PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on "**Disorders of Sodium Balance: Case Examples.**" These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedcases.com/podcasts.

Disorders of Sodium Balance: Case Examples

Developed by Dr. Laura Betcherman, Dr. Talia Lenton-Brym and Dr. Rachel Pearl for PedsCases.com.
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Case 1: Hyponatremia

Case description:
Imagine you are seeing a previously healthy 18-month-old male in the emergency department with a two-day history of fever, diarrhea and decreased oral intake. His parents tell you that he has been less playful and has had fewer wet diapers than usual. He has a fever of 38.7 degrees Celsius, a heart rate of 160 beats per minutes and a blood pressure of 95/65. His weight is 10 kg. Initial bloodwork shows a sodium of 126 mmol/L.

Step 1: Determine the patient's volume status
This patient has had a gastrointestinal illness with diarrhea, decreased oral intake and decreased urine output. They are tachycardic on exam. This points to a case of **hypovolemic hyponatremia**.

Step 2: Correct unstable vital signs
In any case where you are worried about dehydration and vital sign instability, you always start with your ABCs. This patient would probably warrant a bolus of 20cc/kg of normal saline, which is a reasonable start.
Another important consideration is whether they are symptomatic from their hyponatremia. Recall this presents with signs of neurologic instability. This patient is neurologically normal, so no immediate course of action (i.e. a bolus of 3% saline) is required

Step 3: Determine your IV fluid and rate to correct your sodium. A useful tip is to find the patient's **total body sodium** in their current state and steady state (when they are eunatremic). This involves calculating the total body water, which you assume stays constant.

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- Calculate the patient's **total body water:** 0.6 x weight
    - 0.6L/kg x 10kg = 6L
- Calculate the patient's **current total body sodium**: TBW x serum Na concentration
    - 6L x 126mmol/L = 756mmol
- Calculate the patient's **ideal total body sodium**
    - 6L x 140mmol/L = 840mmol
- Calculate the **sodium deficit** = ideal body sodium – current body sodium
    - 840mmol – 756mmol = 84mmol
- Choose your IV fluid – for example normal saline, 0.9%NaCl.
    - Recall that normal saline has a sodium concentration of 154mmol/L
    - If you were to use ½ normal saline (0.45%NaCl) the sodium concentration is 77mmol/L.
- Choose your IV fluid volume
    - If normal saline has a concentration of 154mmol/L, and you need to replace 84mmol, then you need X L of fluid.
    - 154 mmol → 1L
    - 84mmol → X L
    - Cross multiply to get the value of "X" – 84/154 = 0.545L
    - Therefore you need 545mL of normal saline to get back to a eunatremic state
- Calculate the IV fluid rate
    - Remember – only correct 8-10mmol/day. Our patient has a sodium concentration of 126mmol/L. The ideal sodium concentration is 140mmol/L. This means that you are replacing 140-126 = **14mmol**, which can be done safely over 36 hours
    - Recall you need 545mL of fluid, and you will correct over 36 hours, which gives you a rate of: 545/36 = **15mL/hr**
- Your final prescription will be: 15mL/hr of 0.9%NaCl over 36 hours

Caveat: these calculations are theoretical, and assume that you are able to strictly control intake and output. In real life the math does not always work out. This is why it is important to check sodium frequently (every 4 hours initially) to adjust your rate if need be.

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Case 2: Hypernatremia

Case description:
Imagine you are seeing another 18 month old previously healthy toddler. His parents brought him into the emergency department because of a 2 month history of increased diuresis and thirst. The baby is afebrile, with slightly elevated heart rate of 150 beats per minute and a normal blood pressure and respiratory rate. Although the baby looks well, you are concerned for an underlying pathology given the prolonged history of increased urine output and order routine bloodwork and a urinalysis with urine and serum osmolarity. The patient's vital signs are stable, and this time, you find a serum sodium of 154mmol/L with a serum osmolarity of 320mOsm and a urine osmolarity of 185mOsm with no glycosuria.

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