Managing Common Electrolyte Problems in the elderly
24th Annual Clinical Update in Geriatric Medicine

Jamie Johnston, MD
University of Pittsburgh
School of Medicine

Today's Objectives
- Review Common Electrolyte Problems
- After this conference attendees should be able to:
  - Recognize common errors in treating these patients
  - Adequately treat these abnormalities
  - Know when to ask for help

Format
- Case Scenarios
- Discussion
- Topics
  - Sodium
  - Potassium

Electrolytes in the Aging
- 81 million elderly by 2050
- Most common problems
  - Hypernatremia
  - Hyponatremia
  - Decreased GFR → THE norm
  - concentrating/diluting capacity
  - acid/potassium excretion
  - Ability to rapidly adjust

Case 1
- 80 year old woman presents to ER
- CC: weakness, muscle fatigue
- PMH – hypertension, osteoarthritis
- Recent generalized joint pain. Self medicating with OTC NSAIDs for 10 days prior to admission
- Exam - ill woman, diffuse weakness

Case 1
- Meds - amiloride, HCTZ, lisinopril, NSAID
- Labs - H/H - 10.2/30.9
  - BUN 92 (68 baseline)
  - Creat 2.5 (1.3 baseline)
  - K 8.5 (5.0) pH 7.24, calculated bicarb 14.6
  - Glucose 110 mg/dL
  - ECG - widened QRS and peaked T-wave
What do you do first?
A. Calcium gluconate 10% solution, give 10 ml slow IV push over 2-5 min
B. IV Insulin + IV glucose
C. Beta-adrenergic agonist (inhaled albuterol)
D. IV bicarbonate
E. Sodium polystyrene sulfate
F. Renal consult for immediate dialysis

Answer
A. Calcium gluconate 10% solution, give 10 ml slow IV push over 2-5 min
Then → start other medical maneuvers
Stop the medications - especially amiloride, captopril and NSAID
It will take several hours to start dialysis

Approach
Prioritize → what do you have to fix first?
In this case life threatening hyperkalemia with ECG changes
Recognize the underlying problem
Failure to recognize impaired renal function
S\text{Creatinine} in the elderly

Potassium
Primarily excreted by the kidney
98% of potassium is in the cells
Shifted out of cells by increased plasma tonicity and acidemia
Components of evaluation
What is the kidney function?
What is the acid-base status?
Is the glucose elevated?

Kidney Function
Estimate (Many Apps for this)
Cockcroft-Gault \( \frac{(140-\text{Age [y]}) \times \text{LBW (kg)}}{\text{Scr} \times 72} \)
Est Cr Cl = 27 ml/min (est weight = 50 kg)
MDRD Estimate is 33.5 ml/min (est alb = 3.7)

Please note that her BUN was 68 baseline
After age 40, CrCl falls by 0.87 ml/min/yr! Lindeman, et al. J AM Geriatr Soc 1985;33:278.

Effect of NSAID
- Decreases Prostaglandin
- Decreased renal perfusion due to increased pre glomerular arteriolar resistance
- Result - Acute Kidney Injury
  - Decreased ability to excrete potassium
  - Decreased ability to retain bicarbonate - metabolic acidosis
  - K shifts out of cells

Other Medical Maneuvers
- Shifts K into the cells
  - IV insulin + IV glucose
  - Inhaled Albuterol
  - IV bicarbonate
  - Sodium Polystyrene sulfonate
    - binds K in the gut
    - Be Careful!!
    - Gut necrosis

Other Medical Maneuvers
- Dialysis - removes K via diffusion from blood to dialysate.
  - Takes time to get started!!
  - Low potassium diet
  - Stop contributing medications

Volume expansion and diuretic
- Two effects
  - Direct Blockade of transporter
  - Increased Na delivery to Collecting tubule
  - Lumen more electronegative
  - Increased K loss

Thick Limb - Loop of Henle Sodium Reabsorption
Case 2

- 75 year old man, resident of nursing home transferred to an Oakland hospital on a Wednesday for replacement of gastrostomy feeding tube.
- Other history unobtainable from the patient.
Case 2

- Pre-op labs Monday show
  - Na 175
  - K 5.1, tCO₂ 18, Cl 142
  - BUN 35, Creat 1.5
  - OR cancelled
  - Time passes....

Case 2

- It is now Wednesday (7 days after admission)
  - Repeat labs
    - Na 193 K 5.1, tCO₂ 16, Cl 160
    - BUN 45, Creat 2.5

What do you do first?

A. Get a renal consult
B. Immediately start an IV of D₅W at 250 ml/hour
C. Examine the patient
D. Calculate the free water deficit
E. Start IV normal saline at 75 ml/hour

Sir William Osler → W.W.O.D

C. Examine the patient!

- He has marked signs of volume depletion as expected:
  - Decreased skin turgor – 5% volume deficit
  - Decreased eyeball turgor – 10%
  - Lack of axillary sweat and mucosal moisture
  - Blood pressure was 60/palp

#1 Fix the hemodynamic compromise!

- IV normal saline at 75 ml/hour
- What is the [Na] of Normal Saline?
- Monitor serum Na closely -
  - **Correct at no more than 0.5 meq/hour**
  - Correct no more than 8 mEq in 24 hours
- Once hemodynamics stabilized
  - Calculate free water deficit
Where to start

- Volume Status
  - Hypovolemic (water and solute loss)
    - Hypotonic Fluid loss – GI, Renal, Skin*
  - Isovolemic (water loss)
    - Diabetes Insipidus – ADH
    - No access to free water***
  - Hypervolemic (water and salt gain)
    - Hypertonic saline solutions
    - Hyperaldosteronism

Free water deficit

- Current Total body water = 0.6 Curr Wt (kg)
  - Use 0.5 for women, the elderly or cachectic pts
  - Our patient currently weighs 50 kg
- Water deficit = TBW_{curr} \cdot (\text{Plasma} \ [\text{Na}]_{\text{curr}/140} - 1)
- In our patient
  - Deficit = 25 L (.38)
  - Deficit = 9.5 liters

Free water replacement rate

- Rate = \{TBW/\text{plasma} \ [\text{Na}]\} \times \text{desired rate of decrease in [Na]} \times 1000
- In our case 130 ml free water per hour
- Don’t forget insensible losses!
  - ~ 500 ml/day

Why did this happen?

- Patient with inability to access free water
- What didn’t the team do
  - Recognition
  - Provide maintenance fluids
  - Preparation and surveillance

Condition for Hypernatremia

- Hypernatremia only occurs when patients are unable to drink water
Case 3

- 75 year old woman with negative PMH presents for routine check up
- Only abnormality is BP 155/100
- Patient is health conscious and follows low salt diet. She exercises regularly.
- Follow up BPs over next 4 weeks confirm hypertensive readings on multiple occasions.

You begin therapy with hydrochlorothiazide 25 mg daily

Three weeks later the patient calls you. She is weak and has noted the onset of cramps in her hands and feet. Her appetite has been poor and she has noted constipation.

You urge the patient to go to the ER.

On presentation
- History reiterated
- Exam - BP 100/50,
- P 110 with ectopy
- Decreased skin turgor
- Labs - Na 135, K 2.1, Cl 95, \( \text{CO}_2 \) 30
- BUN 45 Creatinine 1.5, Ca - 10.8
- ECG - prominent U wave with occ’l PVC

What do you do?

A. Renal Consult
B. Start a K sparing diuretic
C. Start a slow release oral potassium supplement
D. A big glass of Florida orange juice
E. Start an IV of NS + 10 meq KCL/liter and run at 100 ml/hour with cardiac monitoring and oral K supplementation

Patient is symptomatic and has ECG changes.
- Correction is emergent
- Estimated deficit for each 1 meq decrease in K, total body deficit is 200 - 400 meq K
- IV K replacement always takes place in a monitored setting
- Higher K concentrations can be given but require central line
What happened?
- Diuretic therapy with K wasting diuretic
- Failed to start K supplement
- Failed to increase dietary K sources
- Failed to assess labs 1-2 weeks after diuretic started

Case # 4 Too much of a good thing
- 85 year old woman with negative PMH presents for routine check up
- Only abnormality is BP 155/100
- Patient is health conscious and follows low salt diet. She exercises regularly.
- Follow up BPs over next 4 weeks confirm hypertensive readings on multiple occasions.

Case 4
- You begin therapy with hydrochlorothiazide 25 mg daily
- The patient returns to your office in one month
- Patients feels well
  - Following healthy low salt DASH diet
  - Drinking eight 12 oz. glasses of water a day

More Data
- BP is now 110/56 mm Hg
- Order labs and send patient home
  - RTC 3 mo.
- Later that same day…
  - Lab calls with critical values
  - Patient’s S\(\text{Na}\) concentration is 98 mEq/Liter
  - You immediately admit the patient
What do you do first?

A. Give the patient three tablespoons of table salt (57 g or ~1000 mEq NaCl)
B. Immediately start an IV of 7% saline at 250 ml/hour
C. Examine the patient
D. Calculate the free water clearance
E. Start IV normal saline at 75 ml/hour

C. Examine the patient!

- Treatment options depend on the patient’s volume status
- Rapidity of correction depends on the patient’s symptoms

Approach to Hyponatremia

Case 4

- Examination reveals
  - Awake and alert. Worried.
  - VS - BP 116/60, P 80 seated
  - Standing 100/40, P 110
  - No edema
  - Decreased thigh turgor

Diagnosis

- Hypovolemic Hyponatremia
  - Patient is total body salt and water depleted
  - Salt loss greater than water loss
  - Probable cause – thiazide diuretic
  - In Inpatient and nursing home setting
    - 97% of cases
      - Cause is iatrogenic or non-osmotic ADH release

Treatment

- Slow or Fast? – depends on symptoms
- Seizures, coma…
  - Acute ➔ Rapid correction by 4-6 mEq with 3% saline. Prevent acute hyponatremia consequences.
  - Chronic ➔ changes over a few days. Brain adapts.
  - Correction – no more than 8 mEq per day

Our patient

- Stop diuretic
- One liter of saline slowly to correct volume depletion.
- Close monitoring of Na to prevent rapid correction.
- No more than 0.5 mEq/hour
- No more than 8 mEq/day

Consequences of too rapid correction

- Pontine and extrapontine myelinolysis
- Osmotic demyelination syndrome
  - Especially common in children and women in their childbearing years
  - Due to water shifts out of the brain

What if correction is too rapid?

- Close monitoring – q 1-2 hours
- Decrease replacement or decrease fluid tonicity
- DDAVP

Take Home Points

- Identify what caused the problem
- The problem must be interpreted in the context of the particular patient you are seeing
- If it happened quickly and it causes consequences correct it quickly
- If it happened slowly can generally correct slowly

Good References

Thank you!
Questions?