Serum osmolality and urine osmolality

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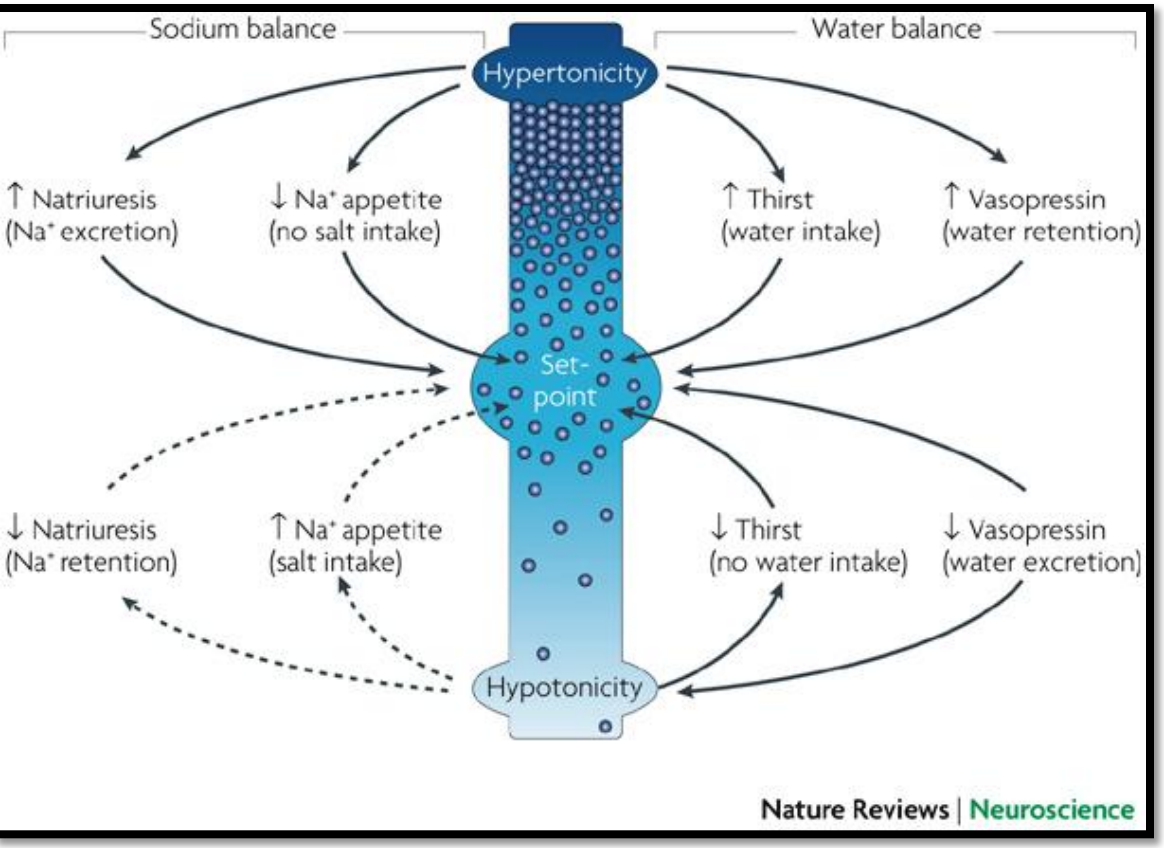
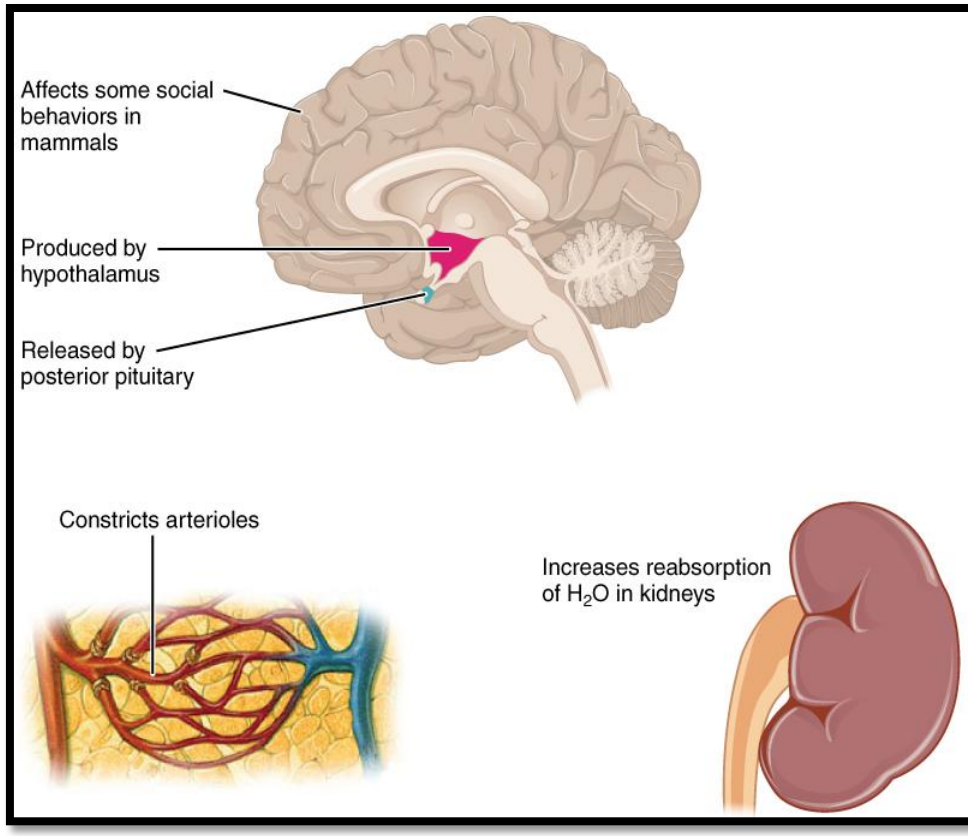


Water and Sodium balance in biological system



ADH

What is The Osmolality?

It is the account of the number of particles in fluid (Serum , urine) or measures the body's electrolyte-water balance.

Osmolality and osmolarity:

osmolality (with an "ℓ") is a measure of the osmoles (Osm) of solute per kilogram of solvent (osmol/kg or Osm/kg), osmolarity (with an "r") is the number of osmoles of solute per litre (L) of solution(osmol/L or Osm/L).

Osmolality can be measured on an analytical instrument called an osmometer

- As cell membranes in general are freely permeable to water, the osmolality of the extracellular fluid (ECF) is approximately equal to that of the intracellular fluid (ICF).
- it shows that changes in *ECF osmolality have a great effect on ICF* osmolality changes that can cause problems with normal cell functioning and volume.
- If the ECF were to become too hypotonic, water would readily fill surrounding cells, increasing their volume and potentially lysing them (cytolysis).
- Many poisons, medications and diseases affect the balance between the ICF and ECF, affecting individual cells and homeostasis as a whole.

Why this test is preformed?

This test helps check the body's water balance. Doctors may order this test if there are signs of any of the following:

1. primarily ordered to investigate Low sodium (hyponatremia)
2. to investigate "osmolality gap“: the difference between measured serum osmolality and calculated serum osmolarity
3. Poisoning from harmful substances such as ethanol, methanol, or ethylene glycol
4. Problems producing urine

Normal Mechanism

- In healthy people, when osmolality in the blood becomes high, the body releases ↑antidiuretic hormone (ADH).
- This ADH causes the kidneys to reabsorb water. This results in more concentrated urine. The reabsorbed water dilutes the blood. This allows blood osmolality to fall back to normal.
- Low blood osmolality suppresses ADH. This reduces how much water the kidneys reabsorb. Dilute urine is passed to get rid of the excess water, which increases blood osmolality back toward normal

What abnormalities mean?

Higher than normal levels may be due to:

- Diabetes insipidus
- High blood sugar level (hyperglycemia)
- High level of nitrogen waste products in the blood (uremia)
- High sodium level (hypernatremia)
- Stroke or head trauma resulting in decreased ADH secretion
- Water loss (dehydration)

Very elevation may be life threatening

What abnormalities mean?

Lower than normal levels may be due to:

- ADH oversecretion
- Adrenal gland not working very well
- Conditions linked to lung cancer
- Drinking too much water or dilute fluid
- Low sodium level (hyponatremia)
- Underactive thyroid gland

Osmol gaps are used as a screening tool to identify toxins.

The osmol gap is typically calculated as:

OG = measured serum osmolality – calculated osmolality

Calculated serum osmolality=

2×[Na mmole/L]+[glucose mmole/L]+[BUN mmol/L]+[ethanol mmol/L]

to convert the mg/dl to mmol/L

Calculated serum osmolality=

2×[Na mmole/L] + [glucose /18] + [BUN /2.8] + [ethanol /3.8]

The normal range of OG < 10mOsm/kg

There are 4 main Causes will lead to increase OG

1-Sugar :(Mannitol ,sorbitol)

2-lipid : (Hypertriglyceridemia)

3-protein: (Hypergammaglobinemia)

4-alcohol: (ethanol , methanol)

Expected values for osmolality

Expected serum osmolality assumes that sodium salts (chloride and bicarbonate), glucose, and urea nitrogen are the primary solutes in the serum. A difference from the expected and actual serum osmolatity values is the osmolality gap. The gap reflects an expected solute composition abnormality or the addition of an unexpected solute such as alcohol,

serum osmolality: 282 - 295 mOsm/kg water;
Urine osmolality: can range from 50 - 1400 mOsm/kg water,,
After an overnight fast, the urine osmolality should be at least 3 times the serum osmolality.
-After 12-14 hours of restricted fluid intake, urine osmolality should be > 850mOsm/Kg

Urine Osmolality

It is a measure of urine concentration, in which large values indicate concentrated urine and small values indicate diluted urine.

In healthy individuals with restricted fluid intake, urine osmolality should be greater than 800mOsm/kg, while a 24 hour urine osmolality should average between 500 and 800 mOsm/kg and a random urine osmolality should be 50 to 1400 mOsm/kg

Why the urine Osmolality test preformed?

It is used to help evaluate the body's water balance and to investigate increased and decreased urine output.

Abnormalities of urine Osmolality

- Increased urine output may be due to increased fluid intake, lack of appropriate amounts of ADH, or due to diabetes, with increased glucose levels leading to increased urine output.

- Decreased urine output may be due to a variety of causes including decreased blood flow to the kidneys, an appropriate response to dehydration, or damage to tubular cells in the kidneys.
- urine osmotic gap is calculated and used to help evaluate the kidney's ability to excrete acid and reabsorb bicarbonate,(kidney function)

Osmometer

is a device for measuring the osotic strenghth of a solution, colloid, or compound.

There are several different techniques employed in osmometer:

1. **Vapor Pressure Osmometers** –determine the concentration of osmotically active particles that reduce the vapor pressure of the solution
2. **Freezing Point Osmometers** –determine the osmotic strength of solution by utilizing freezing point depression

3. **Membrane Osmometers** –measure the osmotic pressure of a solution separated by a semi-permeable membrane.

Questions

What is the chemical composition of antidiuretic hormone (ADH)?

References

- http://www.nlm.nih.gov/medlineplus/ency/article/003609.htm
- http://www.nlm.nih.gov/medlineplus/ency/article/003463.htm