Volume Overload Case Study

Adapted from
ASN Board Review 2004
Dialysis and CKD
Session 1
Module 07-A & B Version 01-1

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General Advice

- Watch for subtleties
- Watch for buzz words
- What is most logical?
- What is most practical?
PD Volume Overload

- 2 yrs on PD, usually uses isotonic solution
- Has not changed diet/intake
- Number of recent acute pulmonary edema episodes
- 2 *S. epi* peritonitis episodes
- PET 2 yrs ago and now same (HA transporter)

**Options to choose from**
- (A) Idiopathic peritoneal fibrosis
- (B) Loss of RRF
- (C) Loss of peritoneal UF due to rising transport status
- (D) Loss of peritoneal UF due to decreasing transport status
- (E) Loss of peritoneal UF due to frequent peritonitis
Volume Overload in PD Patients

Clinical Questions

- Is the patient complying with sodium and fluid restrictions?
- Does the PD prescription provide an adequate osmotic stimulus for UF?
- Is the peritoneal membrane responding properly to the osmotic stimulus?
Factors Affecting Fluid Balance

Residual Renal Function

Reversible Issues
- Appropriate prescription
- Dietary indiscretion, compliance
- Deficient education
- Complex Regimen
- Burn-out

Mechanical causes
- Leaks
- Obstructions
- Entrapment
- Malposition

Membrane Issues
- Low Transport
- Disruption of peritoneal space
- Low Average or High Average Transport
- Mechanical Enhanced reabsorption
- Aquaporin deficiency
- High Transport
- Inherent high
- Recent peritonitis
- Long term PD

Work-up

1. History & physical exam

2. Observe a 2 liter rapid in and out exchange to assess flow mechanics

3. Perform a 2 liter 4.25% dextrose PET
Ultrafiltration in Peritoneal Dialysis

UF with different dextrose concentrations

Drained volume, mL

Time in Minutes

- 4.25% Dextrose
- 2.5% Dextrose
- 1.5% Dextrose

Rippe, KI 1991
Peritoneal Equilibration Test (PET)

D/Do Glucose

D/P Creatinine

Twardowski et al. PDB
Peritoneal Equilibration Test

Drain Volume

Creatinine

D/P
Volume Overload Evaluation

- History (oral intake, previous PET, urine output)
- Physical examination
- Measurement of residual renal \( \text{volume} \)
- Rapid in and out exchange
- 4.25% 2 liter PET
  - Drain Volume (should be > 2400 ml)
  - \( D/P_{\text{creatinine}} \) – has it changed?
Causes Of Volume Homeostasis Failure

- Comorbid diseases
  - e.g. CHF, hypoalbuminemia
- Input dependent
  - Excessive salt and water intake
- Output dependent
  - Uncompensated loss of RRF
  - Inappropriate PD prescription
  - Increased lymphatic reabsorption
  - Peritoneal membrane failure
  - Mechanical failure of dialysis procedure
Loss of RRF

- Protect RRF while on PD
- Decrease in urine volume
- Tends to happen over time on PD
- Work-up:
  - Since history suggests it, measure urine output
    - DOQI suggested q 2 months
  - Rapid in and out exchange is normal
- Treatment/compensation
  - Decrease Na and fluid intake
  - Increase volumes and/or frequency of hypertonic exchanges
  - Diuretics
# Diuretics Do Not Increase Renal Clearance

van Olden JASN 8:293A 1997

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>2 g Furosemide</th>
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<tbody>
<tr>
<td>Urine volume (mL/day)</td>
<td>450</td>
<td>950</td>
</tr>
<tr>
<td>Urine Na (mmol/day)</td>
<td>?</td>
<td>↑ by 57</td>
</tr>
<tr>
<td>GFR (mL/min)</td>
<td>4.3</td>
<td>4.1</td>
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Diuretics In CAPD Pts
Medcalf et al KI 59:1128, 2001
61 incident CAPD pts randomly assigned to furosemide 250 mg/day or to no diuretic

Diuretics had no effect on either urea or creatinine clearances

Fig. 1. Evolution of urine volume (UV) over one year of peritoneal dialysis (PD). UV at randomization was comparable between groups. In the diuretic group (■), it remained constant over one year of CAPD, whereas in the control group (▲), UV declined. Data presented are mean ± SEM at each time point.
Causes Of Volume Homeostasis Failure

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Inappropriate PD Prescription

- Often becomes apparent when RRF is lost
- Work-up:
  - History unremarkable except for previous PET and recent decrease in urine output
  - No mechanical problems with rapid in and out exchange
  - No change in peritoneal transport on 4.25% PET
- Due to fluid absorption during long dwells
- Rx: shorten dwell, hypertonic fluids, icodextrin

Please see Extraneal full prescribing information
Important Safety information for EXTRANEAL

- EXTRANEAL is indicated for a single daily exchange for the long (8-16 hour) dwell during continuous ambulatory peritoneal dialysis (CAPD) or automated peritoneal dialysis (APD) for the management of chronic renal failure.
- EXTRANEAL is contraindicated in patients with a known allergy to cornstarch or icodextrin or in patients with glycogen storage disease.
- In clinical trials the most frequently reported adverse events occurring in ≥10% of patients, and more common in EXTRANEAL patients than in control patients, were peritonitis (26% vs 25%), upper respiratory infection (15% vs 13%), hypertension (13% vs 8%), and rash (10% vs 5%). The most common treatment-related adverse event for EXTRANEAL patients was skin rash (5.5% vs 1.7%).
Important Safety information for EXTRANEAL (Continued)

- Since falsely elevated glucose levels have been observed with blood glucose monitoring devices and test strips that use glucose dehydrogenase pyrroloquinolinequinone (GDH PQQ)-based methods, GDH PQQ-based methods should not be used to measure glucose levels in patients administered EXTRANEAL. The manufacturer(s) of the monitor and test strips should be contacted to determine if icodextrin or maltose causes interference or falsely elevated glucose results.
- Patients with insulin-dependent diabetes may require modification of insulin dosage following initiation of treatment.
- Please see full prescribing information.
Inappropriate PD Prescription

- Inappropriate tonicity of PD fluids
  - Physician reluctance (wisely) to use hypertonic solutions.
    - In US > 50% of dialysate used is 2.5% or 4.25%
    - Consider alternative osmotic agents (Icodextrim)

- Too long a dwell time
  - Mismatch of dwell time and transport status
  - Critical dwell times are:
    - Overnight in CAPD
      - Consider Quantum™ exchange
    - Daytime in APD

Please see Extraneal full prescribing information
The Long Dwell

Rx: add midday exchange or go empty

APD

Cycle 1 Cycle 2 Cycle 3 Cycle 4

CAPD

Long dwell

Manual day exchange

Manual day exchange

Manual day exchange

Rx: Quantum™ exchange

nighttime period

daytime period
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