“Inpatient Heart Failure”

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Outline

• Fluid management
  • Diuretics – The finer points
  • Dietary restrictions
  • I/O Goals
  • BNP Monitoring
• Respiratory management pearls in Heart Failure
  • ABGs
  • Nonrebreather masks
  • “Mixed venous” saturations
  • Home O2
• Take-home points
Have You Ever Heard This?

“Diuretics are overrated!
No trial has ever demonstrated they save lives or reduce hospitalizations in heart failure!”

Other Items Which Have No Proven Mortality Benefit
The Message:
If you manage heart failure...
Learn to love diuretics!

What Should We Diurese For?
1) Excess extracellular fluid (ECF)
2) Elevated filling pressures (e.g. JVD)
3) Neither
Don’t Overthink This!

• Diuretics remove salt (and water follows)
• We diurese because patients have too much fluid where it shouldn’t be
• Remember – many patients have obligatorily high filling pressures!
  • Will never be able to lower to a ‘normal’ JVP or wedge pressure

A Patient Scenario…

• 70 y.o. man with chronic heart failure, LVEF 30%
• Admitted with 20 lb weight gain, dyspnea, edema, JVP to 18-20 cm H2O
• Cr in clinic 1 month ago = 2.1, Cr at admission = 2.0
• You initiate IV diuretics
• 2 days later: 5 lb have come off, JVP still very elevated, Cr has risen to 2.3
What Do You Do?

1) Switch to oral diuretics and send home
2) Initiate ultrafiltration
3) Continue to try to remove volume with IV diuretics

The Most Common Mistake!

• Never a good idea to simply accept that a patient will remain with massive ECF
• Are you really at the limits you will be able to achieve with diuretics?
  • (Early) hint from BUN…
• Would a patient ever choose drowning in fluid over having a higher serum Cr level?
Assessing JVP

- Really useful clinical skill
- My recommended technique:
  - Well-lit room, no penlight!
  - Remove pillow
  - Start at 30-60 degrees
  - Ask patient to turn head one way or the other
  - Look for pulsation
    - Change with respiration, two peaks/cycle, change with position, change w/RUQ palpation → venous rather than arterial
  - Press on RUQ; neck vein *should* rise & become more prominent (Note: This is not +HJR)
  - If cannot see, raise patient up or lie flatter
  - Reporting: Either “6 cm above the sternal angle” or “JVP of 11 cm” – *Never* “At angle of jaw at 30 degrees”
  - Can visit Stanford 25 website for more (stanfordmedicine25.stanford.edu)

Peeing Like a Racehorse

- Lasix: Routinely administered to racehorses on day of race → lighter
- Longtime (legal) practice
  - Must be declared on racing forms
- Very controversial in the racing community!
So Which Loop Diuretic to Use?

- Answer: It doesn’t really matter!
- Your choices
  - Furosemide (Lasix)
  - Bumetanide (Bumex) – lower doses make you feel better
  - Torsemide – More reliable oral absorption (?)

Should We Give Bolus or Infusional IV Diuretics?

- Multicenter, double-blind trial published in NEJM
  - First trial of heart failure network
- ADHF patients, comparing:
  - Bolus dose every 12 hours vs. infusional
  - Low-dose vs. high-dose (no significant differences)
- Primary endpoints:
  - Patients’ global assessment of symptoms
  - Change in serum Cr from baseline to 72 hours
Global Assessment of Symptoms

A: Bolus vs. Continuous Infusion

- AUC with bolus infusions: 4236±1440
- AUC with continuous infusion: 4373±1404
- P=0.47

Change in Renal Function

- P=0.45
- Change in Creatinine (mg/dl)
- Bolus: 0.05
- Continuous: 0.07

Death, Rehospitalization, or ED Visit


**Thiazide Combination**

- Chlorothiazide IV (Diuril)
  - Tremendous cost increase of >800% (!) after purchased from Merck by Ovation Pharmaceuticals last decade
- HCTZ
- Metolazone
Pearls of HCTZ-Loop Combination

• Does it work?
  • Yes! Really well!

• Does it work in patients with kidney dysfunction?
  • Yes! It’s the anti-HTN properties of HCTZ which aren’t as useful for patients with kidney disease

• Timing
  • If giving with oral loop diuretic → give at same time
  • If giving with IV loop diuretic → give HCTZ 30 min earlier

• What to watch out for
  • Hypokalemia (combination w/loop → high rates)
  • Hyponatremia (as with any thiazide)

How About Spironolactone?

• Mortality/hospitalization benefit in symptomatic systolic heart failure
  • If close potassium monitoring is occurring

• Combination w/loop very helpful in cirrhotic patients/ascites

• If you’re replacing K anyway…
  • Probably makes more sense to add spironolactone

• “Aldactazide”
  • HCTZ 25 mg & spironolactone 25 mg combination pill

Adapted from NEJM. 1999;341:709-17.
The Problems with Metolazone

- Too rapidly potent $\rightarrow$ sudden/massive fluid & electrolyte shifts
- Reliably causes hypotension & prerenal azotemia
- If Cr $>$ K $\rightarrow$ Patient is on metolazone!

Question on I/O Goals

You have been signed out a patient who was admitted with massive volume overload because he hasn’t been taking his home furosemide & he has been using organic sea salt to flavor all of his meals. The I/O goal you have been signed out is 1500-2000 cc negative.

The nurse calls you before giving the evening IV furosemide because he is already 3L negative after the morning dose, asking what to do. A PM metabolic panel shows a normal K & stable Cr of 1.8.
What Do You Do?

1) Hold the PM dose of diuretics
2) Hold the PM dose of diuretics & give back 1L of normal saline
3) Give half the dose of diuretics that was given in the AM
4) High-five the nurse & ask that the dose be given as originally ordered

A Few Thoughts About I/O Goals

- They don’t actually make any sense!
- Typical goals: “1500-2000 cc negative”
  - Are you going to give fluid back if the patient diureses ‘too much’
  - If the patient diureses ‘too much’ does it mean the renal function is likely to be worse the next morning… or better?
A Few Thoughts About I/O Goals

• Let’s think about a few scenarios:
  • Scenario 1: Patient has 30 kg of extra fluid due to diet/medication nonadherence
  • Scenario 2: Patient was diuresing well on a given inpatient regimen → stopped doing so

• What should the response be?
  • Scenario 1: Your goal is to diurese the patient. If that’s 4-5 liters & you can keep up with electrolytes, celebrate!
  • Scenario 2: If not meeting goal → knee-jerk response is more diuretics
    • What if it’s because you’ve gotten all you can?
    • What if it’s because the patient has developed low-output?

A Word on BNP Monitoring

• BNP’s use: Distinguishing HF vs. non-HF cause of acute dyspnea

• Should we be measuring regular BNPs & guiding therapy by it?

• General answer: NO!

• Biggest trial: TIME-CHF trial
  • 499 patients age >60 with NYHA II-IV HF
  • All with HF hospitalization within past year
  • Intervention: Symptom-guided management or NT-BNP-guided therapy
  • Primary endpoints: 18-month survival free of hospitalization & QOL at 18 months
  • Not blinded to physician – only patient (possible bias)
No Difference in Hospital-Free Survival

Adapted from Pfisterer et al. JAMA 2009;301:383-92.

No Difference in QOL
(If Anything – Better Without BNP!)

<table>
<thead>
<tr>
<th>Outcomes by Group</th>
<th>Baseline</th>
<th>Month 12</th>
<th>Month 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota Living With Heart Failure questionnaire, mean (SD)*</td>
<td>Symptom-guided</td>
<td>42.0 (20.3)</td>
<td>27.9 (19.6)</td>
</tr>
<tr>
<td>N-terminal BNP-guided</td>
<td>38.3 (20.2)</td>
<td>27.7 (17.9)</td>
<td>28.2 (17.8)</td>
</tr>
<tr>
<td>Duke Activity Status Index, median (IQR)**</td>
<td>Symptom-guided</td>
<td>7.2 (2.7-15.4)</td>
<td>15.2 (7.2-27.5)</td>
</tr>
<tr>
<td>N-terminal BNP-guided</td>
<td>7.2 (2.7-18.6)</td>
<td>12.8 (7.2-27.0)</td>
<td>12.8 (4.5-25.7)</td>
</tr>
<tr>
<td>Short Form 12, mean (SD)**</td>
<td>Physical component</td>
<td>Symptom-guided</td>
<td>34.4 (9.1)</td>
</tr>
<tr>
<td>N-terminal BNP-guided</td>
<td>33.4 (9.8)</td>
<td>37.9 (10.1)</td>
<td>37.4 (10.2)</td>
</tr>
<tr>
<td>Mental component</td>
<td>Symptom-guided</td>
<td>45.6 (10.5)</td>
<td>51.1 (9.5)</td>
</tr>
<tr>
<td>N-terminal BNP-guided</td>
<td>46.1 (11.3)</td>
<td>50.8 (10.4)</td>
<td>50.1 (10.3)</td>
</tr>
</tbody>
</table>

Abbreviations: BNP, Brain natriuretic peptide; IQR, interquartile range.
*Range of possible values is 0 to 100; lower values indicate better quality of life.
**Range of possible values is 0 to 68.7; higher values indicate better quality of life.
***Range of possible values is 0 to 100; higher values indicate better quality of life (a value of 50 is the average in the population).

Adapted from Pfisterer et al. JAMA 2009;301:383-92.
Survival without Hospitalization or Need for Increased Diuretics in BNP-Guided Management

Salt and Water Restriction in Heart Failure

American Dietetic Association: HF Diet Guidelines

- "Fluid intake should be between 1.4 and 1.9 L per day."
- "Fluid restriction will improve clinical symptoms and quality of life."

Adapted from http://www.guidelines.gov/content.aspx?id=12988

Google Search: Top Results for "Heart Failure Diet Recommendations"

- #1: Cleveland Clinic: Limit of 2 liters per day, "Even if you feel thirsty."
- #2: UCSF: "If you drink too much fluid, your body’s water content may increase and make your heart work harder."
- #3: WebMD: "Reduce your fluid intake if you have become more short of breath or notice swelling."
- Emory: “You may be restricted to no more than 2 quarts of fluid per day. Fluid restrictions apply to beverages, high-moisture fruits, yogurt, pudding, ice cream, ice cubes, and any food that melts into a liquid... Even if you are thirsty, do not drink more than the recommended allowance. Instead, you should suck on frozen lemon wedges to quench your thirst."
Other Dietary Advice

- Brigham & Women’s Hospital:
  - “Limit fluid to 2 quarts”
  - “Your fluid restriction may at times leave you with thirst and a dry mouth. Here are a few suggestions to try:”
    - “Eat fresh juicy fruits such as watermelon, grapes, oranges, peaches, etc. However, if you consume more than 3 servings/day of these juicy fruits, count each additional serving as fluid. (1 cup fruit = ½ cup fluid)”
    - “Freeze or partially freeze pieces of fruit, like lemon wedges dipped in sugar, for a refreshing treat.”
    - “Chill mouthwash and gargle for a fresh feeling.”

Trial of Free-Fluid (FF) vs. Fluid-Restriction (FR) in Treatment of Patients Admitted with ADHF

* Time to clinical stability = symptomatic improvement with no evidence of fluid overload, stable weight x 48h, off IV therapies x 48h, no change in cardiac medications for 48h.

Outpatients & Fluid Restriction

- Randomized, cross-over study

- Patients (n=65):
  - CHF with LVEF <45%
  - Stable outpatients without clinical signs of significant volume overload
  - All had been on a recommended fluid restriction of 1.5 L/day (per standard practice) at baseline

- Intervention (cross-over at mid-study):
  - Restricted fluid group: Maximum intake of 1.5 L/day x 16 weeks
  - Liberalized fluid group: Advised to limit intake to weight-based intake (averaged 2.4-2.8 L/day) x 16 weeks


Results

- Diuretic changes:
  - Restricted fluid group: 13 increases, 9 decreases
  - Liberalized fluid group: 9 increases, 9 decreases
- Hospitalizations: 5 (restricted) vs. 5 (liberalized)
- No change in Na, Cr, weight, 6-minute walk

Sense of Thirst

- Restricted fluid
- Liberalized fluid

Reported Difficulty to Adhere to Restriction

- Restricted fluid
- Liberalized fluid

Combined Fluid & Na Restriction?

- 75 patients with ADHF (LVEF ≤ 45%)
- Intervention:
  - Extreme fluid restriction (800 cc/day) & Na restriction (800 mg/day)
  - Control group (standard hospital diet)
- Outcomes:
  - Weight loss at day 7 or end of hospitalization
  - Clinical stability day 7 or end
    - Improved congestion & cessation of IV diuretics
  - of hospitalization
  - Daily perception of thirst
  - 30-day readmission
- Results:
  - No difference in any parameter
  - More thirst in intervention arm


Sodium Restriction

- 123 ambulatory patients with systolic HF (EF<35%)
  - No hospitalization or ER visit for at least 3 months
  - All on stable OMT
- Prospectively assessed dietary sodium intake based on two 3-day food records → divided groups into tertiles of Na intake
  - Tertile 1: ≤ 1.9 grams Na/day
  - Tertile 2: 2.0-2.7 grams Na/day
  - Tertile 3: ≥ 2.8 grams Na/d
- Primary outcome: Hospitalization or ER visit for ADHF
- Mean f/u: 3 years

Incidence of ADHF


Mortality

Conclusion re: Sodium/Fluid Intake

- When there is a problem, it is too much sodium, not too much water!
  - Do not waste time/energy on fluid restricting unless patient is hyponatremic
  - Patient’s non-restricted water intake is based on maintaining sodium concentration… if he/she takes in less salt, he/she will take in less water.
- Best advice (in normonatremic patient): Drink to quench thirst – not more, not less.

How to Institute Low Na Diet

- Most patients think low fat/sugar diet is most important for them.
- Multiple techniques to do low sodium
- Best diet – *fresh* meat/fruits/vegetables
  - Nothing prepackaged/nothing that anyone has had the opportunity to add salt to.
Acute Respiratory Management Pearls

Which is Generally a Good Reason to Check an ABG?

1) Concerned about PE, want to measure the A-a gradient
2) Concerned the patient is acidemic → need to check the pH
3) Concerned the patient is retaining CO2
4) All of the above
5) None of the above
Learning to Love the VBG for pH/CO2

- Reliably:
  - pH: 0.03-0.05 lower than ABG
  - CO2: 4-5 mmHg higher than ABG
- More validated for central venous sample than more peripherally, but in practice usually close
  - How often would a point or two make a difference anyway?
  - Shock: Not as reliable… but still pretty good

Oxygenation

- A good saturation monitor → reliable
- A-a gradient can be estimated very well
  - Besides – A-a gradient isn’t specific for any disease anyway!
  - Buzzword for PE diagnosis… for no good reason!
- Other handy uses for pulse oximetry monitor…
  - Poor man’s (or woman’s) A-line
    - Rough assessment of hemodynamic significance of an arrhythmia
    - Differentiate noise from a real arrhythmia
Speaking of Estimating A-a Gradients…

- Nonrebreather mask
  - Note: *Not allowed* at many hospitals, or only allowed with 1:1 nursing

- Does **not** mean
  - Simple high-flow face mask
  - NRB mask with 2 valves off
  - NRB mask with 1 valve off

How About Home O2?

- Should never be necessary for patient with heart failure (without lung disease)
- Why?
  - People don’t walk around with frank alveolar pulmonary edema
- If a HF patient has significant hypoxia when not in acute pulmonary edema → ask why!
Summary

- Diuretics… So simple, but so important to master!
  - Diurese for ECF – not high JVP
  - Diuretic combinations
  - No metolazone!
  - Na restrict – don’t water restrict!
  - Forget I/O goals
  - Forget about BNP monitoring

- Respiratory management pearls
  - Operation Save the Radial Artery
  - No home O2 for heart failure!