



Electrolyte Disorders



INTRODUCTION

- Monovalent ions most important
- Na, K main cations and Cl & HCO_3^- main anions
- Mg, Ca & Phosphate are major divalent ions



Normal Physiology

- Body tries to maintain electroneutrality & osmolality.
- Body actively maintains distribution of electrolytes in fluid compartments.
- GIT the major site of electrolyte absorption during enteral feeding
- Kidney the major site of reabsorption



HOW?- normal homeostasis

- Balance between intake & loss
- Fluid balance
- Acid –Base balance
- Hormonal Factors : ADH.PTH.
Calcitonin, RAA
system,Thyroxine
- Na-K ATPase system.



WHY?- elec.disorder in ICU

- **Inadequate intake**
- **Improper supplementation & replacement**
- Acid –base imbalance
- Drugs ; Fluid imbalance.
- Primary disorders.



ICU Protocol for electrolytes

- To maintain normal blood levels
- Maintenance of normal anion gap
- Daily estimation of monovalent ions
- Twice weekly divalent ions estimation



SODIUM

- Main extracellular cation
- Functions : Maintenance of osmolality
Neuromuscular
transmission
- Requirements : 1 to 2 meq/ kg / day
- Normal plasma level: 135 to 145 meq/
l



HYPONATREMIA

- Hyperosmolar:DKA,AGE etc
- Hypoosmolar :CCF,SIADH ,Renal Dis.
- Isoosmolar (pseudohyponatremia)
- *Urinary Na^+ > 20meq/l signifies renal cause*
- Upto 120 meq/l is well tolerated.



Hyponatremia Management

- Water restriction /diuretics(in hypoosmolar)
- Sodium replacement

Enteral (upto 120 meq/l):

1gm salt~17meq Na

Parenteral:0.9% saline~154meq/l Na

3% saline ~ 510 meq/l Na



Na Replacement

- Sodium deficit = $(135 - \text{Na}_{\text{meas.}}) \times 0.6 \times \text{Wt}$
- Always $\frac{1}{2}$ correction
- Not more than 20meq/l/d or
0.6 to 0.8 meq/l/hr
- Hypertonic saline via central vein



HYPERNATREMIA

- Usually tolerated upto 160 meq/l
- Restore fluid volume & osmolality
- $Na_1 \times W_1 = Na_2 \times W_2$
- Colloids & hypotonic solution
- Replenish water deficit in 48 to 72 h
- Reduce serum osmolality @ 1 mosm/hr
- Avoid glucose containing fluids



POTASSIUM

- Mainly intracellular (130 to 140 meq/l)
extracellular(3.5 to 5.5 meq/l)
- 1to2 meq /kg /d requirement
- Regulations :catecholamines
insulin
acid-base disorders
hyperosmolality
cell break down



HYPOKALEMIA

- 1meq/l decrease in K^+ ~ 200meq deficit in physiological limits
- 0.5meq/l decrease ~ >400meq deficit when K^+ is 3.0 meq/l
- <2.0meq/l K^+ ~ ~ >>1600meq deficit



POT.REPLACEMENT

- Treat primary cause
- Oral KCl 15ml~20meq(1.5g) of K⁺
- I/V supplement 2meq/ml soln.
- 20to30 meq/hr may be given
- Undiluted @2-3meq/min
- Severe upto 5to7 meq/kg/d may be given



HYPERKALEMIA

- PSEUDO--- eg tourniquet, sampling
- Redistribution– drugs, acidosis, familial par.
- Excess of K^+ --- Renal dis., Addison's dis, myeloma, Diuretics etc
- Plasma level $\sim\sim 8$ precipitates dysrhythmia



Hyperkalemia Management

- Intake restriction
- Physiological antagonism:Ca-gluconate
- Intracellular transfer:Glucose-Insulin infusion,Sod.Bicarb.
- Removal from body:Dialysis,diuretics,cation exchange resin



CHLORIDE DISORDERS

- Major extracellular anion
- Daily req.—1 to 3 meq/kg
- Normal level –95 to 105 meq/l
- Goes hand in hand with Na & K



DIVALENT IONS

- Ca in ecf and Mg & PO₄ intracellular
- All regulated at kidney
- Calcitonin, PTH, VitD regulates Ca & PO₄
- Normal plasma level: Ca—8.5 to 10 mg/dl
Mg—1.7 to 2.4 mg/dl
PO₄--2.5 to 4.5 mg/dl
- 50% is at least ionized & active



DIVALENT IONS

- Requirements :Ca & PO₄⁻ 1000mg/d
Mg---- 300
mg/day
- ICU requirements:-- Alimentation
Renal failure
Primary
disorders
- Deficits coexist with other ions
- Slow to develop & non specific
features



HYPOCALCEMIA

- Rule out hypoalbuminemia & hypomagnesemia
- Symptomatic when $<5\text{mg/dl}$
- Ca Gluconate (10%)~ 9mg/ml
Ca Chloride (10%)~ 27 mg/ml
- 0.5 to 1 mg/kg/hr may be given



HYPERCALCEMIA

- Hyperparathyroidism & Malignancy commonest cause
- ICU– immobilization common
- Management: Hydration , Mobilization, Dialysis, diuretics(loop)
- Others: mithramycin, calcitonin., phosphonates ,chelation



MAGNESIUM DISORDERS

- HypoMg –65 to 70% ICU patients
- Associated with prolonged ventilation
- MgSulphate soln. 1gm~~98mg of Mg
- 30 to 40 mg /kg @ 0.5 to 1g/hr
- Hyper Mg – GI infusion, Diuresis
,dialysis



PHOSPHATE DISORDERS

- Most abundant intracellular anion
- Upto 30% incidence of Hypophosphatemia in ICU & prolonged ventilation
- Na Phos. Soln 93 mg/ml
- 15mg /1000 calories/day recommended
- Hyper PO_4^- — diuresis ,dialysis,antacids



All the best..