

---FLUIDS, ELECTROLYTES, ACID-BASE---

Mg	Ph	K	Ca	HCO3	Cl	Na
1.5-2.5	2.5-4.5	3.5-5	8-10.5	24-30	95-105	135-145

(mEq/L)

Normal Physiology

60-40-20-15-5: TBW-intracl-extracl-interstit-intravasc

7%=intravasc (approx 5L in 70kg pt)

obese, elderly=less muscle, thus TBW<60% of weight

osmolarity = 2[Na] + [Gluc]/18 + BUN/2.8

[H+] = 24 PaCO2/[HCO3]

0.1 change in pH = 0.4mEq/L change in K

ADH secreted when: osm increases (intracranial recep), vol decreases (RA, LA)

Fluids

4-2-1 rule: ml/kg/hour [or if >20kg: wt + 40ml]

POD 3: 3rd space fluid mobilizes; decrease IVFs to prevent overload (esp in CHF, RF)

stress response to surgery/trauma = increased ADH/Aldo

dehydration: hypernatremia draws fluid from cells=blunts picture of volume depletion

prerenal: BUN:Cr >20, FeNa (=UNaPCr/UCrPNa) <1%, UNa<20

maintenance fluids: D5 ½ NS + 20mEq KCl (D5 ¼ NS for kids); No LR (cuz alkalosis)

UOP should be ≥0.5ml/kg/hr (1.0 in kids)

bolus: LR or NS only; No D5 (cuz hyperglycemia); No hypotonic solutions (extravasates)

IVF composition: mEq/L

NS (0.9%): Na 154, Cl 154

LR: Na 130, Cl 110, lactate 28, K 4, Ca 3 (lactate becomes HCO3)

Most “physiologic”

D5 = 50g/dL of glucose

Composition of NL body fluids (key points)

	Na	K	Cl	HCO3
Stomach			↑	0
Bile				↑
Pancreas				↑
SI				
LI	↓	↑		
Perspiration	↓		↓	0

SIADH Rx: H2O restriction, demeclocyline/lithium, lasix / K (dilutes urine)

Electrolytes (hyper usu cuz ↓DTRs, ↓Resp)

---Na

HypoNa: seizures, coma, ↑DTRs

cz: usu hypotonic IVF

Pseudo: hyperglycemia, hyperlipidemia

Hypovol: dehydration, diuretics

Euvol: SIADH

Hypervol: CHF, RF, cirrhosis

HyperNa: seizures, resp depression
cz: GI loss, perspiration, burn, DI, hyperAldo
Correct Na slowly (0.5mEq/hr)

---K

HypoK: ileus, tetany; EKG: **flat T, U wave**, Afib
cz: shift, vomit/NGT, diarrhea, renal loss (also check Mg, Phos)
Paradoxical aciduria (d/t ↓ K and ↓ vol)
Rx: PO <40mEq/hr, IV <10mEq/hr (not w/ D5 b/c czs insulin secretion and shift)

HyperK: EKG: **peaked T**, VFib
cz: shift, renal dz, hemolysis, crush, meds – NSAIDS, ACEI, ↓Aldo, Digoxin
Rx: check digoxin and CK levels (C BIG K Drop)
<6.5: diuretics
6.5-7.5: 10 units insulin w/ 25gr glucose IV over 5mins (w/ EKG)
>7.5: 10-30ml 10% Ca gluconate IV over 5mins

---Cl

HypoCl: no specific Sxs
cz: vomiting, acidosis, CRF, diuretics

HyperCl: rare in surgery pts

---Ca

HypoCa: perioral/hand parasthesias, Chvostek sign, Trousseau, seizure, ↑DTRs
EKG: **long PR, long QT**
cz: parathyroid surgery, renal fail (↓vit D), short bowel synd (fat binds Ca)
pancreatitis, blood transfusions
Rx: Ca gluconate, vit D, thiazides

HyperCa: stones, bones, moans, groans, psychic overtones (depression)
EKG: **long PR, short QT**
cz: CHIMPANZEES – Ca supplements, HyperPTH, Iatrogenic (thiazides),
Mets, Paget's, Addison's, Neoplasm, ZE synd, Excess vit A/D, sarcoid
Rx: NS or ½ NS – large volumes, bisphos, steroids

---Mg

HypoMg: hypoCa Sxs (↓Mg czs ↓PTH=↓Ca)
cz: starvation (EtOH), malabsorption (Crohn's)
Rx: 50-100mEq/day IV Mg

HyperMg: ↓DTRs (preg pts), ↓respiration
cz: iatrogenic, rarely-renal failure
Rx: hyperK Rx (IV Ca)

---Phos

HypoPhos: dizziness, anorexia, weakness, resp fail (diaphragm)
cz: malabsorption, EtOH, hyperPTH, shifts, diuretics, refeeding syndrome
Rx: replete Phos

HyperPhos: no Sxs
cz: renal failure, hypoPTH, shifts, sarcoid
Rx: aluminum antacids, diuretics

Acid Base

Δ in PaCO₂ of 10mmHg = reciprocal Δ in pH of 0.08

Δ in HCO₃ of 10mEq = direct Δ in pH of 0.15

--Resp. acidosis

do not correct hypercapnia too quickly - this may cz arrhythmias or ↓ cerebral perfusion

--Metabolic acidosis

1. loss of HCO₃: diarrhea, renal tubule disorder

2. excess acid: hypoxic vs. non-hypoxic

if pH remains >7.25, may give HCO₃ 1mg/kg bolus + 0.5mg/kg Q10min

--Resp alkalosis

d/t hyperventilation, often in ventilated pts

acute hypocapnia can cz cerebral vasoconstriction (up to 50%)

--Met alkalosis

most common

often due to contraction alkalosis (hypovolemia, hypoK, hypoCl)

contraction alkalosis: ↓vol= ↑aldo= ↑H⁺ secretion

Vomiting: hypovolemia, met alkalosis, hypoCl, hypoK (increased Aldo)

Isotonic volume contraction: diarrhea

Hypertonic volume contraction: perspiration, fever, DI

Hypernatremia: every 3 mEq rise in Na = 1 L of water deficit