

HYPONATREMIAS

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Let's talk Medicine

Outline:

>Mechanism of sodium transport in the nephron

- >Body fluids compartments
- >Hyponatremias classification
- >Diuretic effect on sodium



Basic Nephron Function



Na+ k+ ATPase channels are present in all segment to maintain the negativity of the cells and to allow the passive movement of the molecules.

Tubular Reabsorption of Na+ - PCT:

- <u>Luminal part:</u>
 - ✓ Co-transport with glucose, amino acids
 - ✓ Antiport with H+
- <u>Basolateral part:</u> ✓ Na+\K+ ATPase
- The Na\K ATPase will give 3 Na+ goes out to the blood and 2 K+ into the PCT cell again.
- This will cause increase in the negativity of the PCT cells which will drive the entry of Na+ and other solutes from the PCT lumen

Early Proximal Tubule Tubular Cell Peritubular fluid lumen -4 mV -70 mV 0 mV Lateral intercellular space Na⁺ Na* ATP e.g., glucose e.g., glucose · Na* HCO Apical Basolateral membrane membrane Tight junction



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Loop of Henle



Thick Ascending Limb of Henle



Loop of Henle

- 1. Thin descending:
 - ✓ Highly permeable to water
 - ✓No solutes movement
 - ✓ Increased osmolality (hyperosmolar)
- 2. Thin ascending:
 - ✓No significant reabsorption
- 3. Thick ascending:
 - √Na+-K+2Cl- cotransporter
 - \checkmark Paracellular diffusion of Mg+ and Ca+
 - √Hypoosmolar



Early DCT



- Continuation of the thick ascending loop of henle
- Na\Cl- co-transporter





Late DCT & Collecting tubule

Passively via
Na+ channel





Fluid Compartments in Body





Hyponatremia Na+<135mmol\L







Isotonic Hyponatremia

- Lab error
- Psuedohyponatremia:
 - Ptx doesn't really have low Na+
- Occurs with old lab machines:
 - As the old ones measure the Na+ in the whole plasma not only the aqueous part!



Hypertonic Hyponatremia







Hypertonic Hyponatremia

- Substances that increase ECF tonicity:
 - ✓ Glucose
 - ✓ Mannitol (diuretic)
 - ✓ Ethylene glycol
 - ✓ Toluene
- As a result, more H2O will go to the ECF lowering the [Na+]
- DKA and hyperglycemia case
- How to correct the [Na+] for Glucose (what the [Na+] would be after correcting the hyperglycemia):
 - ✓ (glucose -100)\60 + Na+ measured= Na+ corrected



Hypotonic Hyponatremia



1. Hypovolemic Hyponatremia



Rx: Normal Saline Replacement, replace K+



2. Hypervolemic Hyponatremia

- A. Renal causes (Na+ urine> 20 mmol):
 - ✓ ACUTE renal failure
- B. Non-renal causes (Na+ urine< 20mmol):
 - ✓ CHF
 - ✓Liver failure
 - Nephrotic syndrome: IV depletion will give high ADH and high aldosterone
- ■S & S: weight gain, high JVP, edema
- Rx: water restriction (drugs), and fluid intake restriction





3. Isovolemic hyponatremia

- Minimal volume change and no change in the Na+
- Main causes:
 - ✓ SIADH
 - ✓ Small cell carcinoma
 - ✓Brain trauma
 - ✓ Polydypsia
 - ✓ Drugs: chlorpamide, oxytocin
 - ✓H2O irrigation in TURP
- □S & S: mimmicing other diseases
- □Rx: water restriction

Hyponatremia Clinical Presentation



- Often detected asymptomatically
- Associated with profound disturbances of cerebral function
- Especially in acute hyponatremia, and include anorexia, nausea, vomiting, lethargy, headache, confusion, and stupor; seizures and coma may occur.
- Neuromuscular: hyperexcitability, hyperreflexia



Investigations

- Plasma and urine electrolytes and osmolality.
- Low electrolytes, low osmolality
- Check for potassium depeletion
- Further investigations to exclude Addison's disease, hypothyroidism, (SIADH) and drug-induced water retention, e.g. chlorpropamide.



Summary





Always correct the Na+ SLOWLY Or it will lead to Central Pontine Myelenolysis



Diuretics Action on Sodium

A. Osmotic Diuretic (mannitol):

- Acts on the PCT, descending loop, collecting tubule
- S\E: hypertonic hyponatremia!!!!

B. Loop Diuretics:

- Acts on the thick ascending loop
- Inhibit Na+/K2Cl & (NKCC2) & symporter
- S\E: low Na+, K+, MG+, Ca++

C. Thiazides:

- Acts on DCT
- Blocking the Na+\Cl- (NCC) symporter
- Inhibit Ca++ excretion !!!!!

D. Potassium-sparing Diuretics:

Na+ channel inhibitors>>> inhibit the ENaC







References:

- Crash course 4th edition
- Merk's Manual
- Handwritten tutorials
- BioMed hyponatremias 4 videos
- First Aid Organ System
- Some of our lectures (diuretics, nephron transport process)



For any questions or comments please contact us at:

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