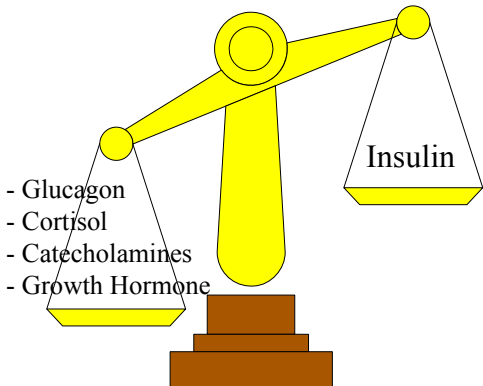


DIABETIC KETOACIDOSIS GUIDELINES

Definition: Metabolic anion-gap acidosis due to elevated serum ketones

PATHOPHYSIOLOGY



- Diagnostic Criteria:**
- Blood glucose > 250 mg/dL
 - Arterial pH < 7.3
 - Serum Bicarbonate < 18 mEq/L
 - Anion Gap > 10
 - Ketonuria and/or ketonemia

1) Ketonemia

Acidemia

2) Hyperglycemia

Osmotic Diuresis

Volume Depletion

Free Water Depletion

Hypokalemia

GOALS OF TREATMENT

- Replace volume deficit*
- Correct ketosis and acidosis with continuous insulin
- Replace electrolyte deficits*
- Replace free water deficit*
- Prevent hypoglycemia
- Determine inciting condition for the DKA
- Correct hyperglycemia (secondary goal)
- When DKA resolved: begin appropriate SQ insulin before stopping Insulin drip

INITIAL CARE

- ENSURE:**
- Secure airway and adequate ventilation/oxygenation
- MONITOR:**
- Orthostatic hypotension (If not hypotensive)
 - Continuous EKG monitoring
 - Urine output
 - Frequent Vital signs
- PLACE:**
- Adequate IV access (may require 3 ports)
 - Foley catheter
- CALCULATE:**
- Anion Gap
 - Serum Osmolality
 - Free Water Deficit
 - Corrected Serum Sodium
- LABS:**
- Basic metabolic panel, Serum phosphate level, hepatic enzymes, A1c
 - beta-HCG. Urine (for women of child bearing age)
 - CBC w/differential
 - Cardiac enzymes
 - Serum ketones/acetone/Beta-hydroxybutyrate
 - PT/PTT
 - Venous/Arterial blood gas
 - UA/Urine micro/Urine culture
- ORDER:**
- EKG
 - CXR
 - Venous thromboembolism prophylaxis: Heparin 5,000 units SQ BID or TID (unless contraindicated)
- CONSIDER, as indicated:**
- Further infectious work up
 - Amylase/Lipase to rule out pancreatitis
 - Head CT/LP if encephalopathic
 - Consider Central access

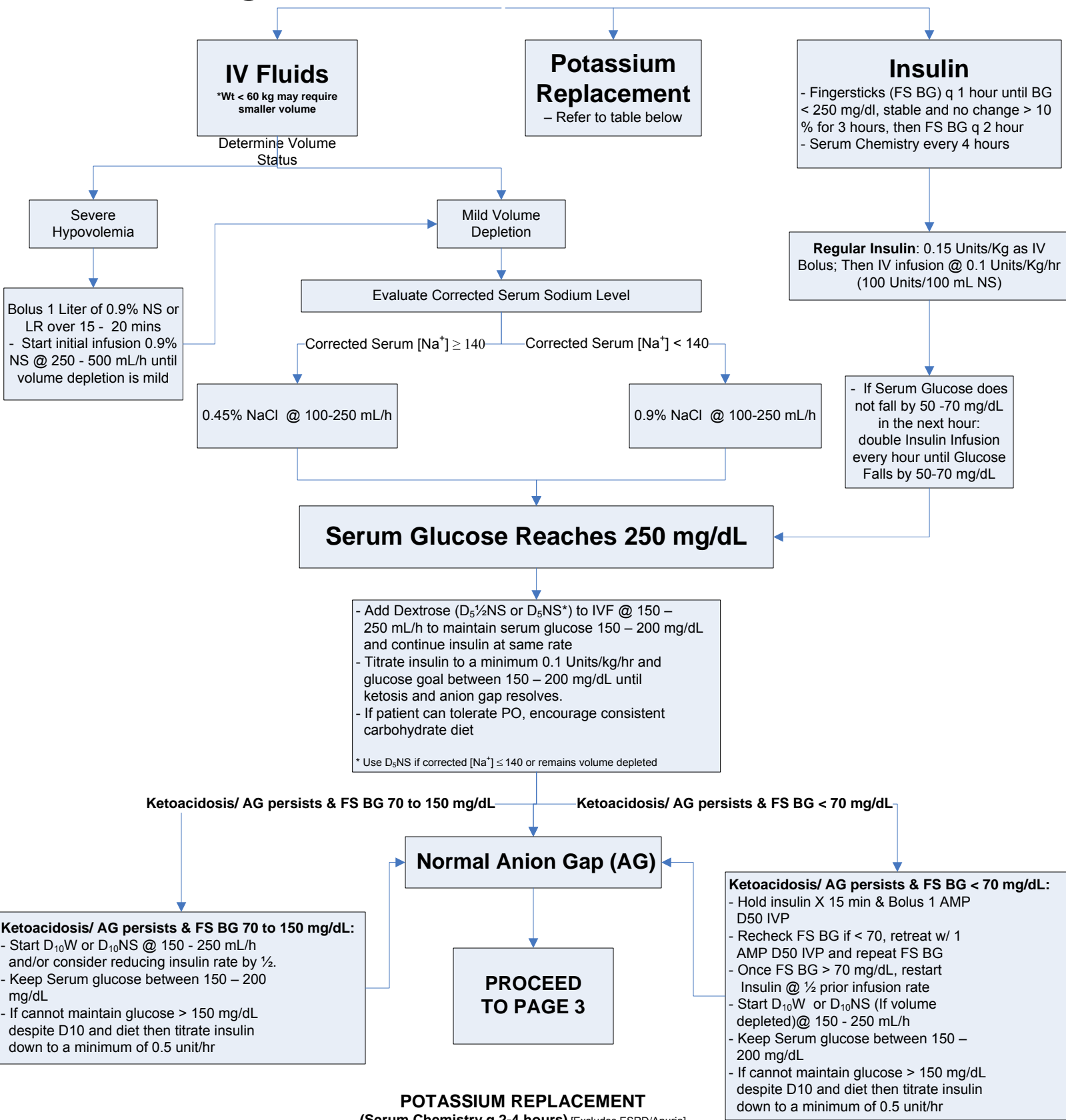
PROCEED TO MANAGEMENT

CALCULATIONS

- **Anion Gap (AG) [$<12-16$]:**
 $AG = [Na^+] - [Cl^- + HCO_3^-]$
- **Serum Osmolality [275-295 mOsm/L]:**
 $= 2 \times \text{Serum } Na^+ \text{ (mEq/L)} + [\text{Glucose (mg/dL)}/18] + [\text{BUN (mg/dL)}/2.8]$
- **Free Water Deficit:**
 $= \text{Dosing Factor} \times \text{wt (Kg)} \times [(\text{Serum } Na^+/140) - 1]$
 {Dosing Factor = 0.6 (Male) and 0.5 (Female)}
- **Corrected Serum Sodium:**
 $\text{Corrected } Na^+ = \text{Serum } Na^+ \text{ mEq/L} + (1.6 \text{ mEq/L for each } 100 \text{ mg/dL glucose} > 100 \text{ mg/dL})$

* Patients with ESRD/Anuria may not require volume and K⁺ repletion.

Management of Adult Patients with DKA



POTASSIUM REPLACEMENT (Serum Chemistry q 2-4 hours) [Excludes ESRD/Anuria]

Serum K ⁺ ¹	Total Replacement Dose ^{2,3} (consider lower dose for renal insufficiency)	Maximum Rate of Infusion
	HOLD INSULIN	
≤ 3 mEq/L	40 - 80 mEq	- Peripheral Line: 10 mEq/hour - Central Line: 20 mEq/hour ^Δ <small>Δ may be exceeded in an adult ICU, ED, OR, PACU or designated patient care units</small>
3.1 - 3.4 mEq/L	40 - 60 mEq	
3.5 - 3.9 mEq/L	20 - 40 mEq	
4 - 5 mEq/L ⁴	Add KCl 20 mEq to each liter of IVF	
> 5.5 mEq/L*	No Potassium Replacement	

*Check Serum K⁺ every 2 hours

¹ If acidemic, serum K⁺ may underestimate potassium deficiency

² Please refer to Adult Potassium Replacement Policy: <http://www.crlonline.com/crlsql/servlet/crlonline>

- Can use oral KCl if patient is tolerating enteral

³ Refer to Phosphate policy for replacement <http://www.crlonline.com/crlsql/servlet/crlonline>

⁴ If patient acidemic requires potassium repletion

AG is closed and serum ketosis resolved

- Maintain insulin infusion to keep serum glucose 70 – 150 mg/dL (minimum 0.5 Units/hr)

Gap closed and not eating reliably:
 - Switch to “Insulin drip: Adult General Care Floor: Goal BG 120 - 180” (NYP/WC – where available) – Must check for type 1 for all DKA patients

If tolerating oral feeds:
 - Discontinue insulin drip 2 hours after administering long-acting SQ insulin
Subcutaneous insulin options (use 1 or 2)
 - Calculate total daily dose (TDD): 0.3 Units/kg/day (type 1 & Renal pts) or 0.5 Units/kg/day (type 2):

* - These combinations deliver continuous insulin and prevent recurrent ketosis
 - If patient’s outpatient regimen was able to achieve optimal glycemic control, consider re-instatement
 - Oral agents generally not useful in immediate post-DKA stage

OPTION #1*
(Preferred)

OPTION #2*

Glargine: 50% of TDD (as above)

For Discontinuation of Drip in AM:
 - Pre-breakfast administer both glargine and aspart dose according to pre-meal aspart order set

For Discontinuation of Drip in PM:
 - Pre- dinner administer both glargine and aspart dose according to pre-meal aspart order set

NPH: 50 % of TDD (as above)

For Discontinuation of Drip in AM:
 - Pre-breakfast administer 2/3 NPH dose and aspart dose according to pre-meal aspart order set

For Discontinuation of Drip in PM:
 - Pre- dinner administer 1/3 NPH dose and aspart dose according to pre-meal aspart order set

PRIOR TO DISCHARGE:
 - Screen and treat for tobacco abuse
 - Screen and treat for hyperlipidemia, HTN, microalbuminuria
 - Assess peripheral neuropathy w/tuning fork and 10 gram monofilament
 - Arrange ophthalmologic/podiatric care as needed
 - Referral for outpatient diabetes self-management training
 - Screen patient to receive influenza and pneumococcal vaccine

- OOB, d/c foley and unneeded intravenous lines
 - If eating reliably can discontinue IV dextrose
 - If not volume or free water depleted discontinue IV fluids

- Change fingerstick to qAC and QHS (NYP-WC) with rapid acting insulin meal bolus coverage
- Start consistent carbohydrate diet
- Obtain endocrine consult on all patients on continuous tube feeds or new Type 1 DM and others as needed.
- Nutrition and Diabetes education consult.

Types of Insulin

Type of insulin	Onset	Peak effect	Duration of action	Dosing time
MEALTIME INSULIN (SHORT ACTING)				
Aspart (Novolog®) (rapid acting)	5 - 15 min	1 hr	3-5 hrs	Within 20 min, before or after a meal
Regular (Humulin R®) (short acting)	30 min	2-4 hr	5-8 hr	30 min before a meal
BASAL INSULIN (LONG ACTING)				
Glargine (Lantus®) (long acting)	1.5-2 hr	No peak	24 hr	Usually q 12 or q 24
NPH (Humulin N®) (intermediate acting)	1-2 hr	4-12 hr	12-18 hr	Once or Twice daily

