HYPONATREMIA CASE SENARIOS

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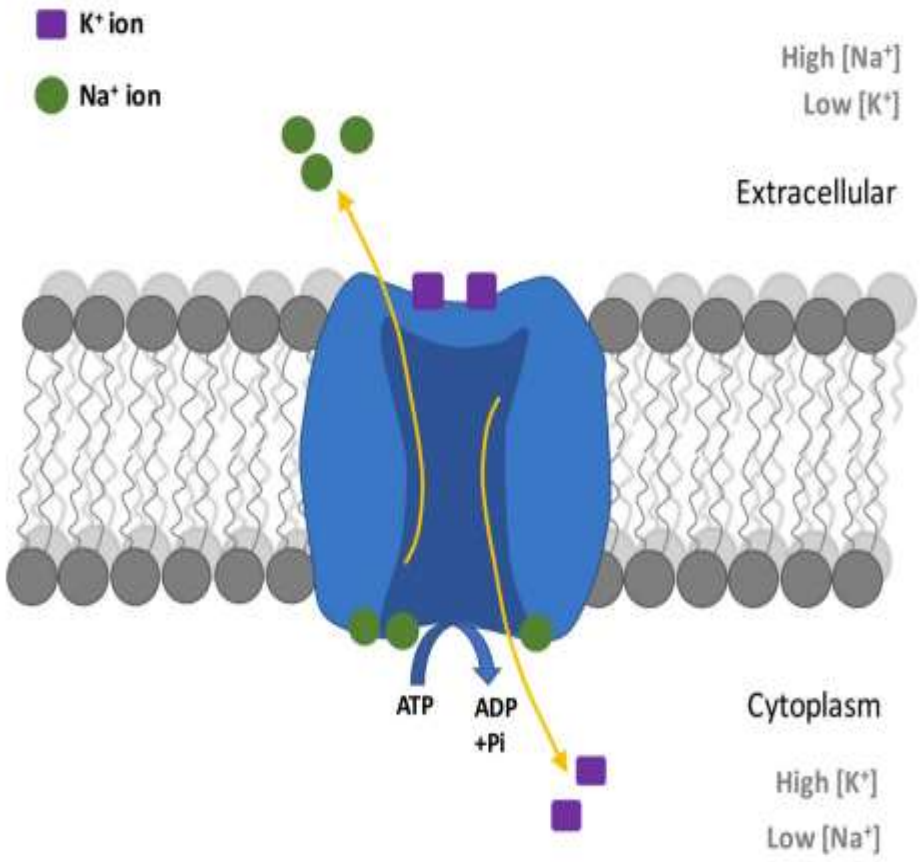
1. PHYSIOLOGY OF Na HOMEOSTASIS:

- Sodium and Its distribution
- Intake and excretion
- Role of Volume and osmolality in Na regulation
- Types of hyponatremia, is everything the same?

2. CORRECTING HYPONATREMIA

Sodium and Its distribution

- Sodium is the major extracellular cation,
- 135-145 mEq/L extracellular fluid.



Intake and Excretion

- Sodium intake: Infants receive sodium from breast milk (7 mEq/L) and formula (7-13 mEq/L).
- An average Indian consumes 10.98 grams of salt per day -- 119 % > recommended (1 g NaCl = 394 mg, 17 mEq or 17 mmol of Na and Cl).
- Excretion: Occurs through urine, stools and skin.
- Sodium intake is now recommended not to take > 2500 mg/day.

Volume and osmolarlity

- The normal osmolality of both intracellular and extracellular fluid is 285-295 mOsm/Kg of water.
- Since sodium is the predominant extracellular cation, sodium salts account for the major portion, approximately 86% of extracellular fluid osmolality.
- In contrast, potassium salts account for the major portion of intracellular osmolality.
- (Serum osmolality = 2 x Na+ Glucose/18+ BUN/2.8)

Concept.....

- Control: Body sodium content is most intimately coupled with extracellular wat
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  and consequent renal water excretion leads to an increase in the sodium concentration.

- *If S. Na is falling, effort to excrete ECF water is initiated.....*
- *If S. Na is raising, effort to conserve ECF water is initiated.....*

What is the priority in a conflicting situation?

- Correction of volume depletion takes priority over osmolality.
- Volume depletion stimulates ADH secretion even when there is hyponatremia. E.g. Hyponatremic dehydration in acute diarrhea.
- Once dehydration is corrected, ADH is switched off, water retention ceases and serum sodium levels raises.

HYPOVOLEMIC HYPONATREMIA	EUVOLEMIC HYPONATREMIA	HYPERVOLEMIC HYPONATREMIA
Na (↓↓) Water (↓)	**Water (↑)**	**Na (↑↑) Water (↑)**
Causes 1.Extrarenal loss (U Na < 20mmol/L) Vomiting, diarrhea 2. Renal Loss (U Na >20mmol/L) • RTA, Cerebral salt wasting • DKA • Diuretic therapy, • Adrenal insufficiency • Pseudohypoaldosternism	Causes 1. Water intoxication Use of 5% Dextrose in post operative Period, Psychogenic water drinking, Tap water enema 2.SIADH	Causes 1.Renal failure (U Na > 40 mmol/L) All others (U Na < 20 mmol/L) 2.Nephrotic syndrome 3.Congestive heart failure 4.Protein energy malnutrition 5.Cirrhosis liver

HYPONATREMIA MANAGEMENT

HYPOVOLEMIC (Dehydrated)	EUVOLEMIC (No edema and dehydration)	HYPERVOLEMIC (Edematous)
• **Add water & Na** • Shock: Correction with • RL/NS bolus • Dehydration: • Replace water and sodium Deficit + maintenance.	• **Water restriction** • Severe, symptomatic - 3 % saline 5 ml per kg, over 1- 2 hrs with diuretics • Treat the underlying cause	• **Restriction of water and Na** • Diuretics • Treat the cause

Case 1

- 1 year old male child (10kg)presented with complaints of diarrhea, and irritability for 1 days.
- He had an episode of GTCS is brought to emergency.
- How to treat this case?

Examination……

Hypoxic cell edema is worsened by hyponatremia

elt.

- CRT 3-4 seconds peripheries were cool.
- Sunken eyes
- Skin turgor-mild delay in going back
- Oral mucosa- dry
- No Neck stiffness

SOME DEHYDRATION HYPOVOLEMIA SEIZURE

Bolus/oxygen

Investigations sent….

- Glucose -90 mg/dL
- Urea- 34 mg/dL
- Creatinine 0.6 mg/dL
- Sodium 110 mEq/L
- Potassium 4.2 mEq/L
- Chloride 98 mEq/L
- Bicarbonate 21 mEq/L
- Ionised calcium 1.2 mmol/L
- Urine sodium levels? 13mEq/L

ADD, SOME DEHYDRATION,
HYPOVOLEMIA
SEVERE HYPONATREMIA

Algorithmic approach to hyponatremia

- 1. Does the child have neurological symptoms? YES
- 2. True or pseudo hyponatremia? TRUE (Glucose 90, not lipemic, site opposite hand)
- 3. Volume status? HYPOVOLEMIA
- 4. Is it acute or chronic? < 48HRS ACUTE
- 5. Urine sodium levels? 13mEq/L (No renal wasting)

Neurologically symptomatic child…

- Target is to increase of serum Na by +5 mEq/L
- What to use and how much? 3% saline 5 mL/Kg or NS 20 mL/kg

- A patient with severe symptoms (seizures) irrespective of the etiology , should be given a bolus of hypertonic saline to produce a small and rapid increase in serum sodium……..WHY
- 1) Quickly reduce cerebral edema
- 2) poor response to anticonvulsants.
- So if ECF Osmolality is increased water moves down from ICS TO ECS.
- In Children central pontine myelinosis is very rare . And consequence of **acute** cerebral edema exceed small risk of central pontine myelinosis

- Avoid correcting serum Na by > 10 mEq/L/24hr or > 18mEq/L/48 hr.
- This guideline doesn't apply to acute hyponatremia as brain has not had time for adaptive decrease in osmolality.
- So a bolus with 3% Nacl to rapidly increase Serum Na by 5 mEq/L is given.
- 1ml/kg of 3% NaCl increases serum Na by 1 mEq/L…. SO A BOLUS OF 4-6ml/kg is needed.
- Both 3% saline 5 mL/Kg or NS 20 mL/kg 25-30 mEq of sodium and will raise by 5 mEq/L

No shock

- 1 bolus with 3% Nacl to raise the serum Na by 5 mEq/L (4-6ml/kg)
- Shift to normal saline for dehydrational correction(defecit + maintainence+ on going losses).
- Check Na values frequently

With shock

- Correct shock first with normal saline (boluses max upto 60ml/kg)
- Is shock corrected, is urine output present, recheck sodium and decide further

Correction goal is 125mEq/L

Only hyponatremia and some dehydration….No seizure, shock

- Calculate volume: Deficit + Maintenance (600 + 1000 =1600 mL)
- Replace as D5 NS with appropriate K
- Give half of total fluid (800ml) in 8 hrs and
  Second ½ (800ml) in next 16 hrs

Correct the dehydration, hyponatremia will get corrected by itself

Clinically monitor, repeat electrolytes after 24 hrs.

If any new symptoms repeat Na at that point

Our case…….

- With 1 bolus of 3% NaCl (50ml) sodium level raised to 114 mEq/L.
- Started some dehydration correction with a goal of 125 mEq/L.
- Defecit ….6%= 600ml (300ml in 8 hrs and next 300 in 16hrs)
- Maintainence 100ml/kg/day = 1000ml
- At 12 hrs Serum Na ,119 mEq/L.
- At 24 hrs serum Na ,130 mEq/L.
- Stopped IV….. After 48 hrs Sodium 136 mEq/L
- Diarrhea subsided, hypovolemia resolvd sodium normalised… discharged

Case 2

	Intracellular (mEq/L)	Extracellular (mEq/L)
Na^+	20	133-145
K^+	150	3-5
Cl^-	---	98-110
HCO_3^-	10	20-25
PO_4^{3-}	110-115	5
Protein	75	10
% Body weight	80	15 (Interstitial); 5 (Intravascular)

	No dehydration	*Some dehydration*	*Severe dehydration*
Decrease in body weight	<5% in infants; <3% in older children	5–10% in infants; 3–6% in older children	>10% in infants; >6% in older children
Mental status	Normal	Irritable	Lethargic to comatose
Thirst	Normal	Increased	Unable to drink
Skin color and elasticity (turgor)	Normal	Cool, pale; mild delay in turgor	Cold, mottled; tenting
Sunken eyes	Normal	Sunken	Very sunken
Mucous membrane	Normal	Dry	Very dry
Pulse rate	Normal	Slightly increased	Tachycardia
Capillary refill	2–3 sec	3–4 sec	>4 sec
Blood pressure	Normal	Normal	Normal or low
Urine output	Slightly decreased	Decreased	Oliguria, anuria