



# Fluid and Electrolytes: Balance and Disturbances

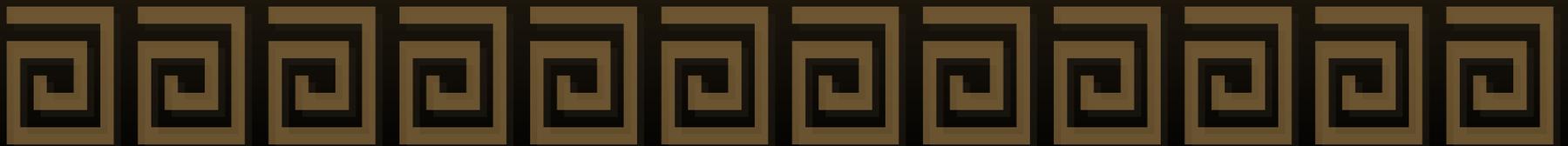
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Marshall Rogers, MSN, RN



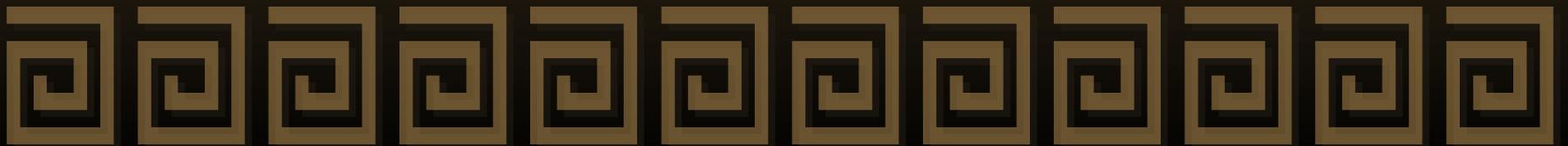
# Body Fluids

- Factors that influence body fluid
- 60% of our body is fluid (water and electrolytes).



# ICF vs. ECF

- Intracellular space (fluid in the cells) and Extracellular space (fluid outside a cell)
- 2/3rds located in ICF and is usually in skeletal mass.
- 1/3<sup>rd</sup> located in ECF.



# ICF vs. ECF

- ECF further divided
  - Intravascular-contains plasma
  - Interstitial-fluid that surrounds the cell
  - Transcellular
- Shifting of fluid
  - Normal
- Third spacing



# Third Spacing

- Manifestations
  - ↓Urine output
- Other s/s
  - ↑Heart rate
  - ↓BP, ↓CVP, edema
  - ↑Body weight
- Imbalances in I/O



# Electrolytes

- Active chemicals in body fluids
  - Cations (+ charge)
    - $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{++}$ ,  $\text{Mg}^+$ ,  $\text{H}^+$
  - Anions (- charge)
    - $\text{Cl}^-$ ,  $\text{HCO}_3^-$ , Phos.



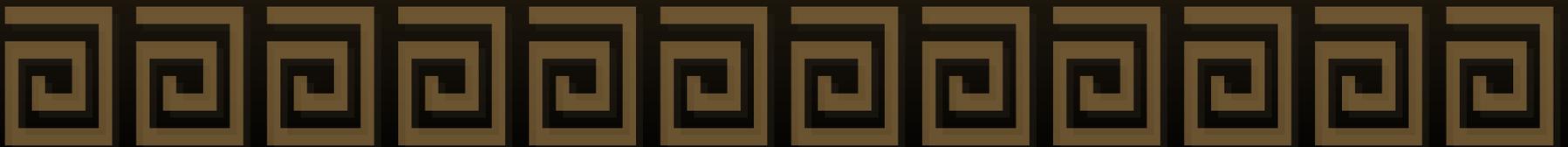
# Regulation of Fluid

- Osmosis and Osmolality
- Diffusion
- Filtration
- Sodium-Potassium Pump



# Routes of Gains & Losses

- Kidneys
- Skin
- Lungs
- Gastrointestinal Tract



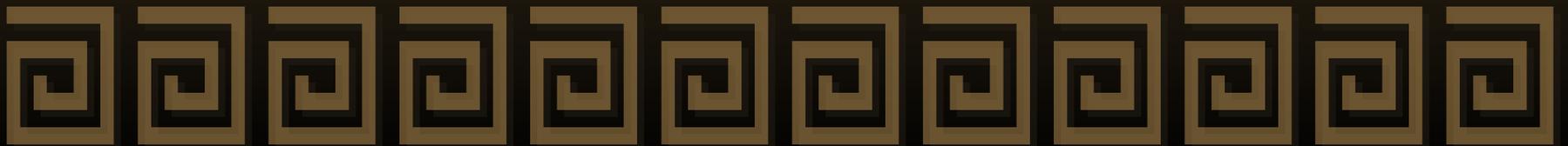
# Sodium

- Major electrolyte in ECF
- Normal: 134-145 mEq/L
- ECF levels effect ICF levels:
  - ✂️ ↓ serum  $\text{Na}^+$  = dilute ECF
    - $\text{H}_2\text{O}$  drawn into cells
  - ✂️ ↑ serum  $\text{Na}^+$  = concentrated ECF
    - $\text{H}_2\text{O}$  pulled out of cells
- $\text{Na}^+$  into cell →  $\text{K}^+$  moves out of cell



# Function of Sodium

- Controls H<sub>2</sub>O distribution
- Determine ECF concentration
- Determine ECF volume
- Electrochemical state for proper muscle & nerve function



Serum sodium level decreases  
(water excess)

Serum osmolality falls to less than  
280 mOsm/kg

Thirst diminishes, leading  
to decreased water intake

Antidiuretic hormone (ADH)  
release is suppressed

Renal water excretion increases

Serum sodium level increases  
(water deficit)

Serum osmolality rises to  
more than 300 mOsm/kg

Thirst increases, leading to  
increased water intake

ADH release increases

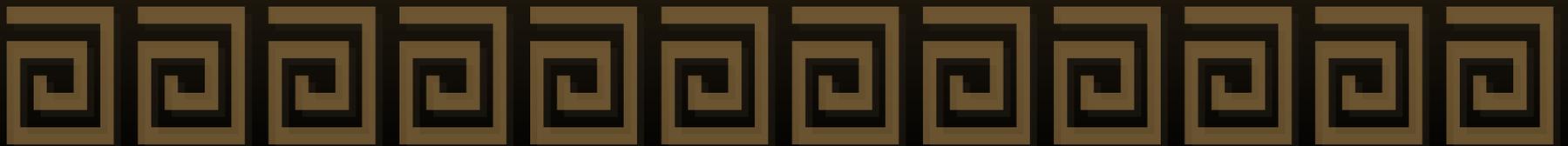
Renal water excretion diminishes

Serum osmolality normalizes

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graph TD; A1["Serum sodium level decreases (water excess)"] --> B1["Serum osmolality falls to less than 280 mOsm/kg"]; B1 --> C1["Thirst diminishes, leading to decreased water intake"]; C1 --> D1["Antidiuretic hormone (ADH) release is suppressed"]; D1 --> E1["Renal water excretion increases"]; A2["Serum sodium level increases (water deficit)"] --> B2["Serum osmolality rises to more than 300 mOsm/kg"]; B2 --> C2["Thirst increases, leading to increased water intake"]; C2 --> D2["ADH release increases"]; D2 --> E2["Renal water excretion diminishes"]; E1 --> F["Serum osmolality normalizes"]; E2 --> F;
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# Hyponatremia

- Sodium < 134 mEq/L
- Causes—See Pathophysiology slide #27
  - “N”
  - “O”
  - “N”
  - “A”



# Hyponatremia-Causes

## (NO Na+)

- “N”a+ excretion increase w/renal problems, NG suction, vomiting, diuretics, sweating, diarrhea, decreased secretion of aldosterone (DI)
- “O”verload of fluid (CHF, RF, hypotonic fluids infusion)
- “N”a+ intake low (low salt diet, NPO)
- “A”ntidiuretic hormone oversecretion (SIADH)



# S/S Hyponatremia

- S/S depend on the cause, magnitude and speed at which the deficit occurs.
  - Pathophysiology Slide #28
  - “S” “A” “L” “T”
  - “L” “O” “S” “S”



# Hyponatremia-Signs/Symptoms

## “SALT LOSS”

- “S”eizures & Stupor
- “A”bdominal cramping, attitude changes (confusion)
- “L”ethargic
- “T”endon reflexes diminished, trouble concentrating (confused)
- “L”oss of urine & appetite
- “O”rthostatic hypotension, overactive bowel sounds
- “S”hallow respirations (happens late due to skeletal muscle weakness)
- “S”pasms of muscles



# Hyponatremia: Lab Data

- Serum  $\text{Na}^+$  < 134 mEq/L
- Serum osmolality < 275 mOsm/kg
- Urinary  $\text{Na}^+$  < 20 mEq/L
- Urine specific gravity < 1.010



# Medical Treatment for Hyponatremia

- Na replacement by mouth, IV, or NGT
- Replacement depends on the rate lost
  - Can use LR, NS
  - When replacing Na, watch for signs of fluid overload or pulmonary edema
- Rule of thumb: serum Na must not be increased  $> 12$  mEq/L in 24 hours.



# Medical Treatment for Hyponatremia

## Water gain:

- Restrict H<sub>2</sub>O safer than giving Na (800ml/24hr)
- Hypertonic solution 3%-5% NaCl
- Edema only-restrict Na
- Edema and Na- restrict both
- Loop Diuretics



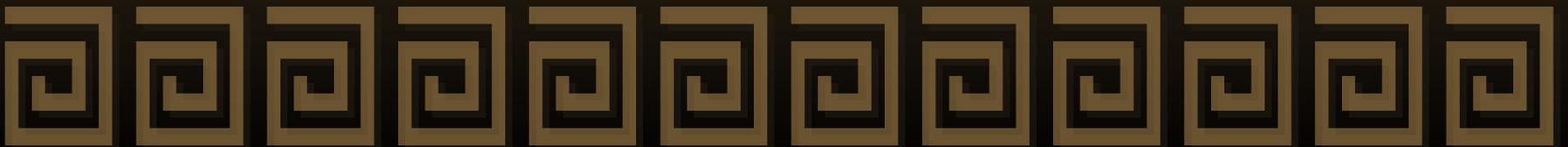
# Nursing Interventions

- Identify pt. at risk
  - Monitor labs, I&O, daily weight
- Review medications
- GI manifestations
- Monitor for S/S of hyponatremia
- Monitor for neurological changes
- Oral hygiene



# SIADH

- Syndrome of Inappropriate Anti-Diuretic Hormone
- Body secretes too much antidiuretic hormone (ADH)
- Disturbs fluid and electrolyte balance
- Major cause of low sodium levels



# SIADH

## What happens:

- ADH increases the permeability of the renal tubules
- Increased permeability of renal tubules increases water retention and extracellular fluid volume
- Leads to:
  - Reduced plasma osmolality
  - Dilutional hyponatremia
  - Diminished aldosterone secretion
  - Elevated GFR
- Increased sodium excretion and shifting of fluids into cells



# SIADH

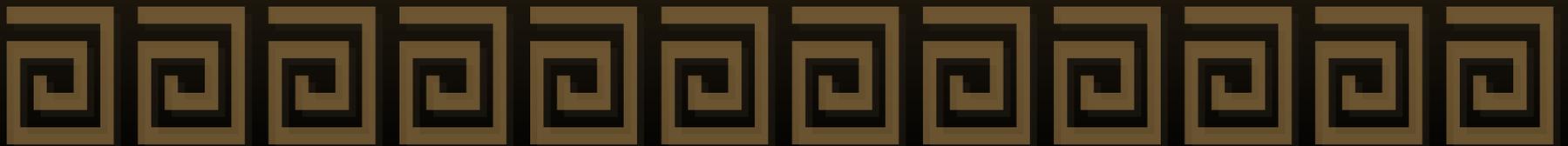
Can result from:

- Sustained secretion of ADH from Hypothalamus
- Production of ADH-like substance from a tumor



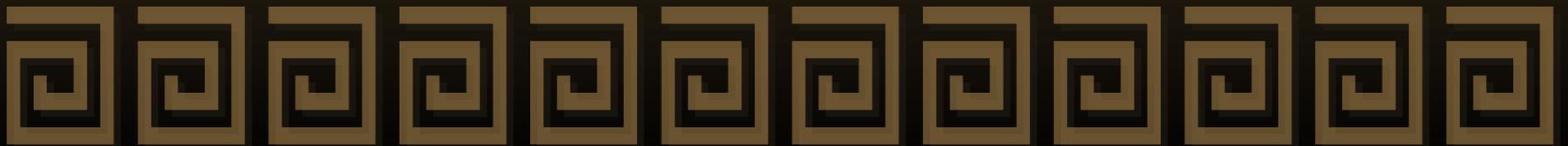
# S/S of SIADH

- Same as Hyponatremia
- Fingerprinting
  - When the finger is pressed over a bony prominence



# Lab Values of SIADH

- Low BUN and Creatinine
- Due to overhydration,
  - elevated urine sodium  $> 20$  mEq/L
  - elevated urine specific gravity  $> 1.012$



# Treatment of SIADH

- Treat the underlying cause
- Replace sodium
  - Hypertonic solution
  - Diuretic –Lasix
- If water restriction is difficult
  - Use lithium or demeclocycline



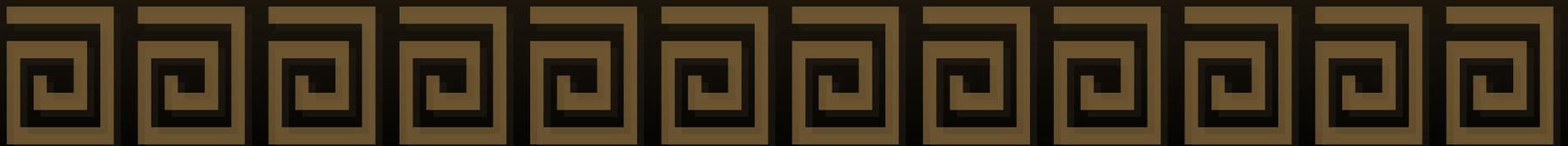
# Nursing Management of SIADH

- Monitor I/O
- Daily weight
- Monitor for Neurological symptoms
- Monitor for lithium toxicity
- Ensure adequate sodium intake
- Avoid excess water supplements
- Monitor urine specific gravity
- Monitor serum sodium



# Hypernatremia

- $\text{Na}^+ > 145 \text{ mEq/L}$
- Causes—See Pathophysiology slide #25
  - “H” “I” “G” “H”
  - “S” “A” “L” “T”



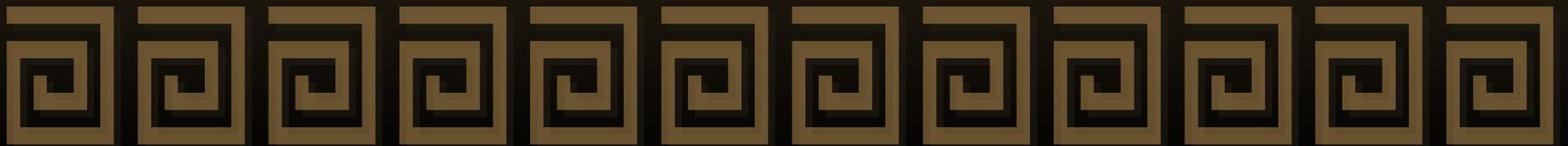
# Hypernatremia-Causes (“HIGH SALT”)

- **“H”ypercortisolism (Cushing’s Syndrome, hyperventilation)**
- **“I”ncreased intake of sodium (oral or IV route)**
- **“G”I feeding (tube) without adequate water supplements**
- **“H”ypertonic solutions**
- **“S”odium excretion decreased and corticosteroids**
- **“A”ldosteronism (hyper)**
- **“L”oss of fluids (infection, sweating, diarrhea, DI)**
- **“T”hirst impairment**



# S/S Hybernemia

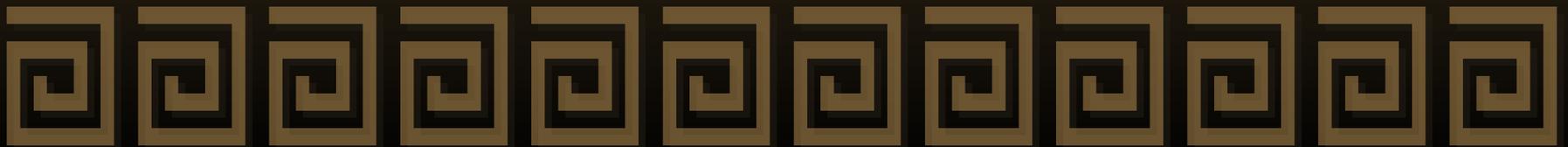
- See Pathophysiology slide #26
  - “F”
  - “R”
  - “I”
  - “E”
  - “D”



# Hypernatremia-Signs/

**Symptoms** (“No FRIED foods for you!”—  
too much salt)

- “F”ever, flushed skin
- “R”estless, really agitated
- “I”ncreased fluid retention
- “E”dema, extremely confused
- “D”ecreased urine output, dry mouth/skin



# Hypernatremia Lab Data

- Serum  $\text{Na}^+$  > 145 mEq/L
- Serum osmolality > 300 mOsm/L
- Urine specific gravity > 1.015



# Hypernatremia Medical Treatment

- ✂ ↓ serum Na<sup>+</sup> level gradually
- ✂ ↓ approx. 0.5-1mEq/L/hr over 48 hrs
- Monitor for neuro changes & cerebral edema
- Hypotonic solution D5W or 0.45% NS
- Desmopressin (DDAVP)



# Hypernatremia Nsg Interventions

- Identify pt at risk
- Monitor fluid loss / gain
- Neuro precautions and behavior changes
- Monitor labs
- Monitor oral Na intake
- Offer fluids
- Note medication with  $\uparrow$  Na<sup>+</sup> content



# Any Questions?

- ????????
- ?!?!?!?!?
- !?!?!?!?!?
- !!!!!!!!!!

