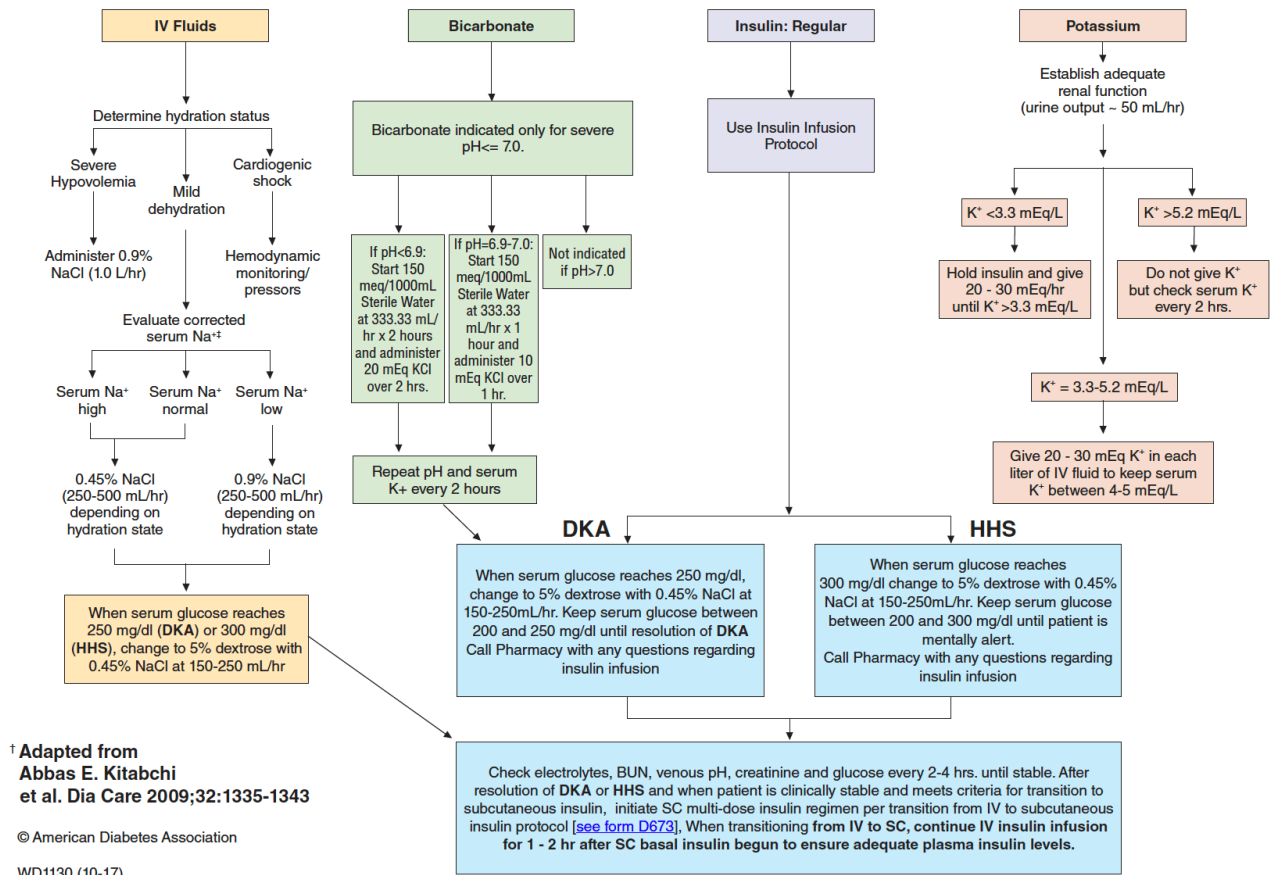
Pathophysiology of DKA and Hyperosmolar Hyperglycemic State (HHS)

Pathophysiology of DKA and HHS

Underlined = clinical signs



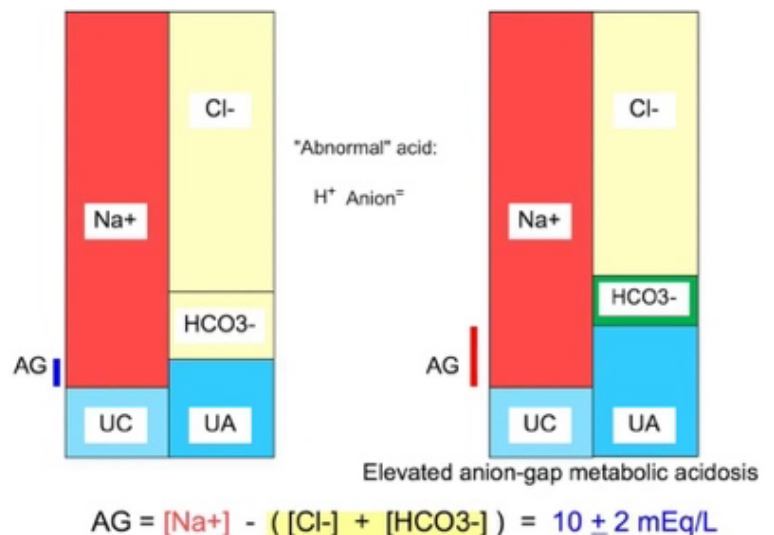
Guideline for Management of DKA or Hyperosmolar Hyperglycemic State (HHS) (University of California at San Diego Protocol)



Anion Gap Explanation ...

When the anion gap is increased, it is usually caused by an increase in unmeasured anions (UA) during acidosis.

- Unmeasured organic acids, such as lactate and pyruvate, increase in acidosis and must be buffered by donating a proton (H⁺) to bicarbonate → decreasing bicarbonate levels and increasing the amount of “unmeasured” anions (i.e., organic anions).
- The total numbers of anions and cations are still equal, but the gap is increased because of a lowering of the “measured anion” (i.e., serum bicarbonate).
- The most common causes of an elevated anion can be remembered by the mnemonic MUDPILES : methanol, metformin, uremia, diabetic ketoacidosis (DKA), ethylene glycol, salicylates, and starvation. These conditions produce an acid load that consumes bicarbonate, increases the anion gap, and lowers serum pH.
- If a patient is acidotic and has an elevated anion gap, it is almost certainly caused by MUDPILES, with each condition having characteristic signs, symptoms, and laboratory values.





Normal Lab Values



Normal Lab Values



Urine

Minimum Volume 0.5-1.0 mL/kg/hr
 Specific Gravity 1.002- 1.030
 Osmolality 50-1400 mOsmol/kg
 Creatinine, M 14-26, F 11-20 mg/kg/day
 Creatinine Clearance
 M 90-136 mL/min/1.73m²
 F 80-125 mL/min/1.73m²
 Urea Nitrogen 12-20 g/day

Sodium 40-220mEq/day
 Potassium 25-125 mEq/day
 Calcium 100-300 mg/day
 Phosphate 0.4-1.3 g/day
 Uric Acid 250-750 mg/day

Amylase 1-17 U/hr

Glucose <0.5 g/day
 Albumin 10-100 mg/day
 Protein 10-150 mg/day

5-HIAA 2-6 mg/day
 17-Ketosteroids
 M 8-22 mg/day
 F 6-15 mg/day
 17- Ketogenic Steroids
 M 5-23 mg/day
 F 3-15 mg/day
 17- Hydroxycorticosteroids
 M 3-10 mg/day
 F 2-8 mg/day
 Homovanillic Acid 1.4-8.8 mg/day
 Metanephrine 0.05-1.2 µg/mg cre.

Toxicology

Acetaminophen >200 µg/mL
 COHgb > 20% saturation
 Ethanol (mg/dL)
 >100 intoxicated, ataxic, slurred speech
 >200 lethargic, stuporous, vomiting
 >300 coma
 >500 respiratory depression, death
 Ethylene Glycol >20 mg/dL
 Lead >100 µg/dL
 Methanol >200 mg/L
 Salicylate >300 µg/mL (trough)

Cerebrospinal Fluid

Pressure 70-180 mm CSF supine
 WBC 0-5 mononuclear cells/ µL
 Protein 15-45 mg/dL
 Glucose 40-70 mg/ dL

Synovial Fluid

WBC <200 /µL (<25% neutrophils)
 Trauma, OA, SLE <3000 WBC/ µL
 Gout, RA >4000 WBC/ µL
 Septic >60000 WBC/ µL
 Protein ≤ 3.0g/ dL
 Glucose > 40mg/dL
 Uric Acid <8.0 mg/ dL
 LDH ≤ Serum LDH

Endocrinology

Aldosterone
 Supine 3-10 ng/ dL
 Upright 5-30 ng/dL
 Cortisol
 0800h 6-23 µg/dL
 1600h 3-15 µg/dL
 2200h ≤ 50% of 0800h value
 Estrogen
 Follicular 60-200 pg/dL
 Luteal 160-400 pg/dL
 Menopausal ≤130 pg/ dL
 Gastrin <100 pg/mL
 Growth Hormone
 M <2 ng/mL, >60yo < 10 ng/mL
 F <10 ng/mL, >60yo < 14 ng/mL
 TBG 15-34 µg/ mL

T₄, total 5-12 µg/ dL
 T₄, free 0.8-2.3 ng/dL
 T₃, total 100-200 ng/dL
 TSH < 10 µU/ mL
 >60yo M 2-7.3 µU/ mL
 F 2-16.8 µU/ mL

FSH
 Follicular 1-9 mU/ mL
 Ovulation 6-26 mU/ mL
 Luteal 1-9 mU/ mL
 Menopausal 30-118 mU/ mL

LH
 Follicular 1-12 mU/ mL
 Midcycle 16-104 mU/ mL
 Luteal 1-12 mU/ mL
 Menopausal 16-66 mU/ mL

Progesterone Follicular 0.15-0.7
 Luteal 2.0-25 ng/ mL
 Prolactin < 20 ng/ mL
 PTH 10-65 pg/ mL
 Testosterone, M
 Total 300-1000 ng/ dL
 Free 52-280 pg/ mL

Hematology

Neutrophils 57-67%
 Segs 54-62%
 Bands 3-5%
 Lymphocytes 23-33%
 Monocytes 3-7%
 Eosinophils 1-3%
 Basophils 0-1%

Hemoglobin
 M 13.5-17.5 g/ dL
 F 12-16 g/dL

WBC
 4.5-11x10³
 per µL

Hematocrit
 M 39 - 49%
 F 35 - 45%

Platelets
 150- 450 x10³
 per µL

RBC
 M 4.3-5.7x10⁶/µL
 F 3.8-5.1 x10⁶/µL
 MCV 80-100 fL
 MCH 26-34 pg/ cell
 MCHC 31-37% Hgb/ cell
 Reticulocyte Count 0.5- 1.5%
 Hemoglobin A_{1c} 5.0- 7.5%
 Haptoglobin 26-185 mg/ dL

PT 11-15 sec
 aPTT 20-35 sec
 Bleeding Time 2-7 min
 Thrombin Time 6.3-11.1 sec
 Fibrinogen 200-400 mg/ dL
 FDP < 10µg/ mL
 ESR
 M <15 mm/hr
 F < 20 mm/hr

Chemistries

Anion Gap 7-16 mEq/L
 Osmolality 275-295 mOsm/ kg

Sodium 135-145 mEq/ L	Chloride 98-106 mEq/L	BUN 7- 18 mg/ dL	Glucose 70- 115 mg/dL
Potassium 3.5- 5.1 mEq/L	Bicarbonate 22- 29 mEq/ L	Creatinine 0.6- 1.2 mg/dL	

Calcium
 Total 8.4- 10.2 mg/dL
 Ionized 4.65- 5.28 mg/dL
 Phosphate 2.7 -4.5 mg/ dL
 >60yo M 2.3-3.7 mg/dL
 F 2.8-4.1 mg/ dL
 Magnesium 1.3- 2.1 mEq/ L

Alkaline Phosphate
 M 38- 126 U/L
 F 70- 230 U/L
 LDH 90- 190 U/L
 SGOT/ AST 7 -40 U/L
 SGTP/ ALT 7- 40 U/L
 GGT
 M 9- 50 U/L
 F 8- 40 U/L

Protein, total 6 -8 g/dL
 Albumin 3.5- 5.5 g/dL
 α₁ Fetoprotein <10 ng/mL
 Bilirubin, Total 0.2- 1.0 mg/dL
 Conjugated 0-0.2 mg/dL

Lipase 10 -140 U/L,
 >60yo 18- 180 U/L
 Amylase 25 -125 U/L
 C- peptide 0.7- 1.89 ng/ mL
 Total Cholesterol <200 mg/dL
 LDL <130 mg/dL
 HDL, M >29 mg/dL
 F >35 mg/dL
 Triglycerides, M 40- 160 mg/dL
 F 35- 135 mg/dL

Lactate, Venous 5- 20 mg/dL
 Uric Acid: M 3.5- 7.2, F 2.6- 6 mg/dL
 Ammonia Nitrogen 10-50 µmol/L
 Acid Phosphatase < 0.8 U/L

CPK
 M 38- 174 U/L
 F 26- 140 U/L
 MB < 5%
 Iron M 65- 175 µg/ dL
 F 50- 170 µg/ dL
 TIBC 250- 450 µg/ dL
 Iron Saturation
 M 20 -50%
 F 15- 50%
 Ferritin, M 20 -250 ng/mL
 F 10- 120 ng/mL
 Vit B₁₂ 100- 700 pg/mL
 Folate 3- 16 ng/mL
 Copper: M 70-140, F 80- 155 µg/dL
 Zinc 70- 150 µg/dL
 PSA < 4.0 ng/mL
 CEA <2.5, smoker < 5 ng/ mL
 CA-125 <35 U/mL

Arterial Blood Gases

pH 7.35- 7.45	PaCO ₂ 35- 45 mm Hg	HCO ₃ 21-27 mEq/L	Oxygen Saturation 95- 98%	PaO ₂ 80- 100 mm Hg	Base Excess ± 2 mEq/ L
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Source: American Medical Association-
www.ama-assn.org

Note: The values listed are for adults.



Normal Lab Values



Normal Lab Values



Urine

Minimum Volume 0.5-1.0 mL/kg/hr
 Specific Gravity 1.002- 1.030
 Osmolality 50-1400 mOsmol/kg
 Creatinine, M 14-26, F 11-20 mg/kg/day
 Creatinine Clearance
 M 90-136 mL/min/1.73m²
 F 80-125 mL/min/1.73m²
 Urea Nitrogen 12-20 g/day

Sodium 40-220mEq/day
 Potassium 25-125 mEq/day
 Calcium 100-300 mg/day
 Phosphate 0.4-1.3 g/day
 Uric Acid 250-750 mg/day

Amylase 1-17 U/hr

Glucose <0.5 g/day
 Albumin 10-100 mg/day
 Protein 10-150 mg/day

5-HIAA 2-6 mg/day
 17-Ketosteroids
 M 8-22 mg/day
 F 6-15 mg/day
 17- Ketogenic Steroids
 M 5-23 mg/day
 F 3-15 mg/day
 17- Hydroxycorticosteroids
 M 3-10 mg/day
 F 2-8 mg/day
 Homovanillic Acid 1.4-8.8 mg/day
 Metanephrine 0.05-1.2 µg/mg cre.

Toxicology

Acetaminophen >200 µg/mL
 COHgb > 20% saturation
 Ethanol (mg/dL)
 >100 intoxicated, ataxic, slurred speech
 >200 lethargic, stuporous, vomiting
 >300 coma
 >500 respiratory depression, death
 Ethylene Glycol >20 mg/dL
 Lead >100 µg/dL
 Methanol >200 mg/L
 Salicylate >300 µg/mL (trough)

Cerebrospinal Fluid

Pressure 70-180 mm CSF supine
 WBC 0-5 mononuclear cells/ µL
 Protein 15-45 mg/dL
 Glucose 40-70 mg/ dL

Synovial Fluid

WBC <200 /µL (<25% neutrophils)
 Trauma, OA, SLE <3000 WBC/ µL
 Gout, RA >4000 WBC/ µL
 Septic >60000 WBC/ µL
 Protein ≤ 3.0g/ dL
 Glucose > 40mg/dL
 Uric Acid <8.0 mg/ dL
 LDH ≤ Serum LDH

Endocrinology

Aldosterone
 Supine 3-10 ng/ dL
 Upright 5-30 ng/dL
 Cortisol
 0800h 6-23 µg/dL
 1600h 3-15 µg/dL
 2200h ≤ 50% of 0800h value
 Estrogen
 Follicular 60-200 pg/dL
 Luteal 160-400 pg/dL
 Menopausal ≤130 pg/ dL
 Gastrin <100 pg/mL
 Growth Hormone
 M <2 ng/mL, >60yo < 10 ng/mL
 F <10 ng/mL, >60yo < 14 ng/mL
 TBG 15-34 µg/ mL

T₄, total 5-12 µg/ dL
 T₄, free 0.8-2.3 ng/dL
 T₃, total 100-200 ng/dL
 TSH < 10 µU/ mL
 >60yo M 2-7.3 µU/ mL
 F 2-16.8 µU/ mL

FSH
 Follicular 1-9 mU/ mL
 Ovulation 6-26 mU/ mL
 Luteal 1-9 mU/ mL
 Menopausal 30-118 mU/ mL

LH
 Follicular 1-12 mU/ mL
 Midcycle 16-104 mU/ mL
 Luteal 1-12 mU/ mL
 Menopausal 16-66 mU/ mL

Progesterone Follicular 0.15-0.7
 Luteal 2.0-25 ng/ mL
 Prolactin < 20 ng/ mL
 PTH 10-65 pg/ mL
 Testosterone, M
 Total 300-1000 ng/ dL
 Free 52-280 pg/ mL

Hematology

Neutrophils 57-67%
 Segs 54-62%
 Bands 3-5%
 Lymphocytes 23-33%
 Monocytes 3-7%
 Eosinophils 1-3%
 Basophils 0-1%

Hemoglobin
 M 13.5-17.5 g/ dL
 F 12-16 g/dL

Hematocrit
 M 39 - 49%
 F 35 - 45%

Platelets
 150- 450 x10³
 per µL

WBC
 4.5-11x10³
 per µL

RBC
 M 4.3-5.7x10⁶/µL
 F 3.8-5.1 x10⁶/µL

MCV 80-100 fL
 MCH 26-34 pg/ cell
 MCHC 31-37% Hgb/ cell
 Reticulocyte Count 0.5- 1.5%
 Hemoglobin A_{1c} 5.0- 7.5%
 Haptoglobin 26-185 mg/ dL

PT 11-15 sec
 aPTT 20-35 sec
 Bleeding Time 2-7 min
 Thrombin Time 6.3-11.1 sec
 Fibrinogen 200-400 mg/ dL
 FDP < 10µg/ mL
 ESR
 M <15 mm/hr
 F < 20 mm/hr

Chemistries

Anion Gap 7-16 mEq/L
 Osmolality 275-295 mOsm/ kg

Sodium 135-145 mEq/ L	Chloride 98-106 mEq/L	BUN 7- 18 mg/ dL	Glucose 70- 115 mg/dL
Potassium 3.5- 5.1 mEq/L	Bicarbonate 22- 29 mEq/ L	Creatinine 0.6- 1.2 mg/dL	

Calcium
 Total 8.4- 10.2 mg/dL
 Ionized 4.65- 5.28 mg/dL
 Phosphate 2.7 -4.5 mg/ dL
 >60yo M 2.3-3.7 mg/dL
 F 2.8-4.1 mg/ dL
 Magnesium 1.3- 2.1 mEq/ L

Alkaline Phosphate
 M 38- 126 U/L
 F 70- 230 U/L
 LDH 90- 190 U/L
 SGOT/ AST 7 -40 U/L
 SGTP/ ALT 7- 40 U/L
 GGT
 M 9- 50 U/L
 F 8- 40 U/L

Protein, total 6 -8 g/dL
 Albumin 3.5- 5.5 g/dL
 α₁ Fetoprotein <10 ng/mL
 Bilirubin, Total 0.2- 1.0 mg/dL
 Conjugated 0-0.2 mg/dL

Lipase 10 -140 U/L,
 >60yo 18- 180 U/L
 Amylase 25 -125 U/L
 C- peptide 0.7- 1.89 ng/ mL
 Total Cholesterol <200 mg/dL
 LDL <130 mg/dL
 HDL, M >29 mg/dL
 F >35 mg/dL
 Triglycerides, M 40- 160 mg/dL
 F 35- 135 mg/dL

Lactate, Venous 5- 20 mg/dL
 Uric Acid: M 3.5- 7.2, F 2.6- 6 mg/dL
 Ammonia Nitrogen 10-50 µmol/L
 Acid Phosphatase < 0.8 U/L

CPK
 M 38- 174 U/L
 F 26- 140 U/L
 MB < 5%
 Iron M 65- 175 µg/ dL
 F 50- 170 µg/ dL
 TIBC 250- 450 µg/ dL
 Iron Saturation
 M 20 -50%
 F 15- 50%
 Ferritin, M 20 -250 ng/mL
 F 10- 120 ng/mL
 Vit B₁₂ 100- 700 pg/mL
 Folate 3- 16 ng/mL
 Copper: M 70-140, F 80- 155 µg/dL
 Zinc 70- 150 µg/dL
 PSA < 4.0 ng/mL
 CEA <2.5, smoker < 5 ng/ mL
 CA-125 <35 U/mL

Arterial Blood Gases

pH 7.35- 7.45	PaCO ₂ 35- 45 mm Hg	HCO ₃ 21-27 mEq/L	Oxygen Saturation 95- 98%	PaO ₂ 80- 100 mm Hg	Base Excess ± 2 mEq/ L
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Source: American Medical Association-
www.ama-assn.org

Note: The values listed are for adults.