METABOLIC DISORDERS OF ACID-BASE CHEMISTRY

Disorder	Etiology	Pathophysiology	Lab Findings and Diagnosis	Treatment
METABOLIC ALKALOSIS	**Generation** LOSS OF PLASMA H+ **Renal** *Increased aldosterone* Sodium-dependent: electroneutrality Sodium-independent: activate apical H+ ATPase in intercalated cells) *Diuretics* (except CA inhibitors) *Bartter* and *Gitelman* *Primary Hyperaldosteronism* *Milk-Alkili Syndrome* *Post-Hypercapneic Alkalosis* **GI** *Emesis* and *NG suction* *Factitious Diarrhea* (loss of Cl-) *Adenoma* **Trancellular H+ Shift** Occurs in hypokalemia GAIN OF PLASMA HCO3- **Bicarbonate Infusion** **Massive transfusion (citrate)** CONTRACTION ALKALOSIS **Loss of bicarbonate-free fluid** (e.g. diuresis of edema fluid) **Maintenance** INTRAVASCULAR VOLUME DEPLETION **Activation of RAAS**: AngII → increase PCT H+ excretion via activation of Na+/H+ exchangers **Secondary hyperaldosteronism**	Urinalysis shows characteristic chemistries **EARLY PHASE (1 – 3 d)** **Increased** bicarbonate **Increased** Na+ **Increased** K+ Decreased Cl- pH > 6.5 **CHRONIC PHASE (> 3 d)** **Decreased** bicarbonate **Decreased** Na+ **Decreased** K+ Decreased Cl- pH < 5.5: **paradoxical aciduria** The kidney protects ECF volume by massive reabsoption of all presented ions! Thus, metabolic alkalosis generally is NOT self-limiting	The most important test: **Urine Cl-** **Urine Cl- < 15 mEq/L** Upper GI loss Remote diuretic therapy Post-hypercapneic hypokalemia Tx: volume resuscitation with NML saline + K+ replacement (KCl) **Urine Cl- > 15 mEq/L** Primary hyperaldosteronism Steroids Bartter Syndrome Tx: treat underlying disease	Treat underlying disease + infuse NML saline for volume expansion

	CHLORIDE DEPLETION **Increased CD HCO3- reabsorption** Involves Type A intercalated cells: low luminal Cl- → increased apical secretion via Cl-/H+ cotransporter **Decreased CD HCOE- secretion** Involves Type B intercalated cells: low luminal Cl- → decreased activity of Cl-/HCO3- exchanger (less Cl- reabsoprtion). **HYPOKALEMIA** Increase in ammoniagenesis (PCT) via intracellular acidosis → increased secretion of organic acids			
METABOLIC ACIDOSIS	**NON-ANION GAP (NAGMA)** **Loss of bicarbonate** Diarrhea (also results in hypokalemia) GI fistula Type II RTA (proximal RTA) **Decreased regeneration of bicarbonate** Type II RTA (distal hyperkalemic) Type IV RTA (distal hypokalemic) Primary hypoaldosteronism Hyperkalemia **ANION GAP (AGMA)** **High Acid Input** Poisoning: EtOH, MeOH, paraldehydes, salicylates, ethylene glycol Shock and lactic acidosis Ketoacidosis (DKA, starvation, alcoholism) **Low Acid Output** Renal failure **MIXED METABOLIC ACIDOSIS**		**Diagnosis of RTAs** **Type I RTA** Distal hypokalemic Decreased H+ ATPase activity in the CD Etiology: AR and AD, amphotericin B Serum HCO3- < 10 mEq/L Urine pH > 5.6 always **Type II RTA** Proximal hypokalemic Decreased HCO3- reabsorption in the PCT (e.g. defective serosal Na+/HCO3- cotransporter) Urine can be acidified Serum HCO3- = 12 – 20 mEq/L **Type IV RTA** Distal hyperkalemic Decreased adosterone activity and reduced ammoniagenesis	IV sodium bicarbonate if pH < 7.20

	Typically seen in advanced renal failure, and involves RTAs and retention of organic acids It can also be seen in diarrhea with contraction alkalosis		Associated with hyporeneninemic hypoaldosteronism Urine may be acidified Serum HCO_3^- > 16 mEq/L	