

Electrolyte Disorders

1) A 79 yo man presents with fatigue, weakness and a recent foot drop. On physical exam he has lymphadenopathy and splenomegaly. Lab- Na 120, Cl- 82, WBC-5.8, HB - 9, HCT – 27 rouleux formation on smear. SPEP shows M protein spike of 3.8 g/dl. What is the most appropriate management of this patients hyponatremia?

- A) Fluid restriction
- B) .9NS @100cc/hr
- C) 3% saline @40 cc/hr
- D) No intervention

Hyponatremia

- | Step 1

Determine if hyponatremia is real

- | Step 2

If hyponatremia is real, determine water status of patient

Pseudohyponatremia

- | Hyperglycemia

Sodium is 1.6 meq less for every 100 glucose is over 100

- | Hypertriglyceridemia, increased plasma proteins (Waldenstroms)

Classification of hyponatremia by volume status

- | Edematous- too much sodium, way too much water

CHF, nephrotic syndrome, cirrhosis

- | Hypovolemic- too little sodium, too little water
these patients are hypotensive
with dry mucous membranes

- | “Euvolemic”- normal sodium ,a little too much water

- | 2) A 19 yo woman is brought to the ED by friends after a seizure. They report she was feeling well yesterday, and went to a party last night. She stayed up all night and this morning was confused, had trouble walking and then had a seizure. She had been clenching her teeth for much of the early morning hours. BP 150/90 P 110 T 37. Patient is unable to converse.
- | Lab: WBC 11,000 Bun 4 Cr .4 HCO3 16 Na 118
- | What is the most likely cause of this patients problems?
- | A) Meningitis
- | B) Cocaine use
- | C) Beer drinkers potomania
- | D) MDMA use
- | E) Tetanus

3) What Therapy do you Recommend

- A) Fluid restriction
- B) D5 ½ NS
- C) Normal saline
- D) 3% saline

Features of MDMA (Ecstasy) Intoxication

| Common Features

Euphoria

Bruxism

Tachycardia

| Serious Side Effects

Severe Hypertension

Hyperthermia

Hyponatremia

| Distinguishing Features

Bruxism

Hyponatremia

Methamphetamine Abuse

I Important Clinical Features

Hypertension/tachycardia

Meth mouth with chronic use (less saliva/bruxism leads to dental cracking and severe caries)

Skin excoriations

- | 4) A 86 yo woman returns for follow up. She has been sleeping more, and has been more tired over the past 2 months. She has lost about 5 pounds. VS BP 160/80 P 68 BMI 19 exam is unchanged from visit 3 months ago. Medications: Hydrochlorothiazide , amlodipine, omeprazole, Vitamin D
- | Labs: Na 132 K 3.4 Bun 14 Cr .8
- | Which medication puts her at greatest risk for developing severe hyponatremia?
- | A) Methylphenidate
- | B) FeSo4
- | C) Sertraline
- | D) Spironolactone
- | E) Bupropion

SSRI's AND Hyponatremia

- | Older age
- | Female
- | Concomitant diuretic use
- | Low body weight

- | 5) A 66 yo woman presents with fatigue and not feeling well for the past week. She has had no confusion, no seizures or headaches. PMH: alcoholism. Medications: Bupropion, sertraline
- | Physical exam: BP 136/60 P 88
- | Neurologic exam – normal
- | Labs: Na 122 K 3.6 Cl 86 Bun 4 Cr .8

What Is The Most Appropriate Immediate Treatment?

- A) .9 normal saline, matching cc for cc urine loss
- B) .9 normal saline 75 cc/hr and matching urine loss
- C) 3% saline, matching cc for cc urine loss
- D) 3% saline, 50 cc/hr with q 2 hour Na check
- E) Water restriction

Hyponatremia- “Euvolemic” Causes

- | Endocrine- hypothyroidism, adrenal insufficiency
- | Drugs- Thiazide diuretics, SSRI's, Carbamazepine, Ecstasy (MDMA)
- | Other causes of SIADH
 - Carcinomas-small cell
 - Lung disorders- especially pneumonia, also seen with pneumothorax/severe asthma
 - CNS disorders

6) A 69 yo man presents with weight loss and fevers. He has been sick for the past 6 weeks. He has a past history of CHF and CVA. On exam he is a cachectic man who appears weak and tired. He has rales bilaterally in the upper lung fields. He has no organomegaly and no peripheral edema. Chest xray- bilateral upper lobe infiltrates. Lab- Na-126, Cl-93, Bun-4, Cr- .6, Ca- 11.3
What is the most likely cause for his hyponatremia?

- A) Adrenal insufficiency
- B) CHF
- C) Hypothyroidism
- D) Tuberculosis
- E) Type 2 RTA

- | 7) A 68 yo woman with dementia presents with increased fatigue, anorexia and weight loss. She has had a recent fall. PMH: hypertension, GERD, breast cancer and depression. Medications: hydrochlorothiazide, sertraline and tamoxifen. Exam: BP 130/70 sitting, 130/74 standing p 88 sitting (90 standing) BMI 20. extremities without edema.
- | Lab: BUN 5, Cr .4 Na 126 K 3.9 Cl 90 HCO₃ 24 glu 75 serum osm- 266 TSH 1.3 urine osmolality- 50 (nl 300-900), K 15 (nl> 17), Na- 12 (NI> 15)

What is the Most Likely Cause of Her Hyponatremia?

- A) Pseudohyponatremia
- B) Hypovolemia
- C) Low solute intake
- D) Addison's disease
- E) Sertraline

Using Urine Osmolality and Electrolytes

| Urine Osm >100

| Urine Na < 20

Hypovolemia

CHF

Nephrotic syndrome

Cirrhosis

| Urine Na >40

SIADH

Urine Osm <100

Urine Na < 20

Primary polydypsia

Low solute intake

I A 60 yo man with a 70 pk-yr smoking history and recent diagnosis of metastatic small cell lung cancer presents with increased fatigue and confusion. He finished a cycle of chemotherapy 1 week ago. Labs: Na 118 K 3.5 Bun 3 Cr .8 Serum osmolality 245, urine Na 120 meq/L, Urine potassium 26 Urine osmolality 530 meq/l. What do you recommend for this patient?

- A) Fluid restriction <1 L /day
- B) 3% saline
- C) Hydrochlorothiazide
- D) Desmopressin
- E) Demeclocycline

Management of Hyponatremia

- | Edematous- Diuretics (usually loop diuretics like furosemide)
- | Hypovolemic- Normal saline infusion
- | “Euvolemic”- Water restrict
 - If severe symptoms (seizure, coma) , especially in setting of a rapid drop in Na
give hypertonic saline (start with 100 cc bolus of 3% saline)
 - chronic- can treat with vassopressor receptor antagonists (tolvaptan) , fluid restriction with NaCl tablets
or lithium/demeclocycline

9) A 77 yo woman with dementia presents with obtundation and decreased urine output. The patient has been less responsive the past two days and is not eating. No fevers, chills or signs of infection.

Lab- Na-163, CL-110, K-3.0, Bun-90
Cr-3.0, WBC-11,000, HCT-44

What is Your Next Step in Management?

- A) Give DDAVP
- B) Give IV Normal Saline
- C) Give D5W
- D) Give Lithium
- E) Give Mannitol

Causes of a high Bun/Cr ratio

- | Volume depletion
- | Gastrointestinal bleeding
- | High dose corticosteroid use
- | Pre renal state due to poor CO or ACE inhibitor/NSAID

Hypernatremia Calculation of free water deficit

$$\frac{(\text{Actual plasma Na} \times \text{TBW}) - \text{TBW}}{\text{Desired plasma Na}}$$

$$\text{TBW} = \text{Body weight(Kg)} \times .6$$

Hypernatremia

- | Most common cause- inability to get to water

usually patient bed bound, stroke or unconscious

- | Less common

Central diabetes insipidus

Nephrogenic diabetes insipidus

Central Diabetes insipidus

Causes

- | Head Trauma
- | A whole bunch of zebra's
 - Sarcoidosis
 - Histiocytosis X
 - Craniopharyngioma
 - Vasculitis

Nephrogenic DI

- | Toxic most common- THINK LITHIUM
- | Vascular- Sickle cell
- | Inflammatory- Sarcoid, Sjogren's
- | Structural- Polycystic kidney disease

10) A 52 yo man presents with fatigue and dizziness. As part of his workup he is found to have a magnesium level of .8 (normal 1.6-2.2)
What other lab is very likely to be abnormal?

- A) Sodium
- B) Potassium
- C) Bicarbonate
- D) phosphate
- E) Creatinine

11) A 33 yo man with chronic alcoholism comes into the ED with a head injury. He has been drinking 16-20 beers a day as well as a fifth of gin every other day. What electrolyte abnormalities would you expect to see?

- A) High phosphate, low potassium, high bicarb, high sodium
- B) Low potassium, low magnesium, low calcium, low bicarb
- C) Low phosphate, low potassium, low magnesium, high calcium
- D) Low magnesium, low bicarb, high phosphate, high calcium, low potassium

What should I Know about A Low Magnesium?

- | Most common causes: Heavy alcohol intake, diuretics, Cis Platinum
- | If magnesium is low, potassium is almost always low
- | Potassium can't be replaced adequately until magnesium is replaced

12) A 36 yo women presents with fever, chills and flank pain. On exam BP 80/60, p-145, T-39.8. She has right flank tenderness and an enlarged spleen. Lab- Na 136, K-7.4, Cl-102, Cr- 1.2, WBC-344,000, HCT-22, Plt-34,000, UA-Packed field WBC's and GNR on gram stain. What is the most appropriate initial order?

- A) ECG
- B) Calcium gluconate
- C) IV glucose and insulin
- D) Kayexalate

Hyperkalemia

- | Is it real?

 - Causes of pseudohyperkalemia

- | Hemolysis

- | Very high WBC (leukemia)

- | Very high platelet count

13) A 85 yo man is brought to the ED for evaluation of weakness and nausea. He was diagnosed 10 days ago with prostatitis. His other problems include hypertension, CHF and CRI. Meds: Carvedilol, furosemide, TMP/Sulfa, verapamil, digoxin. Exam- BP 100/60 P-100 T 36.9 lower extremity edema present. Lab: Na- 132 K -6.8 BUN 37 Cr- 2.3. Two weeks ago, creatinine was 1.6 and K was 4.8. What is the most likely cause of his hyperkalemia?

- A) Renal insufficiency
- B) Carvedilol
- C) TMP/Sulfa
- D) Verapamil
- E) Digoxin

Why Did His Creatinine Increase?

Trimethoprim Induced Increase in Creatinine

- | Trimethoprim causes a reversible inhibition of tubular secretion of creatinine (Which resolves within 1 week of stopping the drug)

- | [Br J Urol.](#) 1985 Jun;57(3):265-8.

Effect of Standard Dose TMP-Sulfa on Potassium in Elderly Men

- | **Thirty-three patients who received standard-dose TMP/SMX for 3 or more days comprised the study group. Twenty patients who received oral cephradine or amoxicillin for 3 or more days comprised the control group.**
- | **Patients taking ACEI, NSAIDS, B Blockers or who had CRI were excluded**
- | **The serum potassium concentration in the study group was 4.22 ± 0.40 mmol/L and increased by 0.31 ± 0.38 mmol/L at the end of therapy ($p < 0.001$).**
- | **Ann of Pharm 1996;30 (4): 347- 350.**

Drug Induced Hyperkalemia

- | ACEI
- | ARBS
- | K sparing diuretics
(amiloride/spironolactone)
- | TMP/Sulfa
- | NSAIDS

Hyperkalemia- Causes

- | Too much intake
 - Iatrogenic or too much salt substitute
- | Too little excretion
 - Renal failure
 - Drugs that block renal K excretion
- | Shift
 - Acidosis
 - Muscle injury (rhabdomyolysis)

A 45 yo IDU is brought into the ER comatose. His friend last saw him 2 days ago. He is quickly intubated and labs come back- Na 150, K-7.8 ,Bun-77, Cr-8.0, HCO₃-14. Review of his chart shows he had a Bun of 15 and Cr of 1.0 two weeks ago.

- | What are the likely causes for his hyperkalemia

14) What Immediate Treatment Do You Recommend?

- A) IV furosemide
- B) IV Kayexylate
- C) NG Kayexylate
- D) IV Calcium
- E) Albuterol

Treatment of Hyperkalemia

- | Emergent- IV calcium gluconate
- | Urgent- IV HCO₃
IV glucose and insulin
- | Timely
Kayexalate
Furosemide
Dialysis

ANSWERS

- 1) D- No intervention
- 2) D-MDMA use
- 3) D- 3% Saline
- 4) C- Sertraline
- 5) E- Water restriction
- 6) D- Tuberculosis
- 7) C- Low solute intake
- 8) E- Demeclocycline
- 9) B- Give IV NS
- 10) B- Potassium
- 11) B- Low K, Low Mg, Low Ca, Low HCO₃
- 12) A- ECG
- 13) C- TMP/Sulfa
- 14) D- IV calcium