Hyponatremia Encephalopathy

Key Article

- *Archinger SG, Ayus JC. Treatment of hyponatremic encephalopathy in the critically ill. Crit Care Med. 2017; epub ahead of print.*

Background - John

- Hyponatremia defined as Na < 135 mEq/L; reflects an overall hypo-osmolar state
- Frequently encountered problem in the critically ill patient
- Hyponatremic encephalopathy
    - Neurologic symptoms due to hypo-osmolar induced cerebral edema
    - A true medical emergency
    - Treatment is determined by clinical symptoms and not the duration of hyponatremia or absolute decrease in serum Na value

Pathogenesis - Rob

- Hyponatremia develops when water intake exceeds excretion
- Usually occurs in setting of impaired free water excretion by the kidneys
- Conditions associated with impaired urinary diluting capacity include:
    - Hypovolemia hyponatremia
        - Renal
            - Diuretics (i.e., thiazide type)
            - Mineralocorticoid deficiency
            - RTA
            - Cerebral salt wasting
        - Extrarenal
            - Vomiting
            - Diarrhea
            - Pancreatitis
    - Hypervolemic hyponatremia
        - CHF
        - Cirrhosis
        - Acute and chronic renal failure
    - Euvolemic hyponatremia
        - Postoperative state
        - Exercise induced
        - Ecstasy
        - SIADH
        - Hypothyroidism
        - Glucocorticoid deficiency
- During hyponatremic states, osmotic gradient develops between the circulation and the brain, results in water movement into the brain
- Fluid movement results in cell expansion and increase in brain volume
- Initially the increase in brain volume is offset by shunting of CSF from intracranial vault

Initially the increase in brain volume is offset by shifting of CSF from intracranial vault

- Ultimately this has limited capacity
- Neurologic injury occurs normal mechanisms are unable to compensate for the increased ICP/cerebral edema

Clinical Manifestations - Peter

- Absolute change in serum sodium alone is a poor predictor of clinical symptoms
- Acute
    - < 48 hours
    - Usually hospital acquired – postoperative, use of hypotonic fluids
- Uncertain duration
    - Most common presentation
    - Diuretic related, hypovolemia, SIADH, adrenal insufficiency
- Chronic
    - > 48 hours
    - Patient with recurrent episodes of CHF
- Patients with any type can develop hyponatremic encephalopathy
- Early signs: nausea, vomiting, and HA
- As ICP rises – altered mental status, seizures, respiratory failure, herniation, death

Risk Factors for Hyponatremic Encephalopathy - John

- Gender, Age, and Hypoxia are three primary risk factors and have been shown to be predictive of poor outcome – rather than the rate of development of hyponatremia or the absolute value of sodium
- Age
    - < 16 years
    - Children are at increased risk – due to high brain-to-cranial vault size ratio
- Females of premenopausal age are at increased risk of postoperative hyponatremia
    - Estrogens decrease the catalytic activity of astrocyte Na/K ATPase preventing solute extrusion
    - Impaired regulatory brain volume decrease
    - Seen in association with ecstasy use, diuretics, exercise, and use of DDAVP
- Hypoxia
    - Also decreases the catalytic activity of astrocyte Na/K ATPase preventing solute extrusion
- Brain injury
    - Vasogenic cerebral edema
    - Cytotoxic cerebral edema

Treatment of Hyponatremic Encephalopathy – Rob/Peter

- Goals of therapy
    - Remove patients with severe cerebral edema from immediate danger
    - Correct sodium to mildly hyponatremic levels
    - Maintain this level of sodium to allow the brain to adapt to changes in serum osmolality
- Hypertonic saline is the treatment of choice
    - Used in both children and adults
    - Used in patients with acute and chronic hyponatremia presenting to the ED
    - Time course over which hyponatremia develops is not a determinant of therapy for someone with encephalopathy
    - Indiscriminate use and administration can produce neurologic injury from too rapid a correction
    - Concerns about osmotic demyelination syndrome should not prevent therapy with hypertonic saline when encephalopathy present

- Authors approach is 2 ml/kg 3% hypertonic saline
    - 100 ml of 3% saline
    - Bolus can be given through a peripheral IV
    - A single bolus will result in a typical rise of 2 mEq/L in serum Na
    - No head to head studies evaluating bolus therapy to continuous infusion
- In most cases, a 4-6 mEq/L rise in serum Na will reverse the neurologic symptoms
    - If it does not result in clinical improvement, then hyponatremia is likely NOT the cause of the patient's symptoms
    - In general, sodium should not be corrected more than 5 mEq/L in the first 1-2 hours
    - Final correction of sodium should not exceed more than 15 mEq/L in first 48 hours
- Check Na every 1-2 hours until the patient is stable
- Monitor urine output

Risk Factors for ODS - Mike

- A complication of overcorrection of severe hyponatremia
- Primarily seen in patients with hyponatremia > 48 hours and plasma Na < 115 mEq/L
- Does NOT appear to be related to an excessive hourly rate of correction provided that overall correction is < 20 mEq/L
- Main risk is NOT from the use of hypertonic saline, but rather from the renal response to fluid therapy and a spontaneous free water diuresis that occurs when the stimulus for vasopressin release abates
- Risk factors
    - Thiazide induced hyponatremia
    - Water intoxication
    - DDAVP-induced hyponatremia
    - Severe liver disease
    - Hypokalemia
    - Alcoholism
    - Malnutrition
    - Hypophosphatemia
    - Hypoxia
- Symptoms usually occur days to week following correction of hyponatremia
- Symptoms can range from asymptomatic to extreme agitation
- MRI is necessary for the diagnosis