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STANDARD GUIDELINE SUBJECT
Hyponatremia Treatment Guideline – Adult

DEFINITIONS:
Hyponatremia: is a relative water excess in relation to sodium. Serum sodium (s[Na+]) <135 mmol/L

Clinically significant hyponatremia: s [Na+] < 130 mmol/L

PROCEDURE:
Patients found to have hyponatremia should be assessed for:
- Severity of symptoms of hyponatremia
- Volume status
- Possible causes using algorithm included in standard orders package

Patients with severe symptoms of hyponatremia require emergent treatment.
For patients with mild to moderate hyponatremia symptoms, it is not essential to start treatment in the Emergency Department. In general, it takes most patients more than 48 hours to develop hyponatremia and correcting the s[Na+] level should also take place over 48 hours or more. This should be a slow process.
Upon making the diagnosis of hyponatremia, the physician is responsible to sign the Hyponatremia Standard Orders form, activating all standard orders, and checking appropriate boxes to activate optional orders. If there are orders on this document that the physician would like to omit, the physician must stroke out and initial these orders.

There are four different sets of standard orders. Patients with severe symptoms of hyponatremia require emergent treatment, as per page 1 of the Hyponatremia Standard Orders. Those with mild to moderate symptoms are managed according to their volume status using the appropriate set of standard orders from pages 2-4. Cross out the pages that are not applicable to this patient.
The goal of treatment is to increase the serum sodium by 6-8 mmol/L per 24 hour period, with lower rates for patients with liver disease, menstruating females and the elderly. Physicians are responsible for ensuring the rate of rise of the serum sodium is within the goals suggested in order to prevent osmotic demyelination syndrome.

IMPORTANT POINTS TO CONSIDER:

1. Symptoms of hyponatremia are classified as follows**:**
   - Severe hyponatremia – obtundation, seizures, coma, and respiratory arrest
   - Moderate hyponatremia - confusion and lethargy
   - Mild hyponatremia - dizziness, gait disturbances, forgetfulness.
2. Symptom severity does not correlate with the severity of the serum sodium concentration.
3. Investigations - blood and urine samples should be obtained prior to giving intravenous fluids as per standard orders.
4. Volume status: Classify patients as hypovolemic only if they display obvious clinical signs of hypovolemia. Mild hypovolemia should be treated as euvolemia; therefore IV fluids are not required.
5. The Hyponatremia Algorithm is to be used as a guide in working up a patient with hyponatremia. Suggestions for treatment are found at the end of each branch of the algorithm. If more than one cause of hyponatremia is present, the algorithm may not fit. It is then advisable to go with most likely cause first and see the response.
6. Hyponatremia patients should be properly assessed including history, physical, electrolytes, BUN, creatinine, uric acid, serum osmolality and spot urine sodium.
7. In patients with mild to moderate symptoms
   - Reviewing and stopping drugs that may contribute to syndrome of inappropriate diuretic hormone may be all that is required.
   - Always look for a cause and treat the cause if there are no emergency i.e. any symptoms of severe hyponatremia.
   - These patients developed hyponatremia over more than 48 hours and slow correction is required.
   - Management of these patients consists of treating the cause, with the following order of priority:
     1. Stop offending drugs
     2. Treat nausea and pain
     3. Restrict fluids
     4. Replace salt with either salt tablets or IV solution – not required unless obviously hypovolemic or Syndrome of Inappropriate Diuretic Hormone (SIADH) is present.
8. The goal of sodium correction is to increase the serum sodium by 6-8 mmol/L in 24 hours.
9. Overcorrection - If correction occurs too rapidly the patient is at risk of developing osmotic demyelination syndrome (see 11 below). Overcorrection is likely to occur in the following situations:
   - Volume replacement – in correcting hypovolemia with normal saline, once near euvolemic, ADH secretion will decrease and stop with euvolemia resulting in diuresis and rapid correction of the serum sodium.
   - With the administration of glucocorticoids in adrenal insufficiency, rapid correction of serum sodium may occur.
10. It is important to monitor for sudden rapid diuresis as this will indicate that the s [Na+] will rise rapidly. If this occurs, administer desmopressin 2 mg every 6 hours to control the diuresis, and stop saline infusion if applicable.
11. Osmotic Demyelination Syndrome (ODS).
    - ODS is a severe irreversible condition that presents 2 to 6 days post serum sodium correction.
    - It is important to adhere to the daily goals of sodium rise in order to prevent ODS.
    - ODS is more likely to occur in those with chronic hyponatremia whose serum sodium concentration is <120mmol/L, but may also occur in acute onset hyponatremia with serum sodium concentration levels >120 mmol/L.
    - The clinical features of ODS include dysarthria, dysphagia, paraparesis or quadriparesis, behavioral disturbances, lethargy, confusion, disorientation, obtundation, and coma. Seizures may also be seen but are less common.
    - ***Slower rates of correction should be used for patients with hypokalemia, advanced liver disease, and severe malnutrition***.

12. Potassium given orally or by infusion will increase the s [Na+] by the same amount as infusing sodium, as it will result in moving sodium out of the cells and into the extracellular fluid. Sometimes, just replacing the potassium will correct the serum sodium.
13. To estimate the probable serum sodium increase resulting from infusion of 0.9% saline or 3% saline, one could use the following formula:
    - First determine the estimated increase in serum sodium when 1 litre of saline is infused:
      Increase in serum sodium from 1 liter solution = $\frac{\text{(Infusate [Na] + [K]) – serum [Na]}}{\text{TBW + 1}}$

      Where:
      The total sodium per liter in:
      - 3% saline is 513 mmol/L
      - 0.9% saline is 154 mmol/L

      Total Body Water (TBW) is a fraction of the body weight in kilograms (BW) calculated as follows:
      - Children: 0.6 x BW
      - Nonelderly males: 0.6 X BW
      - Nonelderly females: 0.5 X BW
      - Elderly males: 0.5 x BW
      - Elderly females 0.45 x BW

      Once you have calculated what 1 litre will do to the serum sodium level, calculate the number of milliliters required to achieve the daily goal as follows:
      Number of mls required = $\frac{\text{Daily Goal Required}}{\text{Increase in sodium from 1 liter solution}}$

      Be aware, this is an estimate and the serum sodium will still need to be checked as indicated below to ensure overcorrection does not occur.
14. Monitor serum sodium every 2 to 3 hours, in order to monitor for an overly rapid increase in serum sodium.
15. Management of overcorrection of serum sodium
    - Administer D5W 6 ml/kg lean body weight (LBW) over 1-2 hours. This typically lowers the serum sodium concentration by 2 mmol/l.
    - LBW is usually estimated using mathematical formulas. The following formula may be used:
      For men: LBW = (0.32180*W)+ (0.33929*H) - 29.5336
      For women: LBW = (0.29569*W)+ (0.41813*H) – 43.2933
      Where W is body weight in kilograms and H is body height in centimeters.
    - Measure serum sodium concentration after each infusion of D5W.
    - Repeat until the therapeutic goal is achieved and in order to hold the serum sodium at the desired therapeutic goal.
    - Administer Desmopressin 2 mcg subcut/IV every 6 hours (may increase to a maximum dose of 4 mcg if 2mcg not effective). This can be repeated every 6 to 8 hours if the serum sodium concentration is again rising more rapidly, or a rapid diuresis occurs.
    - Once the desired goal is achieved, stop the D5W, but continue the desmopressin to maintain the serum sodium levels and prevent over correction.

      Note: When managing overcorrection the goal is to lower serum sodium concentration by 1 mmol/l per hour and aim to obtain a serum sodium concentration rise <10 mmol/l in any 24 hour period and <18 mmol/l in any 48 hour period.
16. Slowing the serum sodium rise: When according to the trajectory the sodium rise will be greater than the daily goal, the rise can be slowed as follows:
    - Administer Desmopressin 2 mcg (maximum 4 mcg) every 6 hours subcut/IV. This will stop or slow the rise in serum sodium concentration.

- If the serum sodium is not increasing after the desmopressin dose then add a 3% saline infusion at 10 to 30 ml/hour – use only if serum sodium concentration ceases to rise.
- Measure serum sodium concentration every 4 hours and adjust infusion accordingly until serum sodium concentration is 125 to 130 mmol/L.

17. Holding the serum sodium level constant:
    - When the maximum goal for a particular 24 hours period is reached, hold the serum sodium concentration steady by giving Desmopressin 2 mcg (maximum of 4 mcg) every 6 hours to prevent diuresis.
    - Fluid administration is generally not needed with this; however, monitoring the serum sodium level remains important.
18. For patients with SIADH, e.g. from tumors etc, management takes place in the following order:
    1. Fluid restriction.
    2. IV 0.9% saline or salt tablets are then added to the management if the serum sodium concentration is not increasing.
    3. If the serum sodium concentration decreases with 0.9% saline infusion then 3% saline needs to be infused.

SUPPORTING DOCUMENTS:

CLI.5110.SG.003.FORM.01 Hyponatremia Standard Orders and Algorithm

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