Hypernatremia

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- A previously healthy 6-month-old girl presents to the ER with 3 days of watery diarrhea, fever and vomiting. She is having 6-10 diarrhea episodes a day without blood or mucus, and has been vomiting 4-5 times a day without bile or blood. She has not had cough, respiratory distress or rash, but has been irritable for 2 days and the past 12 hours very sleepy. She was born at 38 weeks with BW of 3kg, all vaccines are UTD. On PE W 5kg, T 39, HR 160, RR 38, BP 60/45, she is lethargic, has sunken eyes, dry mucous membranes, poor skin turgor and her capillary refill is delayed. No focal findings.

- Her labs reveal:
  - Hemoglobin 12.3 g/dL
  - WBC 21.6 × 10^3/mcL with 37% neutrophils, 57% lymphocytes, and 4% eosinophils.
  - Sodium 171 mEq/L
  - Potassium 5.0 mEq/L
  - Bicarbonate, 15 mEq/L
  - BUN 23 mg/dL
  - Creatinine, 0.6 mg/dL
  - Results of a urinalysis are normal. A chest radiograph shows no infiltrate.
- What is the first step correcting this child's dehydration ?

1) normal saline bolus 10ml/kg

2)normal saline bolus 20ml/kg

3) hypertonic saline bolus 10ml/kg

4) 0.45 saline bolus 10ml/kg

5)0.45 saline bolus 20ml/kg

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- One bolus of 100ml of normal saline is required to restore vascular volume. What is the next best option for fluid replacement in the next 24 hours?

1) Normal saline at 20ml/hour plus ongoing losses

2) Dex 5% 0.45 NS at 20ml/hour plus ongoing losses

3) Dex 5% 0.45NS at 30ml/hour plus ongoing losses

4) Dex 5% 0.2 NS at 20ml/hour plus ongoing losses

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General recommendations for treating hypernatremic dehydration

- If hypernatremia is corrected too rapidly, brain edema, seizures, and death can occur.
- Decrease the serum sodium level no faster than 0.6 mEq/L (0.6 mmol/L) per hour or 15 mEq/L per day.

Phases for treating hypernatremic dehydration

- Emergency phase (restoration of vascular volume)
- Rehydration phase (the sum of the free water deficit and maintenance fluid requirements administered evenly over 48 h-72h).

Emergency phase

Emergency phase

- restoration of vascular volume with:
- 10 to 20 mL/kg of isotonic intravenous [IV] fluid:

  – lactated Ringer solution with 130 mEq/L of sodium
  – or normal saline with 154 mEq/L of sodium.

❖In cases of severe hypernatremic dehydration, the aforementioned general management plan is problematic.

Emergency phase

- When sodium is >175 mEq/L, NS IV fluids are hypotonic compared with the patient's serum.
- Therefore, various amounts of 3% normal saline (513 mEq/L should be added such that the IV fluid sodium concentration is approximately 10 to 15 mEq/L lower than the serum sodium level.
- If the history reveals a potential case of severe dehydration of a breastfed infant, it is likely that the serum sodium exceeds 175 mEq/L (175 mmol/L), and the preparation of hypertonic fluids for support and maintenance of volume should be considered.

Example :

- A breastfed term infant who had a birthweight of 3 kg presents to the emergency department 1 week after discharge from the newborn nursery with the primary complaint of increasing fussiness. The history indicates that the infant is a “slow feeder,” and he appears dehydrated. His current weight is 2.4 kg, and his serum sodium concentration is 195 mEq/L.

Emergency Phase :

- Create an IV solution that has a sodium concentration 15 mEq/L (15 mmol/L) below the serum sodium concentration. (195−15)= 180 mEq/L

Example

- Use this formula to calculate the amount of 3% normal saline that should be added to 1 L of normal:

[1,000×(desired Na^+−154)]/(500−desired Na^+)=mL of 3% NS

[1,000×(180−154)]/(500−180)= 81 mL of 3% NS to be added to 1 L of NS.

- That would make an IV solution that contains 180 mEq/L of Na
- Administer 10- to 20-mL/kg boluses of prepared IV fluid until the infant is hemodynamically stable.

Rehydration phase

Rehydration phase

Initial bolus of isotonic saline is given to reverse shock at 20 mL/kg; may repeat bolus if needed.

After shock state is reversed, calculate rehydration using 5% dextrose 0.2 normal saline as follows:

$$\text{Current weight (kg)} \times 2/3 = \text{TBW}^*_{\text{(current)}}$$

$$(\text{Current serum sodium}/140) \times \text{TBW}_{\text{(current)}} = \text{TBW}_{\text{(desired)}}$$

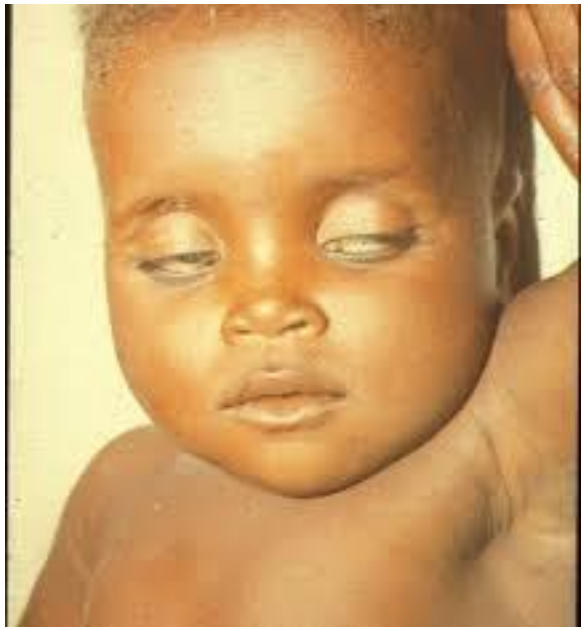
$$\text{TBW}_{\text{(desired)}} - \text{TBW}_{\text{(current)}} - \text{initial fluid bolus} = \text{TBW}_{\text{(deficit)}}$$

If current serum sodium is less than 170, then correct over a minimum of 48 hours.

If current serum sodium is more than 170, then correct over a minimum of 72 hours.

$\text{TBW}_{\text{(deficit)}}$ is divided by 48 or 72 (see above) to determine the rate of fluid for correction on an hourly basis. To this value, maintenance requirements must be added.

- If there are signs of circulatory collapse, fluid resuscitation with normal saline or colloid should be instituted before going to this phase



During the rehydration phase, 5% dextrose in 0.2% normal saline (31 mEq/L) is the usual IV fluid composition.

A solution of 5% dextrose with 0.2% normal saline is adequate for the rehydration phase of mild hypernatremic dehydration, but a higher sodium concentration should be considered (5% dextrose/0.45% normal saline) for the rehydration phase of severe cases.

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5kg x 2/3= 3.33 (Total body water)$_{current}$

171/140 x 3.33= 4.06 (Total body water) $_{desired}$

4.06 – 3.33 - 0.1 (initial bolus)= 0.63L (TBW) $_{deficit}$

Goal: to correct over 72 hours

0.63L/72= 9ml/hour

Plus maintenance fluids: 20ml/hour

Desired rate: 29ml/hour

The child should receive 29ml/hour Dextrose 5% 0.2NS

Rehydration phase

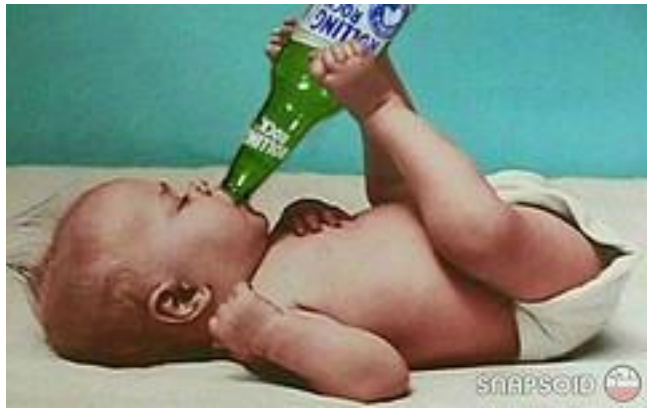
Alternatively you can also this formula to calculate free water deficit.

$$\text{Free water deficit (mL)} =$$
$$4\ \text{mL} \times \text{lean body weight (kg)} \times$$
$$[\text{desired change in serum sodium mEq/L (mmol/L)}]$$

Our case: 4x5x15= 300mL

300ml/24hours= 12.5ml/hour
Plus maintenance fluids: 20ml/hour
Desired rate: 32ml/hour
The child should receive 32ml/hour Dextrose 5% 0.2NS

- ✓ The calculated deficit does not account for insensible losses or ongoing urinary or gastrointestinal losses.
- ✓ Oral hydration should be instituted as soon as it can be tolerated safely.
- ✓ Check the serum electrolyte concentrations every 2 to 4 hours.
- ✓ If the serum sodium is decreasing faster than 0.6 mEq/L per hour, decrease the rate of IV fluid infusion or increase the concentration of the sodium in the IV fluid.



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