Lunch with the expert
Hyponatremia, beer potomania

Richard H. Sterns, MD

History

A 44 year old woman with a history of heavy beer drinking (at least a six pack daily) visits her PCP and is started on a thiazide diuretic for hypertension and an SSRI for depression. Two weeks after starting these medications, she develops progressive weakness and lethargy, and for the next several days she experiences multiple falls.

History

She is brought to a rural hospital where she is found to be afebrile, normotensive, awake and oriented, but slow to respond. She weighs 45 kg, has multiple bruises, including evidence of head trauma and her general physical examination is unremarkable.

Laboratory Data

Serum Na 94, K 2, Cl 65, CO2 25 mmol/l;
BUN 8, Creat 0.5, Glucose 140 mg/dl

History (cont)

At the rural hospital the laboratory tests are repeated and confirmed, a negative CT scan of the head is obtained, fluids by mouth are withheld, and she is given an unknown amount of isotonic saline and potassium chloride intravenously while arrangements for transfer are being made.

History (cont)

Eight hours later she arrives at a city hospital ED where admission lab work show that her serum sodium is 97 mmol/l and serum K 2.4 mmol/l. She is given 0.9% NaCl with 40 mmol KCl/L at 250 ml/hr and 40 mmol of KCl orally.

History (cont)

Six hours after arrival in the city hospital ED she is transferred to the ICU where additional laboratory work are obtained:

- Serum Na 107 mmol/l, K 2.7 mmol/l
- Urine osmolality: 50 mOsm/kg
- Urine Na 2 mmmol/l

Question #1

Which of the following etiologies for hyponatremia is consistent with the history and laboratory findings:

A. Beer potomania

B. Thiazide-induced hyponatremia

C. SIADH due to SSRI's

D. All of the above

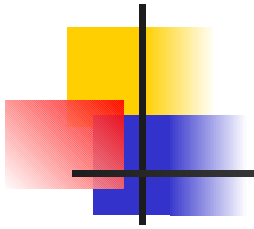
E. None of the above

History (cont)

Six hours after arrival in the city hospital ED she is transferred to the ICU where additional laboratory work are obtained:

- Serum Na 107 mmol/l, K 2.7 mmol/l
- Urine osmolality: 50 mOsm/kg
- Urine Na 2 mmmol/l

Hyponatremia with Maximally Dilute Urine



No defect in water excretion

- Psychotic polydipsia
- Infants fed dilute formula

Solute limited water excretion

- Beer potomania
- Tea and toast diet + large water intake

Beer Potomania

- Severe symptomatic hyponatremia, often with hypokalemia
- Large amounts of beer (> 4 L/day) with low sodium content
- Little food intake
- Urine osmolality classically < 100 mOsm/kg
- In some reports Uosm elevated

Diet and Water Excretion

$$\text{Urine output} = \frac{\text{Urine Solute}}{\text{Urine Osmolality}}$$

Urine solute = Dietary Protein & Salt

Maximally Dilute Urine = 50 mOsm/L

Hyponatremia With Dilute Urine

<u>Psychotic Polydipsia</u>

- Uosm = 50 mOsm/L
- Dietary solute = 900 mOsm/day
- Urine output = 18 L/d
- Fluid intake intake > 0.75 L per hour

<u>Beer/Tea Diets</u>

- Uosm = 50 mOsm/L
- Dietary solute = 300 mOsm/day
- Urine output = 6 L/day
- Fluid intake > 6 L/day

Hyponatremia with dilute urine

Urine Osmolality	50 mOsm/L
Urine Solute Excretion	300 mOsm/day = 12.5 mOsm/hr
Urine Output	250 ml/hr
Δ Serum Na/hr	1.25 mEq/L/hr

Hyponatremia With Maximally Dilute Urine: Summary

- Unsustained, acute hyponatremia
- Spontaneous, rapid correction when water intake stops

But this patient's serum sodium concentration increased by only 3 mEq/L in the first 8 hours

Hyponatremia with reversible defects in water excretion

- Concentrated urine initially
- Dilute urine during therapy

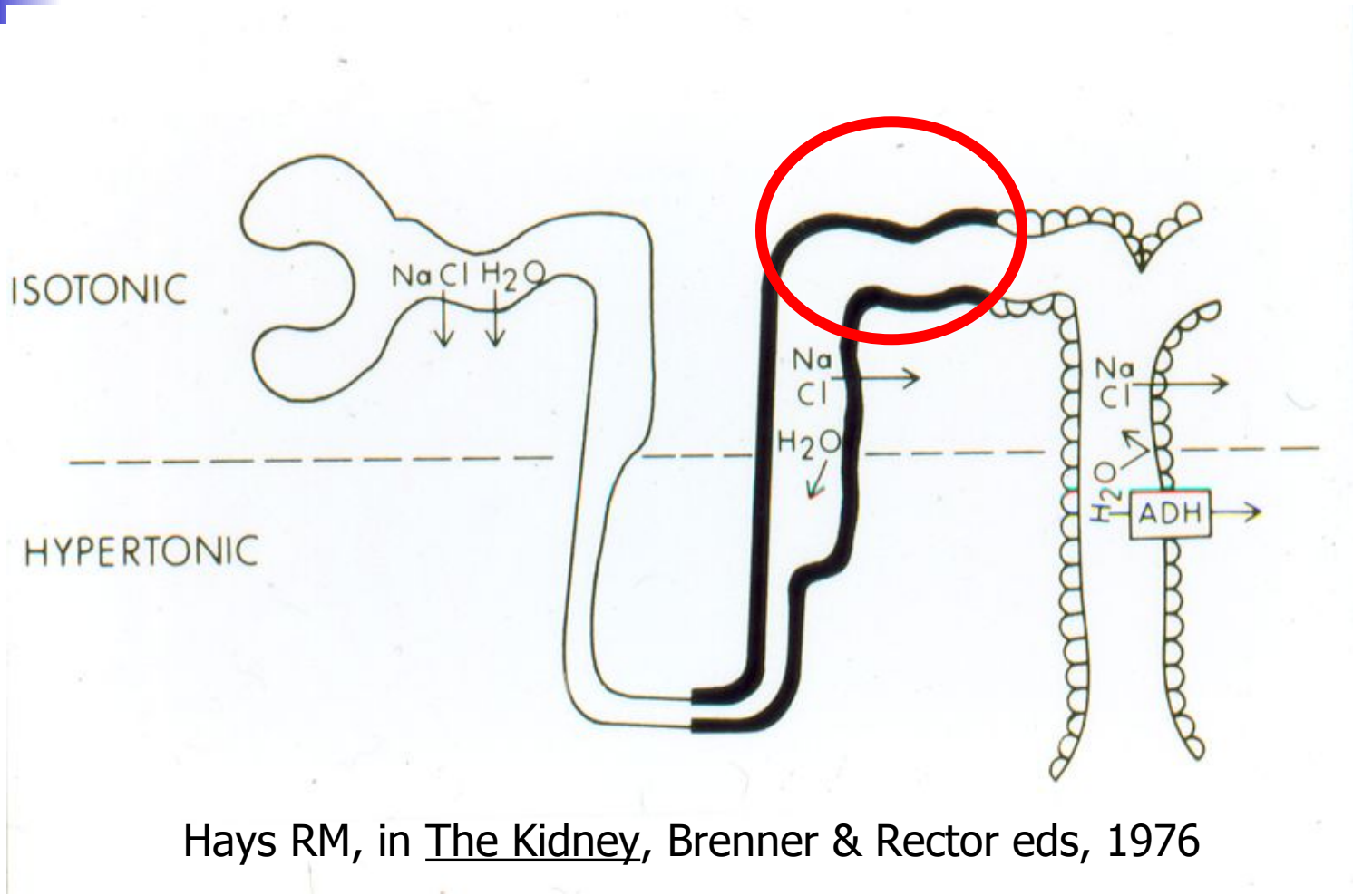
Reversible defects in water excretion

- Hypovolemia
- Thiazides
- Drug-induced SIADH
- DDAVP and vasopressin
- Cortisol deficiency

Thiazide Hyponatremia Pathogenesis

- Thiazides block distal diluting site
- Renal concentrating mechanism intact
- Increased vasopressin (e.g. acute illness, other cause for SIADH) + thiazides = profound hyponatremia
- Cation depletion (Na^+ and K^+)

Thiazides & Renal Water Handling

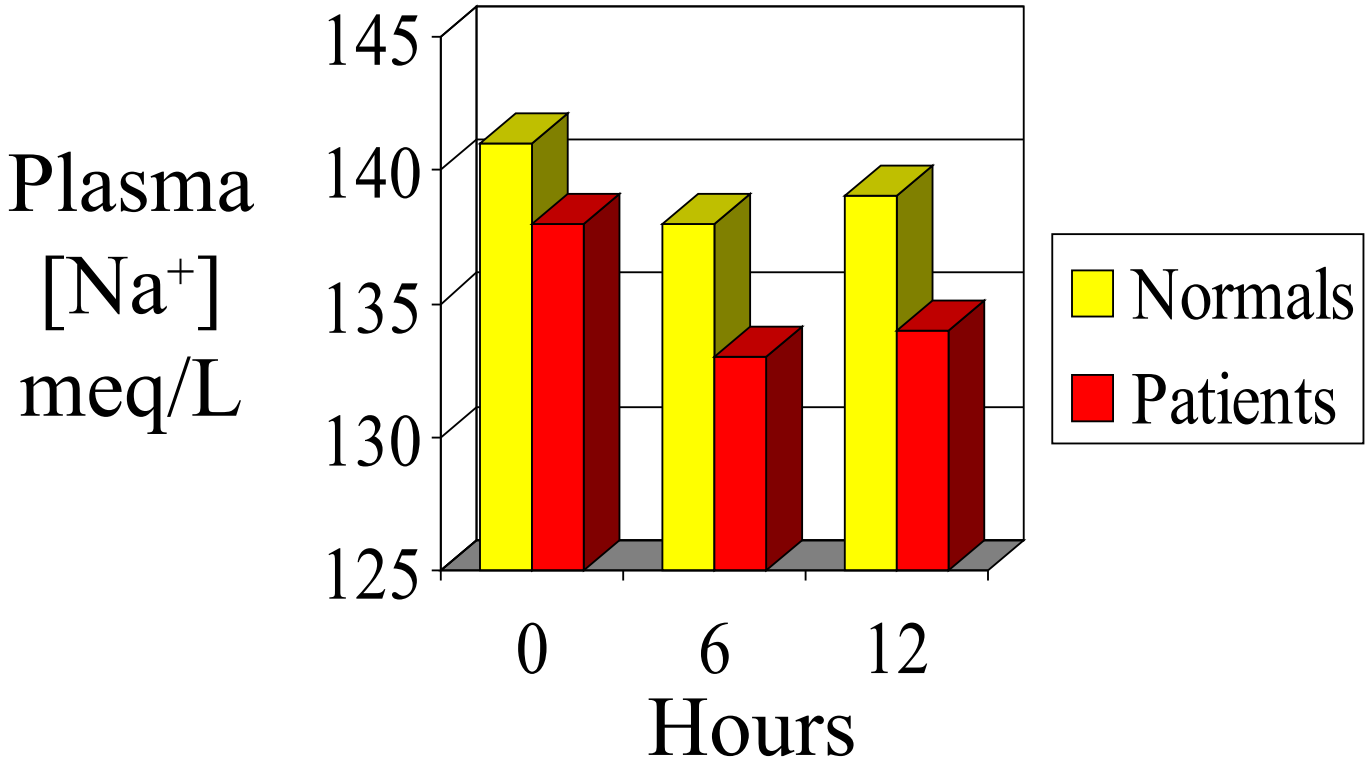


Hays RM, in The Kidney, Brenner & Rector eds, 1976

Thiazide-Induced Hyponatremia

- Elderly women
- Habitual water drinkers
- Low protein intake
- Usually clinically euvolemic (mimics SIADH)
  - Normal BP
  - Normal BUN
  - Low uric acid

Thiazide-Induced Hyponatremia



Friedman, Ann Int Med 1989;110:24

SSRI's & SIADH

- Hyponatremia 4x higher in SSRI users
- Most common in 1st two weeks of Rx
- Unrelated to high drug levels or drug slow drug metabolism
- Risks increased with polypharmacy

7. Movig KL*Eur J Clin Pharmacol* 58(2):143-8, 2002
8. Stedman CA*Hum Psychopharmacol* 17:187-90, 2002
9. Fisher A*Adverse Drug React Toxicol Rev* 21:179-87, 2002

Question #1

Which of the following etiologies for hyponatremia is consistent with the history and laboratory findings:

A. Beer potomania

B. Thiazide-induced hyponatremia

C. SIADH due to SSRI's

D. All of the above

E. None of the above

History

Six hours after arrival in the city hospital ED she is transferred to the ICU where additional laboratory work are obtained:

- Serum Na 107 mmol/l, K 2.7 mmol/l
- Urine osmolality: 50 mOsm/kg
- Urine Na 2 mmmol/l

Question #2

What should be the goal of therapy now?

A. Correct to a serum Na of 120 mEq/L by 1 mEq/L/hr

B. Correct to a serum Na of 115 mEq/L by 1 mEq/L/hr

C. Correct to a serum Na of 115 mEq/L by 0.5 mEq/L/hr

D. Keep the serum Na where it is now

Question #3

In addition to potassium replacement, which of the following would be the most appropriate treatment now:

A. D5W to match urine output

B. 0.45% saline to match urine output

C. Isotonic saline to match urine output

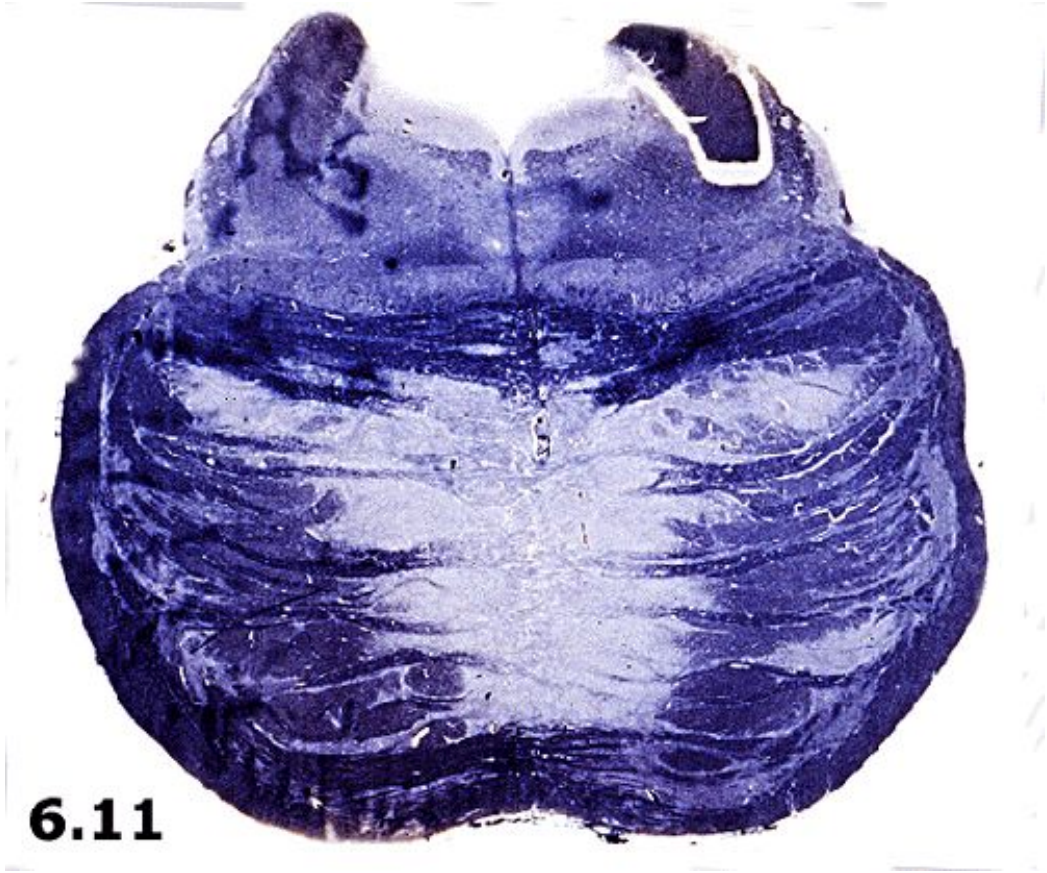
D. 3% saline at 50 ml/hr

E. 3% saline at 100 ml/hr

Central Pontine Myelinolysis

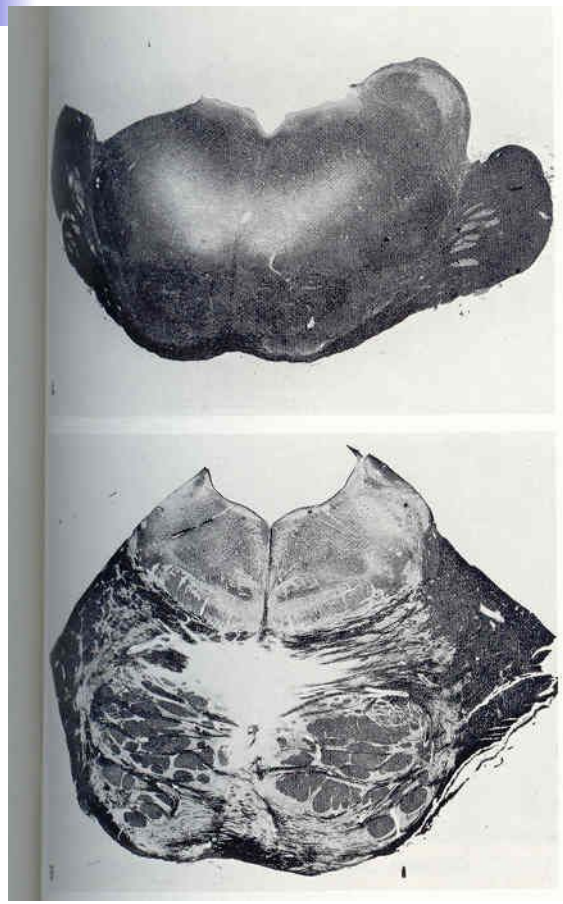
Image from WebPath, courtesy of Edward C. Klatt MD,
Florida State University College of Medicine.

Central Pontine Myelinolysis



D. P.Agamanolis<http://www.akronchildrens.org/neuropathology>

Experimental CPM

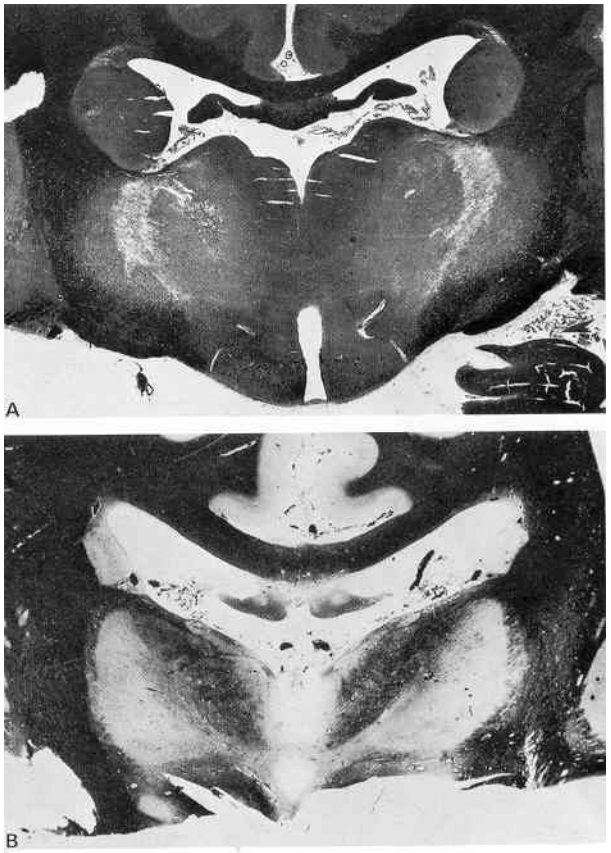


Dog

Serum [Na^+]
106 to 139
mEq/L in
2 days

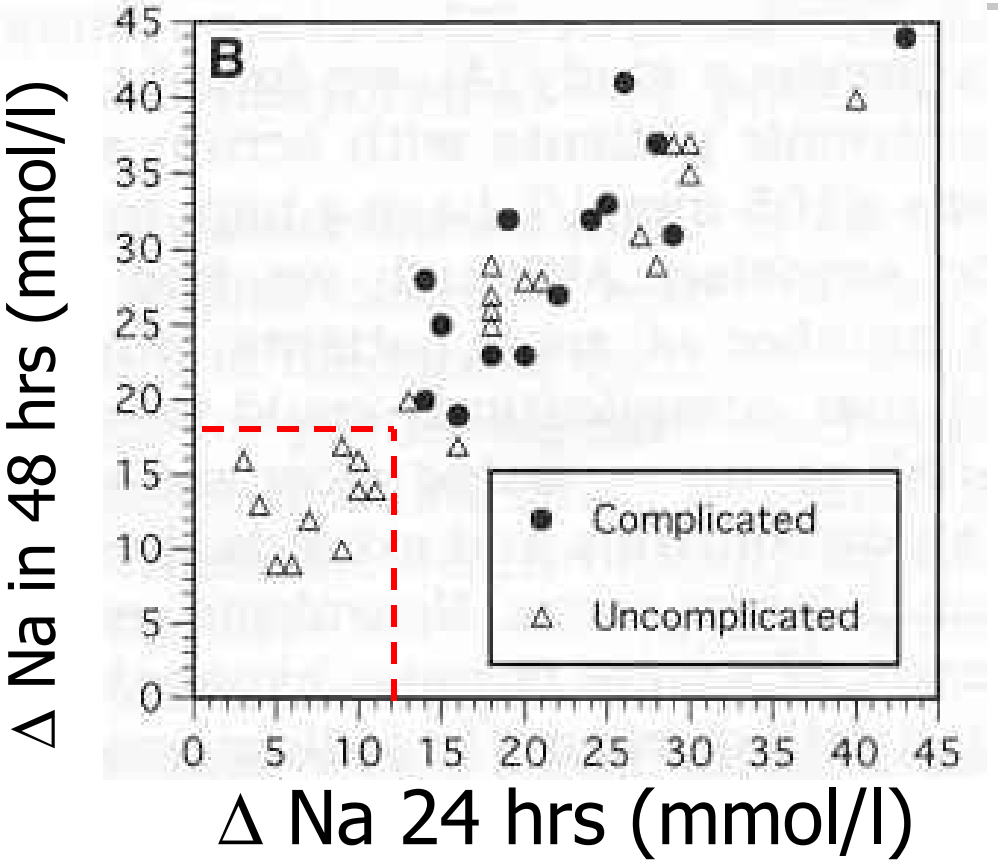
Human

with CPM
& EPM
(Thalamus)



Laureno, Ann Neurol 1983; 13:232-242, 1983

Serum Sodium ≤ 105 mEq/L Correction & Outcome

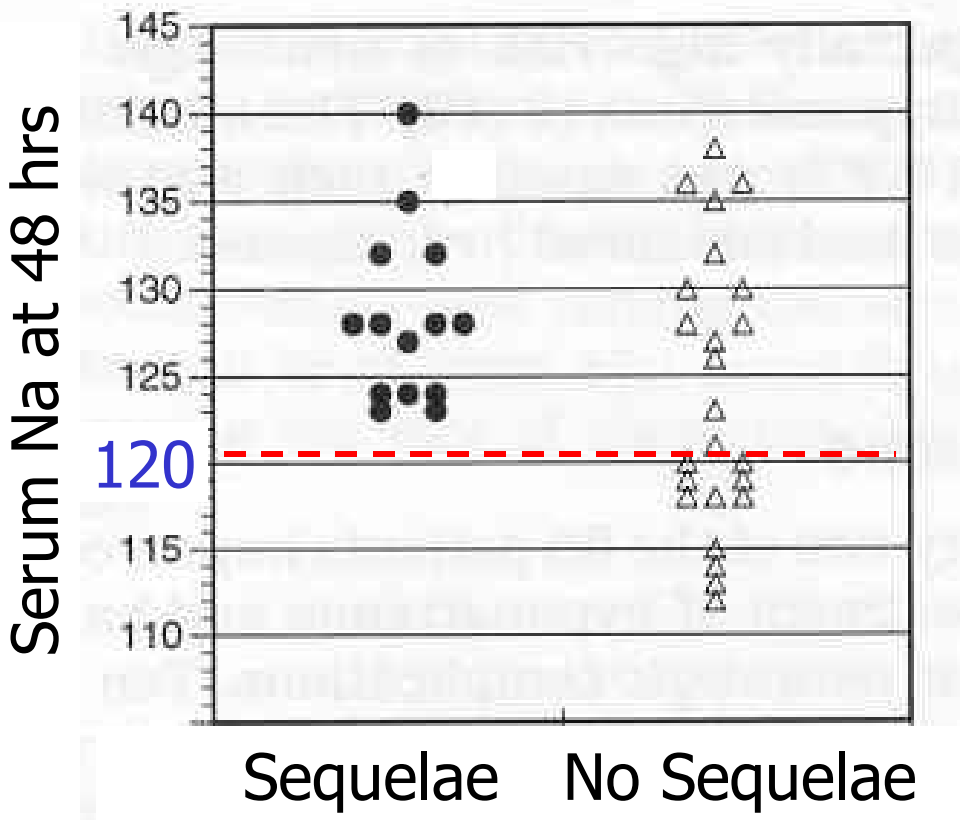


Chronic Cases:

- 10 pts with permanent neurologic sequelae (3 documented CPM)
- 4 pts with transient sequelae

Sterns, JASN 1994; 4:1522-1530

Serum Sodium ≤ 105 mEq/L Corrected Sodium & Outcome



Sterns, JASN 1994; 4:1522-1530

Chronic Cases:

- 10 pts with permanent neurologic sequelae (3 documented CPM)
- 4 pts with transient neurologic sx's

Serum Sodium ≤ 105 mEq/L Treatment and Outcome

Correction Rate	Sequlae/Rx'd	Statistics
>0.55 mEq/L/hr	14/25	p = 001
>12 mEq/L/day	14/28	p = .005
>18 mEq/L/48hr	14/27	p = .003

Current Patient

- Initial serum sodium 94 mmol/l 14 hrs earlier
- Risk factors for ODS
  - Chronic hyponatremia
  - Na < 105 mmol/l
  - Hypokalemia
  - Alcoholism & malnutrition
- Serum sodium *was* 107 when drawn an hour ago (Δ 10 mmol/l/6 hrs; Δ 14 mmol/l/14 hrs)
- Uosm 50 mOsm/kg

Question #2

What should be the goal of therapy now?

A. Correct to a serum Na of 120 mEq/L by 1 mEq/L/hr

B. Correct to a serum Na of 115 mEq/L by 1 mEq/L/hr

C. Correct to a serum Na of 115 mEq/L by 0.5 mEq/L/hr

D. Keep the serum Na where it is now

Question #3

In addition to potassium replacement, which of the following would be the most appropriate treatment now:

A. D5W to match urine output

B. 0.45% saline to match urine output

C. Isotonic saline to match urine output

D. 3% saline at 50 ml/hr

E. 3% saline at 100 ml/hr

Hyponatremia with reversible defects in water excretion

- Concentrated urine initially
- Dilute urine during therapy
- Dilute urine results in rapid correction of hyponatremia

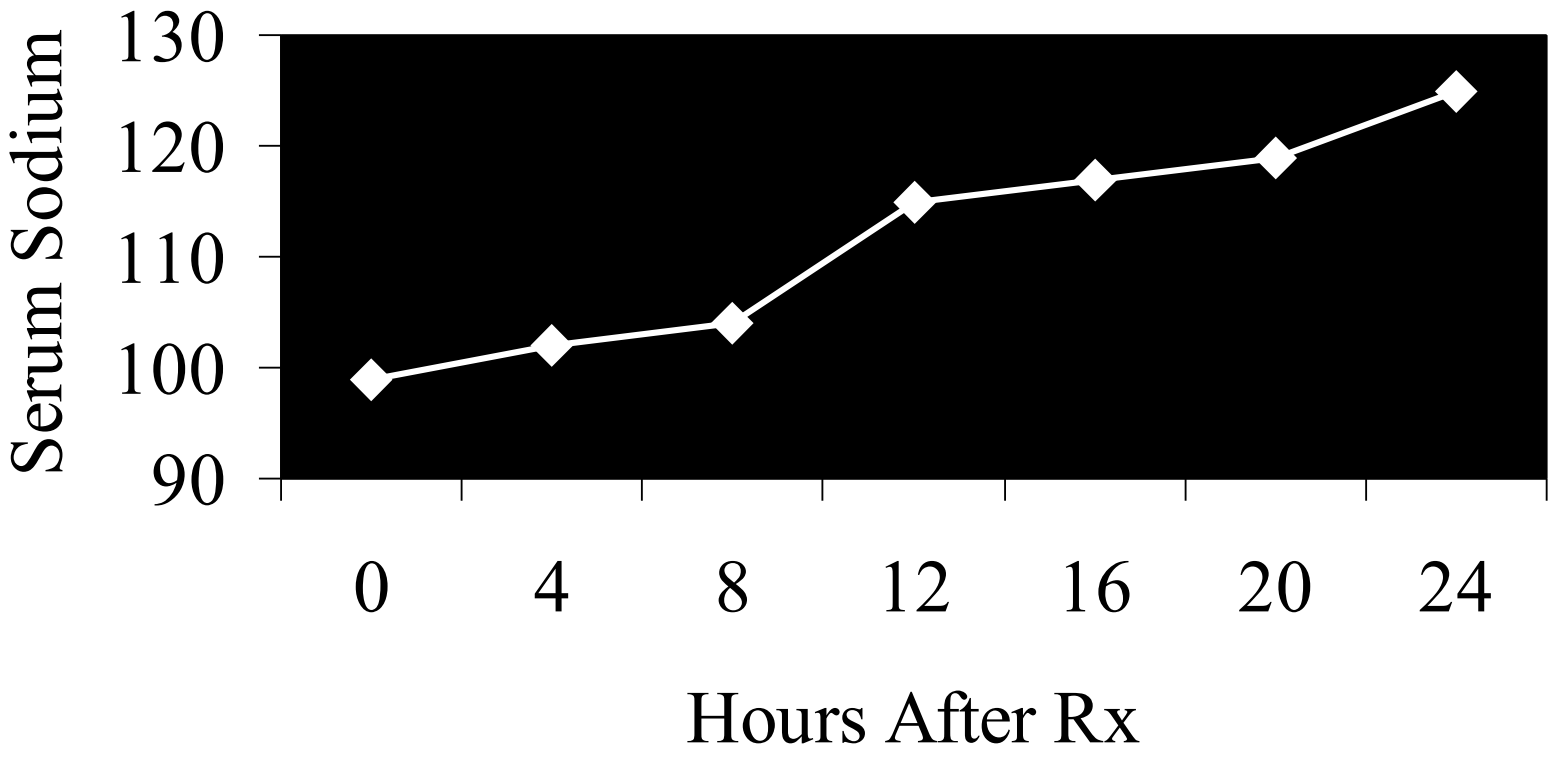
  Uosm < 100 mOsm/kg =

  Correction by 1 to 2.5 mEq/L/hr

Osmotic Demyelination Syndrome

Hart, NEJM 1995; 333:1259

A 30-year-old alcoholic woman with confusion and disorientation after a grand mal seizure.



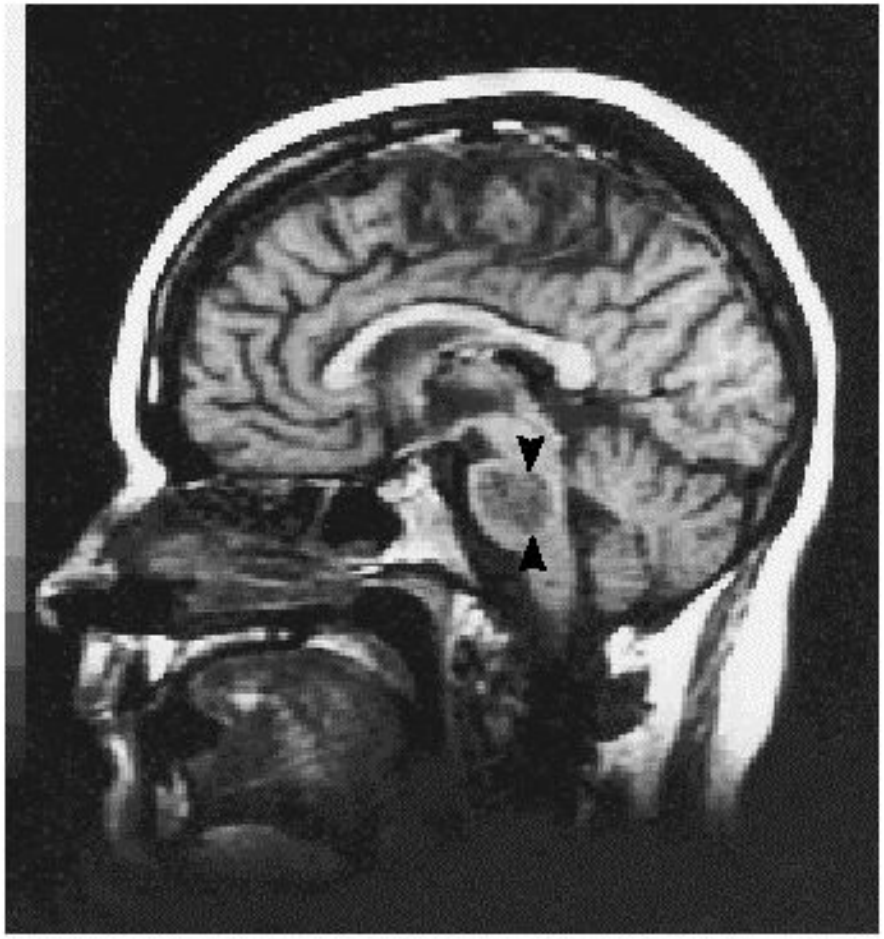
Osmotic Demyelinaton

- Initial serum sodium 99 mmol/l
- Treatment was initiated with a slow infusion of normal saline, resulting in serum sodium values of 102 mmol per liter 4 hours after admission, 104 mmol per liter at 8 hours, 115 mmol per liter at 12 hours, 118 mmol per liter at 18 hours, and 125 mmol per liter at 24 hours

Hart, NEJM 1995; 333:1259

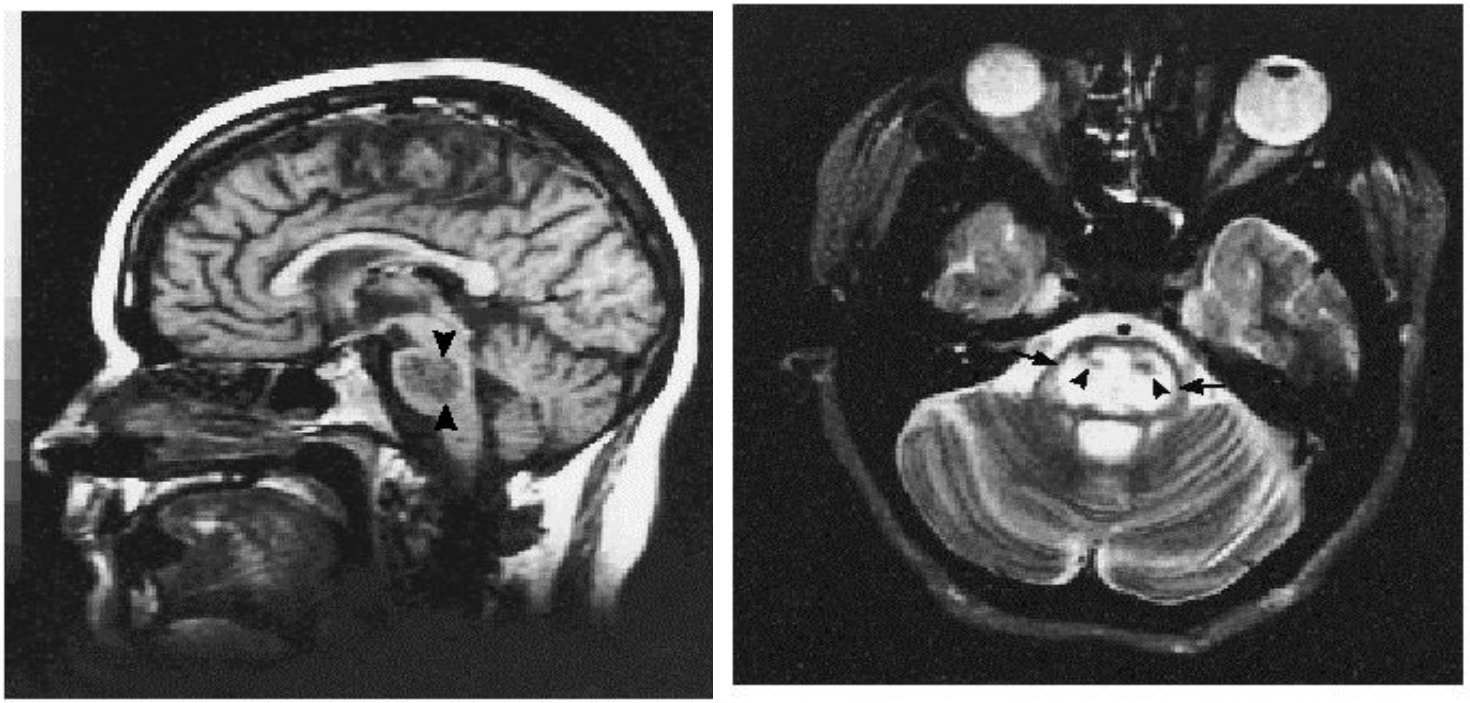
Osmotic Demyelination Syndrome

Hart, NEJM 1995; 333:1259



During days 2 to 6 with a normal serum sodium concentration, her condition gradually improved, On the seventh day she became unresponsive to commands and painful stimuli and had a Babinski reflex.

Osmotic Demyelination Syndrome



Images from Hart, NEJM 1995; 333:1259

Correcting the serum Na

Increase Numerator

$$\text{Serum Na} = \frac{\text{Total Body (Na + K)}}{\text{Total Body Water}}$$

Decrease Denominator

Question #3

In addition to potassium replacement, which of the following would be the most appropriate treatment now:

A. D5W to match urine output

B. 0.45% saline to match urine output

C. Isotonic saline to match urine output

D. 3% saline at 50 ml/hr

E. 3% saline at 100 ml/hr