Fluid Stewardship

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How do we define fluid overload?

- Depends on the resources you use
- More objective ways to define:
  - Receives enough IV fluids to account for at least a 10% weight increase from their admission body weight
    - 1 L crystalloid fluid = 1 kg body weight
  - Radiographic findings/Physical exam

What are some complications that may occur secondary to patients being fluid overloaded?

- We know that being fluid overloaded is bad, but we do a bad job at prevention
  - Not judicious with fluid use up front
    - Need to try to be proactive rather than reactive
- Increased need for interventions:
  - Including paracentesis and thoracentesis
- Increased need for diuretics or ultrafiltration
- Spend a longer time on the ventilator and in the ICU
- Higher fluid overload at ICU discharge meant patients were less likely to be discharged home
- Less likely to independently perform ADL post-discharge
- Concern in surgical patients:
  - Impaired wound healing and anastomotic leaks
- Can cause acute kidney injury (AKI)
- Also contributes to patient mortality
  - Majority of these studies are retrospective
  - Question of the confounding factor of severity of illness:
    - Sicker patients are more likely to require more IV fluid
- May not be the fluid itself but rather the underlying disease process
- If someone has a drop in their urine output or an increase in their SCr, may reflexively want to administer IVF
  - In reality, that may make the acute kidney injury worse
  - More renal edema, intra-abdominal hypertension, and abdominal compartment syndrome

**Why does fluid overload still occur with everything we know about the complications that occur secondary to this?**

- The initial fluid boluses given when patients are acutely hemodynamically unstable are probably okay
- Run into problems with fluid that we don’t account for or intentionally administer
  - Maintenance IV fluid (mIVF)
    - In many disease states still figuring out the role of mIVF
  - Hidden fluids
    - Fluid associated with IVPB or continuous infusions
    - Saline flushes post-IV push medication administration
      - In some studies, 40-60% of total fluids that ICU patients receive are unintentional

**Is there a way to have a nurse-driven or team-driven titration of maintenance IV fluids (mIVF)?**

- First question to ask, how often are maintenance IV fluids even indicated?
- The answer is that it probably needs to be individualized & patient-specific
  - 1:1 ratio for fluid administration may be right it may not be right
    - The right answer depends on the starting point and indication
      - Could be 0.5:1, 1:1, or 2:1
    - May be using maintenance IV fluids that are truly indicated with just a different goal (different titration parameter)
• Rhabdomyolysis, AKI, Tumor Lysis Syndrome (TLS), Target methotrexate (MTX) clearance, Urine pH

**Are specific patients or patient populations more at risk for becoming fluid overloaded?**

- Surgical patients:
  - Good to know pre-op and intra-op fluid balance
  - Estimated blood loss v. fluid given in OR is important to be aware of
- Patients who are not diuretic naïve (received diuretics prior to admission)
  - May lead to diuretic resistance
  - Important to have diuresis goals
- Patients who are receiving lots of hidden fluid (multiple IV continuous infusions and IVPB)
  - UGAC3 data demonstrates that 2 largest contributors to fluid overload was Sodium Bicarbonate (NaHCO₃) continuous infusions and Vancomycin IVPB
- Patients receiving lots of blood products
- Patients with a long ICU stay
  - More fluid builds up over time

**In short, everyone**

**What tools do we have available to determine if patients are fluid responsive?**

- Be careful with the term pre-renal AKI
  - Several different disease states may be masked as a pre-renal AKI where in fact fluid was a causative factor
  - Pre-renal AKI could be volume-dependent or perfusion-dependent
    - Someone with sepsis likely presents with volume-dependent pre-renal AKI
    - Someone presenting with abdominal compartment syndrome or cardio-renal syndrome also have a pre-renal AKI but it is perfusion dependent
• In this case, they have plenty of fluid on board it just can’t get to the kidneys

- Dynamic v. Static markers of fluid responsiveness
  - Dynamic (preferred):
    - Passive leg raise (PLR), fluid challenge, point-of-care ultrasound (POCUS e.g. bedside Echo), stroke volume variation (SVV), pulse pressure variation (PPV)
  - Static (not preferred):
    - Central venous pressure (CVP)
      - May be less useful in looking at absolute value
      - May be reasonable to look at trends

- Limitations to using markers to track fluid responsiveness
  - Validated with very specific ventilator settings
  - Various patient-specific factors that will render the test useless

- What to do if you don’t have equipment or training for some of these tests?
  - SVV is the AUC of the waveform on the arterial line
  - Solution if you don’t monitor SVV:
    - Go to the patient’s bedside (if they have an arterial line placed)
    - Zoom in on arterial line waveform on their vitals monitor
      - Can eyeball the pulse pressure
        - Difference between peak systolic and diastolic
        - Look at where the peaks and valleys and compare to their respiratory cycle
          - If you can visualize a difference in the pulse pressure between inspiration and expiration then there is likely a 10-15% difference indicating they are likely fluid responsive
      - Can also do PLR or 250-500 cc fluid challenge
        - Look at their change in CVP or End-tidal CO₂
Does fluid responsiveness mean that patients should receive fluid until they are not?

- Definitely no
- Just because data at the bedside says they may be fluid responsive; does not mean we need to be giving volume
  - We live at the lower end of the Frank-Starling curve
    - We have some cardiac reserve
    - If you give us fluid our CO will increase
    - The difference is that we are hemodynamically stable
- In the ICU, if the data suggests they may be fluid responsive then go look at the patient and see if there is a true correlation
  - Use small amounts of fluid and re-assess

Define what the phrase fluid stewardship means.

- Similar to antibiotic stewardship
  - Use early aggressive antibiotics and you can have significant downstream effects
    - We also use early, aggressive fluids in ICU patients
  - The difference is:
    - When do those downstream effects occur?
      - For antibiotics it is 3-9 months down the road
        - Super infections and MDR pathogens
      - The downstream effects from fluid overload may be evident and contribute to morbidity and mortality much sooner
- It’s easy to blame other reasons why patients are unable to wean from the ventilator or their kidney function worsens
  - Their volume status and fluid overload may have contributed
What does the phrase “Four D’s” mean and where did this term originate?

- Authors in Belgium first used this phrase in 2015 when discussing fluids as they relate to septic shock
  - Drug – Type of fluid, tonicity, crystalloid v. colloid v. blood product
  - Dose – What rate? How much?
  - Duration – How long?
    - “Early adequate, late conservative”
    - When someone first presents, want to be more aggressive
      - Use fluid responsiveness to tailor how much to give then
      - After initial resuscitation phrase, generally fluids aren’t the answer to the question
        - Fluids you give later on may cause more iatrogenic harm
    - De-escalation – Give fluid more conservatively? Stop giving fluid? Start diuresis or removing fluid?
      - Can be a misleading phrase

During the typical time course of septic shock, there are four distinct dynamic phases of fluid therapy. This is described by the acronym ROSE. Walk us through ROSE and questions we may be asking our teams within the different phases.

- 4 phases of fluid administration
  - First used to describe the time course of septic shock patients
  - Thinking about it graphically:
    - Time course is on X axis and Volume administered on the Y axis

- Rescue
  - First several minutes post-presentation up to the 1st hour

- Optimization
  - This is over several hours
  - Trying to fine-tune volume status
    - Using volume responsive metrics to optimize volume status
Resuscitation is the combination of the Rescue and Optimization phases

- **Stabilization**
  - Achieved euvolemia
    - Try to maintain net neutral or negative for daily fluid balance
  - De-escalation may occur
    - May not actively diurese
    - But may stop giving fluids (late conservative)
  - If still on vasopressors in this phase:
    - Start investigating other reasons they may still need vasopressors
      - For example: adrenal insufficiency, thyroid issues

- **Evacuation**
  - Actively trying to remove fluids
    - Try to achieve total ICU fluid balance of zero
  - Can take days to weeks
  - We don’t have great evidence on how to de-resuscitate, we just know that we need to

**You published a paper detailing fluid stewardship in critical illness focusing on all ICU patients, not just those in septic shock. What is this paper’s overall purpose?**

- Super-imposed the ROSE model and the 5 Rights of Medication Administration
- Developed a construct of Fluid Stewardship as the 4 Rights of Medication Administration
  - Applies to all ICU patients, not just septic patients
- Highlighted problems with fluid administration
- Discussed potential solutions
- Mentioned areas of research that are needed in each area
- Focused on the role the Pharmacist could play at the bedside as a “fluid steward”
Discuss more about the 4 Rights of Medication Administration with the Fluid Stewardship construct.

- **Right Patient**
  - Know where the patient is within the ROSE model

- **Right Drug**
  - Balanced Solutions v. Hyperchloremic Solutions
    - Hyperchloremic fluids (“Ab-“Normal Saline)
    - Isotonic
    - Acidic – pH 5.3
    - Fluid of choice for: Hypochloremic metabolic alkalosis
      - Maybe the only classic true indication
    - Balanced Solutions (Lactated Ringers & Plasmalyte)
      - Contains very small amount of K (4-5 mEq/L)
        - Provider may be concerned when using if patient is in AKI, oliguric, and/or has hyperkalemia
        - Plasmalyte has 5 mEq/L (compared to LR = 4 mEq/L)
          - Slightly more expensive than Lactated Ringers
      - Some type of buffer (acetate/lactate)
        - Lactate accumulation shouldn’t be a problem if no ESLD is present
      - If you want more use of Balanced Solutions make it easier to use
        - Make fluid order sets default to balanced solutions
        - Have these fluids stocked on the floor to ensure easy access

- **Right Route**
  - Early EN may negate much of the indication for maintenance IV fluids
    - So important, easy justification to d/c fluids
  - Changing the route is an easy intervention
    - IV to PO for Pharmacists helps with hidden fluid intake

- **Right Dose**
  - Give small aliquots of fluid (250-500 mL) at a time with a therapeutic goal in mind
    - If the fluid helps achieve the goal, continue and then use volume responsive assessments
Avoid choosing arbitrary amounts of fluid (e.g. 1 L) without a therapeutic goal in mind
- Doesn’t only apply to fluid boluses
- Put in stop dates and stop times for fluids
  - “Don’t set it and forget it”
- Constantly re-assess, don’t wait 24 hours to see if target is achieved

What are some examples of interventions that Pharmacists or others could make that fall within a specific category of the 4 rights you described?

- Right Patient
  - Do they need fluids? Enteral fluid?
    - Do they need maintenance IV fluid v. bolus IV fluid?
    - Crystalloid v. Colloid?
  - Use volume responsive tool to see if patient does need IV fluids/boluses

- Right Drug
  - Medication diluent (D5W v. NS)
  - Concentrate infusions (to reduce hidden fluids)
    - Straight sodium bicarbonate infusion rather than 150 mEq NaHCO₃ in 1L fluid
  - Administer fluid v. diuretic?
    - Initiating/Stopping either of those above
    - Changing timing of diuretics if using multiple

- Right Route
  - IV to PO to minimize hidden fluids

- Right Dose
  - Concentrated v. Non-concentrated albumin depending on indication
    - To mobilize fluids (adjust oncotic pressure) use 25% concentrated albumin
There are lots of questions in your fluid stewardship call to action paper, what would you say are some of the most critical or important?

- How much initial fluid should be given in sepsis resuscitation?
  - ABW v. IBW v. AdjBW
  - However, fluid stewardship applies to more than just sepsis
- Balanced v. hyperchloremic fluids?
  - Looking at specific patient populations/disease states (e.g. DKA patients)

What are some trials related to fluids and fluid stewardship we should be keeping our eyes open for?

- CLOVERS
- RADAR-2 - Focusing on de-resuscitation
- VOLUME-CHASERS group has work on the horizon
- RIFTS
- FADE – Furosemide and albumin to promote diuresis
- TOPMAST-1 and MIHMoSA – Preliminary trials looking at isotonic v. hypotonic maintenance IV fluids in surgical patients

Take-home points

- Fluids are drugs, Pharmacists are drug experts. Embrace that point.
- Hidden fluids contribute a lot to overall fluid administered over an ICU stay
  - Always account for these fluids
- Computer systems don’t have artificial intelligence related to IV fluids
  - Takes more work on the part of the Pharmacist
- Fluid stewardship is a great way to give Pharmacists more purpose
  - Evaluate data in real time
  - Expand the range of clinical services that Pharmacists provide
  - Increase the types and variety of recommendations Pharmacists make on rounds