Neurologic Fluid and Electrolyte Disturbances

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REGULATION OF BODY FLUIDS
WATER DISTRIBUTION

- Main component of the body is H2O and is distributed between intracellular and extracellular spaces.
- Balance maintained through osmosis which is a passage of H2O through the cell membrane to equalize concentrations of the two compartments.

REGULATION OF BODY FLUIDS/DISTRIBUTION

- Osmolality is the concentration of a solute (Na, K, Cl, glucose) to a solvent.
- There are neuro-hormonal and renal mechanisms that control H2O balance.

REGULATION OF BODY FLUIDS/DISTRIBUTION

- Normal Serum Osmolality is 280-295 mOsm/kg
- Normal Urine Osmolality is 300-900 mOsm/kg

REGULATION OF BODY FLUIDS/DISTRIBUTION

- Serum Osmolality helps the brain regulate water balance through secretion of anti-diuretic hormone (ADH).

ANTIDIURETIC HORMONE (ADH)

- ADH: A potent hormone that affects re-absorption of water in the kidney.
- Produced in the hypothalamus
- Stored in the pituitary
- Secreted by the posterior pituitary and regulated based on plasma Osmolality
ADH & Volume Effects

- Increased extracellular fluid (ECF) volume and/or increased BP causes:
  - Decreased ADH secretion
  - Increased urine output

ADH & Volume Effects

- Decreased ECF volume/Decreased BP causes:
  - ADH secretion increased
  - Decreased urine output

OTHER STIMULI AFFECTING ADH

INCREASED ADH
- Emotion/exercise
- Nicotine/narcotics
- Hypoxia
- Trauma/pain/stress
- Hyperthermia

DECREASED ADH
- Alcohol
- Dilantin
- Hypothermia

DIABETES INSIPIDUS (DI)

- “High and dry”
- A condition of decreased secretion of ADH
  - Neurogenic (central): an absolute or relative lack of ADH released from the pituitary.
  - Nephrogenic: kidneys do not respond to ADH (rare and less severe)

CAUSES OF NEUROGENIC DI

- Brain tumors
- Head trauma- basilar skull fractures
- Neurosurgery
  - DI is very common following pituitary tumor resection
- Anterior communicating artery aneurysms
- CNS infections-meningitis
- Ischemia/hypoxic events
- Brain death

SIGNS AND SYMPTOMS DI

- Poly-urea (hourly outputs >200cc/hr)
- Extreme thirst if mechanism intact
- Hemodynamic signs of hypovolemia/dehydration
- Decreased weight
- Labs:
  - urine specific gravity <1.005
  - urine osmo < 200
  - serum osmo >300
  - serum Na >145
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TREATMENT DI

- ADH replacement. Vasopressin or DDAVP may be given IV, SC, or intranasal.
  - 2-4 mcg/day IV in two doses common.
- Fluid replacement. Replace output plus 10% (If patient tachypneic or febrile, may need more.)
  - Low sodium fluids used (e.g. D5 ¼ NS) if serum sodium extremely high
  - If caught early, fluid replacement may not be necessary

NURSING MANAGEMENT DI

- Strict I & O
- Fluid administration
- Frequent vital signs
- Neurological exam
- Watch for dehydration
- Monitor lab values
- Daily weights

SYNDROME OF INAPPROPRIATE ANTIDIURETIC HORMONE (SIADH)

- A condition of excessive secretion of ADH
- Low and wet

CAUSES OF SIADH

- Head trauma
- Hydrocephalus
- Meningitis, encephalitis
- Stroke
- Brain tumors
- SAH
- Oat cell (small cell) carcinoma

SIGNS AND SYMPTOMS (SIADH)

- Small amounts of concentrated urine
- Weight gain/ pitting edema
- Hypertension (increased volume)
- Signs of H2O intoxication: nausea, vomiting, headache, irritability
- Labs:
  - serum Na <130 (dilutional)
  - serum osmo <275
  - urine Na 70-140
  - high urine specific gravity & urine osmo
  - decreased hemoglobin(dilutional)

TREATMENT SIADH

- Strict fluid restriction 500-1000cc/day
  - Include tube feedings and vasopressors as part of I&O
- If necessary:
  - Administer diuretics
  - IV fluids should be isotonic, if given
  - Replace sodium slowly with 3% saline over 3-6 days if severe hyponatremia present
  - If no improvement, may administer drugs that inhibit ADH release (Lithium, Dilantin, Demeclocycline)
NURSING MANAGEMENT SIADH
- Strict I & O
- Maintain fluid restriction
- Frequent vital signs
- Neurological exam
- Watch for fluid overload (lung sounds, edema)
- Daily weights
- Monitor lab values
- Skin care due to edema causing increased risk of breakdown
- Frequent oral care for patient on restriction with dry mouth
- Patient/family education

CEREBRAL SALT WASTING SYNDROME (CSWS)
- A condition where true hyponatremia occurs without increases in ECF volume.
- Causes: Uncertain but leading hypothesis is that stress or trauma of the neurologic system cause release of brain natriuretic hormone
  - Common in patients with subarachnoid hemorrhage

SIGNS AND SYMPTOMS CSWS
- Hyponatremia
- Hypo-osmolality
- Decrease plasma volume
- Increased BUN
- Symptoms of hyponatremia (malaise, N/V, confusion, lethargy, seizures)
- Negative sodium balance
- Decreased ADH levels
- Urine output can be low, normal or high
  - Increased Na in urine

TREATMENT AND MANAGEMENT CSWS
- Sodium replacement (hypertonic saline, sodium tablets)
- Fluid replacement to maintain euvolemia
- Sometimes mistaken for SIADH but does not respond to fluid restriction
- Typically self-limiting but can last for several weeks

NURSING MANAGEMENT CSWS
- Frequent vital signs
- Neurological exam
- If sodium < 120, implement seizure precautions
- Daily weights
- Monitor lab values
- Patient/family education

Parameter | DI | SIADH | CSW
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Serum Sodium | High | Low | Low
Serum Osmo | High | Low | Normal or high
Plasma volume | Down (Dry) | Fluid up (Wet) | Normal to low
Urine | High output & dilute | Low output & concentrated | High sodium & higher output
Skin | Dry | Pitting Edema |
Weight | Down | Up | Slightly down
ADH | Decreased | Increased | May be decreased
Treatment | Give ADH | Fluid Restrict | Give Sodium
TIP: ADH and Alcohol

- Alcohol inhibits ADH from being secreted
- Leads to frequent urination, dehydration and hangover-HA
- Drink 2 glasses of water for every one drink of alcohol

Queens University at campus.queens.edu/faculty/jannr/cells/index.htm