

IX: Electrolytes. Sodium disorders

Dan Henry, MD
Clerkship Director
University of Connecticut School of Medicine

Specific Learning Objectives:

Knowledge

Subinterns should be able to describe:

- a) The differential diagnosis of Hyponatremia (congestive heart failure, cirrhosis, thiazide diuretics, SIADH, adrenal insufficiency, hypothyroidism, primary polydypsia)

Skills

Subinterns should demonstrate skill in:

- a) Conduct a history:
 - i. Obtain from patients and correctly interpret symptoms that could indicate an underlying electrolyte disorder, and they should be able to obtain and interpret the significance of the patient's medication history
- b) Conduct a physical examination:
 - i. Assess volume status, perform a mental status examination
- c) Develop a management plan:
 - i. Work through the differential diagnosis for hyponatremia in order to arrive at a specific diagnosis
 - ii. Develop an efficient plan for using laboratory tests (including urine sodium to determine the cause of the hyponatremia)
 - iii. Write orders for the correction of hyponatremia
- d) Hyponatremia: prescribe the following interventions as appropriate with careful to avoid overcorrection:
 - i. Fluid restriction
 - ii. Volume repletion
 - iii. Diuresis

Attitudes and professional behavior

Subinterns should demonstrate:

- a) Motivation towards learning how to recognize and treat their patients' hyponatremia

1. In patients with hyponatremia they are classified as either hypovolemic, euvolemic, or hypervolemic. What are some of the causes for each of the classifications and under each of the classifications what is the mechanism to explain the U_{Na} & U_{osm} ?

	Hypovolemic		Euvolemic	Hypervolemic
	Nonrenal	Renal		
U_{Na}	< 20 mEq/L	> 20 mEq/L	> 20 mEq/L	< 20 mEq/L
U_{osm}	Increased	Increased	Increased	Increased

A. Hypovolemic

Nonrenal

1) U_{Na} —

U_{osm} —

2) Renal

U_{Na} —

U_{osm} —

B. Euvolemic

U_{Na} —

U_{osm} —

C. Hypervolemic

U_{Na} —

U_{osm} —

CASE 1

SCENARIO: A 50-year-old man with congestive heart failure secondary to a myocardial infarction is admitted to the hospital with dyspnea on exertion, orthopnea, and paroxysmal nocturnal dyspnea. He was being treated with captopril (ACE inhibitor) and the loop diuretic furosemide, but ran out 1 week ago. On physical examination his blood pressure is 110/70 mm Hg, pulse is 110/min, and respirations 20/min. He has jugular venous distention, and rales are heard over the lower 1/2 of the lung fields. Heart sounds reveal a normal S1 and S2, and an S3 gallop at the apex. A grade II/VI holosystolic murmur is also heard at the apex, and radiating to the axilla. He has 2+ pitting edema in his legs. The following laboratory data are obtained.

Serum [Na ⁺]	=	130 mEq/L	(nl = 135 – 145 mEq/L)
Serum [K ⁺]	=	3.8 mEq/L	(nl = 3.5 – 5.0 mEq/L)
Serum [Cl ⁻]	=	94 mEq/L	(nl = 95 – 105 mEq/L)
Serum [HCO ₃ ⁻]	=	25 mEq/L	(nl = 24 – 28 mEq/L)
Serum [BUN]	=	28 mg/dL	(nl = 7 – 18 mg/dL)
Serum [creat.]	=	1.1 mg/dL	(nl = 0.6 – 1.2 mg/dL)
Urine osm	=	600 mosm/L	
Urinary sodium	=	10 mEq/L	

- ## Hyponatremia Student Version

The electrolyte free water equation is:

$$\text{Urine Volume (V)} = \frac{(U_{Na} + U_k) V}{P_{Na}} + CH_2O$$

CASE 2

SCENARIO: A 46 year old man with a history of AIDS due to intravenous drug use is seen because of a severe headache for 3 days. He was diagnosed 5 years ago and was on HAART treatment but was poorly compliant and it was discontinued one year ago. His most recent CD₄ is 50/mm³ and viral load 50,000 copies/ml. He has no complications and takes TMP/SMX for PCP prophylaxis. Three days ago he began having severe headaches. The headache is constant and located in the occipital area and he rates it an 8 on a 10 point scale. Two days ago he noticed decreased ability to write due to right hand weakness. No visual problems or other neurological symptoms. Yesterday he vomited once and has had decreased food intake. Blood pressure is 100/60 mmHg, pulse is 100/min, respirations are 20/min temperature is 38°. Neurological exam reveals decreased hand grip and decreased flexion of right wrist. There is no edema.

The following laboratory are

Serum [Na ⁺]	=	125 mEq/L	(nl = 135 – 145 mEq/L)
Serum [K ⁺]	=	3.8 mEq/L	(nl = 3.5 – 5.0 mEq/L)
Serum [Cl ⁻]	=	90 mEq/L	(nl = 95 – 105 mEq/L)
Serum [HCO ₃ ⁻]	=	25 mEq/L	(nl = 24 – 28 mEq/L)
Serum [Cv]	=	1.0 mg/dL	(nl = 0.6 – 1.2 mg/dL)
Serum [BUN]	=	8 mg/dL	(nl = 7 – 18 mg/dL)
Urine sodium	=	60 mEq/L	
Urine osmolality	=	400 mOsm/L	

CT scan shows a ring enhancing lesion one in the left parietal area.

1) What is the most likely cause of the hyponatremia?

2) What is the treatment?

References

General overviews:

Electrolyte Free Water Excretion

Rose BD. New approaches to disturbance in the plasma sodium concentration. Am J Med 1986; 81:1033

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Adroque HJ, Madias NE. Hyponatremia. NEJM 2000, 342(21): 1581-9.