A Stunning Fact You Should Know: Why Volume Management and Blood Pressure Control is Critical in Preventing Cardiovascular Events in Dialysis Patients

Lisa Koester
Renal Nurse Practitioner
Washington University School of Medicine
St. Louis, MO

Goal and Supporting Research

To reduce morbidity, mortality and treatment loss associated with chronic volume overload in hemodialysis patients

2

Intro: Daily Dialysis Scenario

A patient arrives for dialysis with excess fluid to remove…..

- What happens?
- A (sometimes ugly) confrontation occurs with: "*… you have not adhered to your fluid restriction …*"
- With lots of fluid to remove, a high ultrafiltration rate (UFR) is required and set.

Daily Dialysis Scenario

Mr. Jones Reply:

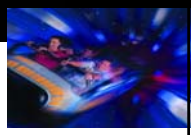
"I can take it off. I have done it before"

Staff:

Patient is set for goal and then….

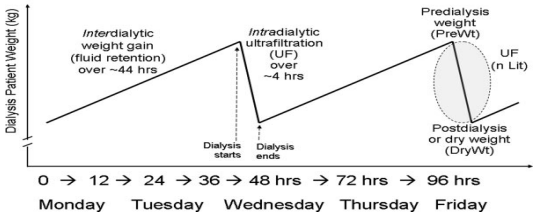
My Reply:

"The Volume Roller Coaster" Disney Style



DryWt = PreWt – UF

UF = Fluid Retention



Kalantar-Zadeh, et al. *Circulation.* 2009,119:671-679

What normal happens

- Patient goes "flat" halfway through
- Urgent "resuscitation" starts, with normal saline (of course)
- But wait: isn't dialysis meant to be *removing* excess salt and water?

Daily Dialysis Scenario

- After loading up with salt and water (saline), more fluid is taken off, and fast, for time is now short
- Cramps are occurring, hypotension and overall feeling poorly
- Goal: Did get volume off patient?
- Did we succeed? What happens next……

Daily Dialysis Scenario

- Patient leaves – THIRSTY – so they drink! So would you —you would have to! Your brain stem would insist on it!
- And so this "noncompliant" patient complies with the primal survival drive of thirst, and drinks!

This blog post was made by Dr. John Agar on December 17th, 2013.

Daily Dialysis Scenario

- In 2 days time (or 3, at the staff-convenient weekend), the patient returns, finally revitalized by fluid, but volume overloaded AGAIN.
- More angry berating ensues "*You must be more compliant, you are killing yourself …*"
- No … **we** are the ones doing the killing.

Dialysis Mistakes

Mistake #1:

- The dialysis session is too short. A longer session allows the removal of the same volume over a longer time at a lower UFR

This blog post was made by Dr. John Agar on December 17th, 2013.

Mistake 2

- Berating a patient for "non-compliance" is (a) cruel and (b) an abuse of a patient for our own mistake:
- '*excess fluid to remove*' is fluid that *we* forced the patient to drink—an instinct *we* ignited—through far too rapid a contraction of blood volume abetted by further salt loading during the inevitable circulatory resuscitation

This blog post was made by Dr. John Agar on December 17th, 2013.

Mistake 3

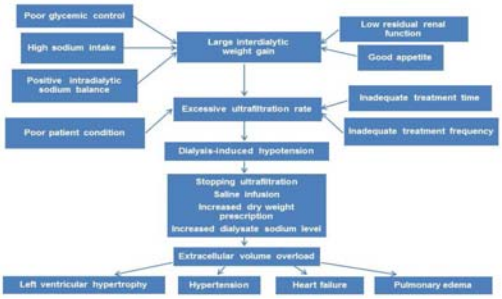
- It isn't the patient who "*doesn't get it*."
- We are the ones that don't get it!

This blog post was made by Dr. John Agar on December 17th, 2013.

Factors Influencing My Response

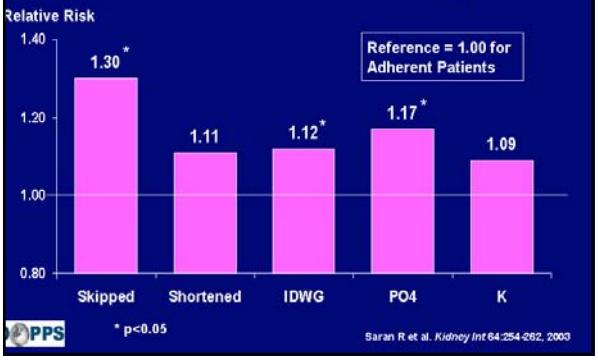
- What is the patient's weight?
- Remember .03% vs .05% Fluid Removal
- Example: DW 70 KG
  - .03% is 2.1 kg removal
  - .05% 3.5 kg removal TOO MUCH

Why is fluid removal important?

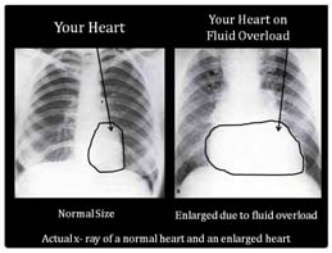


Source: Chazot & Jean, 2008

Noncompliance is Associated with an Increased Risk of Mortality

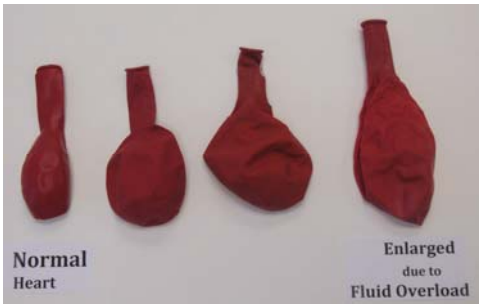


Fluid Overload



Ball, L – 2014 Network 13

Fluid Overload



Ball, L 2014 Network 13

Fluid Overload

Dyspnea-- lead to pulmonary complications

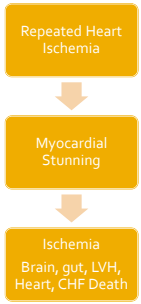
Kraemer M, Rode C, Wizemann V. KI 2006; 69; 1609-1620.

Fluid Overload

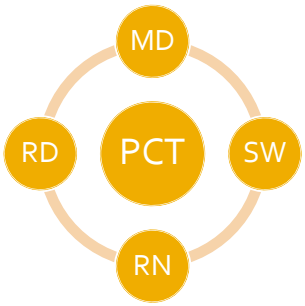
Edema—facilitates skin breakdown

Kraemer M, Rode C, Wizemann V. DeteKl 2006; 69; 1609-1620.

Hypotension Repeated d/t large IDW gains > 5% Fluid Removal



Most Important Role.....



PCT: On the front lines

- Witness patients weigh in and out
- Assess at your patient – look at them
  - Breathing Hard
  - Fluid – edema evident (hands, feet, face)
  - Vital Signs
- Look at flow sheet trend?
- Does it make sense?
- Hospitalizations? Is DW correct?

On the Front Lines

- Talk with your patient
  - How did your last treatment go?
  - How did you feel in between treatments?

- Talk with your co-workers
- Notify RN of any patients that has gained > 5% of DW before starting treatment
- Notify RN if patient is above DW post treatment

PCT Trending Report

PCT Trending Report

DaVita

Treatment	09/06	09/03	09/01	08/30	08/27	08/25	08/23	08/20	08/18	08/16	08/13	08/11	08/09	08/06
Pre WT (kg)	61.0	62.0	61.5	62.0	60.0	61.0	61.0	60.5	51.0	62.5	61.5	62.0	62.5	62.5
Post WT (kg)	59.0	59.5	59.5	59.0	59.0	59.0	59.0	59.0	59.0	59.5	60.0	59.5	59.5	59.5
EDW (kg)	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0
Weight Gain (kg)	1.5	2.5	2.5	3.0	1.0	2.0	2.0	1.5	-8.5	2.5	2.0	2.5	3.0	3.0
Vol Rem (kg)	2.0	2.5	2.0	3.0	1.0	2.0	2.0	1.5	-8.0	3.0	1.5	2.5	3.0	3.0
PreBP Sit	159/73	127/72	126/68	145/70	126/67	148/65	128/62	133/62	134/70	142/68	159/60	156/68	131/70	150/66
PostBP Sit	145/63	134/61	122/68	146/67	146/73	140/71	123/63	103/52	133/68	142/65	143/71	132/62	150/73	130/60
PreBP Stand	170/78	133/61	123/63	133/66	147/65	141/64	129/66	129/63	101/51	139/67	137/60	128/62	139/62	138/63
PostBP Stand	116/67	111/59	105/56	109/56	136/64	129/65	110/51	128/64	131/68	111/57	120/70	105/60	128/70	108/56
Lowest BP	90/47	99/62	101/55	99/60	102/59	107/59	94/53	102/48	101/51	104/56	91/51	93/50	121/54	98/58
Static VP														
Blood Flow ml/min	385	450	450	450	450	450	450	450	450	450	350	450	450	450
VP @ 200	60	60	70	70	70	70	70	60	60	60	60	70	70	70
Reuse	6	5	4	3	2	1	0	36	98	94	93	92	91	90
Primary Access	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG
Secondary Access														
Time on Dialysis	03:00	03:01	03:30	03:00	03:00	03:00	02:59	03:06	03:00	03:04	02:57	03:00	03:05	03:01
Saline														

HCT CALC (HGBX3)	Date	Corrected Calcium	Date
37.5	9/6/2010	9.7	9/6/2010
URR	**Date**	**Corrected Phos**	**Date**
79	9/4/2010	4.1	9/6/2010
KTV	**Date**	**Corrected Product**	**Date**
1.95	9/4/2010	39.8	9/6/2010

Emergency Contact | Telephone | Doctor | Telephone

24

Definition of Dry Weight

- 1967 - Thomson et al
  - Reduction of BP to hypotensive levels during ultrafiltration and unassociated with other obvious causes.
- 1980 - Henderson et al
  - Weight obtained at the conclusion of a regular dialysis treatment below which the patient more often than not will become symptomatic and go into shock.

Thomson GE, et al: *Arch Intern Med 120: 153–167, 1967*

Definition of Dry Weight

- 1996 – Charra et al
  - That body weight at the end of dialysis at which the patient can remain normotensive until the next dialysis despite the retention of fluid and ideally without the use of antihypertensive medications
- 2009 – Sinha and Agarwal
  - The lowest tolerated post dialysis weight achieved via gradual change in post dialysis weight at which there are minimal signs and symptoms of hypovolemia or hypervolemia

Charra B, et al: *NDT 11[Suppl 2]: 16–19, 1996*
Sinha AD, Agarwal R: *Semin Dial 22: 480–482, 2009*

Dry Weight

- Is what the patient's weight would be with no extra fluid and with a normal blood pressure
- MD/NP prescribes a DW and this number is then used to decide how much fluid weight is to be removed during the treatment.
- At the end of HD w/ normal BP, no edema & no SOB

Dry Weight: What Affects it?

- Hospital Stay or illness with loss of appetite, diarrhea, or vomiting can cause drop in DW
- Holidays often cause increases in DW
- More urine production
- Pt may be exercising or lifting weights to build muscle
- Clothes
- Scale Accuracy
- Medications
- Diet

Assessment of DW: After HD

AT DRY WEIGHT

- Normal BP (varies)
- No edema
- No shortness of breath
- Stable overall

ABOVE DRY WEIGHT

- HTN
- Evidence of fluid
  - Edema
  - SOB
  - Feeling bloated or full

Assessment of DW: After HD

Below Dry Weight

- Hypotension
- Headache
- Elevated HR
- Cramps
- Nausea/vomiting
- Dizziness
- Required intervention(saline)

The Weight Challenge

"Too Dry"

- Classic symptoms
  - drop in blood pressure (BP)
  - feeling faint
  - cramping
- Blood pressure drop results in ischemia
  - BP is too low to deliver oxygen to the cells

31

Effects of Ischemia (hypotension)

- Dizziness, seizures
- Headache, stroke
- Chest pain, MI
- Nausea, vomiting, diarrhea
- Muscle mping
- *Possible* long-term affects
  - Damage to vital organs, including heart and brain

32

Reducing Sodium in dialysis and dietary

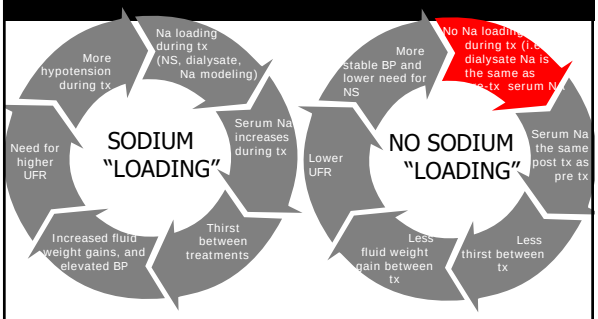
- Excess sodium exposure (intradialytic and interdialytic) is a primary cause of excessive interdialytic fluid weight gain and poor control of sodium and volume mediated hypertension

Intradialytic Sodium Exposure

Dialysate sodium and Sodium Profiling

- Greater than 138 mEq/L dialysate sodium represents excessive exposure to sodium
- Can lead to increased thirst, higher IDWG, worsening hypertension and left ventricular hypertrophy
- KDOQI clinical practice guidelines state that use of high dialysate sodium and sodium profiling should be avoided

Loading vs No Loading: Sodium



Davita RD Meeting 2010

Interventions

If-the-BP-falls-give-salt: old and wrong

- Limiting sodium intake is not just a dietary issue
- The patient is not the only one responsible for limiting sodium load
- Any action that adds sodium to the patient's intravascular system has the potential to increase thirst and fluid weight gains

*Broth given for hypotension contains as much as 700-1000 mg sodium (1/3 to 1/2 of daily recommendation

Is dialysis long enough?

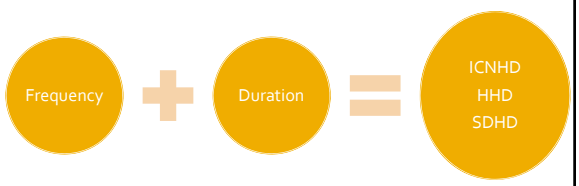
Maximum UF Rate

- Ultrafiltration rate above 15 ml/kg/hr: recommended 10-13ml/kg/hr
  - Higher rate of intradialytic hypotension
  - Unstable dialysis sessions
  - Higher mortality
  - Intradialytic ischemic episodes

Dialysis Treatment Time

- Increase treatment time when needed to
  - Decrease intradialytic and post dialysis hypotension
  - Optimize blood pressure control

Ways to Reduce Stunning



Understanding Fluid Behavior

- Intake of fluids is related to:
  - Physical needs
  - Habits
  - Customs
  - Social rituals
  - Disease
  - ***CONTROL**

People drink because….

- Alleviate dry mouth
- Match ingestion of food
- Enjoy the taste or experience of liquid
- Take prescribe medications

People drink because….

- Seasons of the year affect consumption
- Regulatory reaction to thirst/physical deficit of fluid
- Motivational and cognitive processes
- Dialysis pts are drinking in response to osmometric thirst and sodium intake is important part of the behavior

The Battle with Self-Care

- "Controlling fluid intake is essential for proper self-care. However, clinical experience has shown that, compared to attendance to HD sessions or fulfillment of drug prescription, this is the factor with the highest level of non-compliance"

Carmelo Iborra-Molto et al. Adherence to fluid restriction, Nefrologia 2012;32(4):477-85

How much can you drink?

Restrictions for Anuric Patient:

.5-.9 liters/day (make 1 liter/day)

Normal Hydration is 2 liters between HD sessions to prevent intradialysis events by 75% and the risk of mortality by 50%

Carmelo Iborra-Molto et al. Adherence to fluid restriction, Nefrologia 2012;32(4):477-85

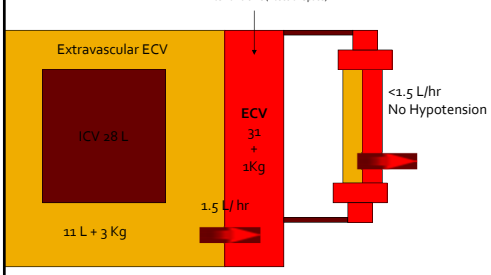
ULTRAFILTRATION: What is it?

- Ultrafiltration during dialysis is the result of the TMP (transmembrane pressure) in the dialyzer which removes plasma water from the blood compartment of the dialyzer to the dialysate compartment.
- If the rate of removal exceeds the rate of plasma refill then hypovolemia and hypotension occur.

Tools: ULTRAFILTRATION PROFILES

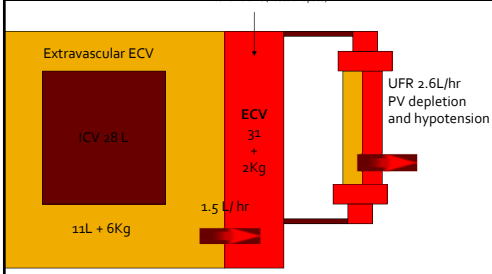
- Interval UFR profiles seem to optimize plasma refill and allow UF goals to be reached with minimum to no intradialytic complications

FLUID MOVEMENTS IN RELATION TO ULTRAFILTRATION



70Kg patient with normal fluid distribution, gains 4 kg in between dialyses.
Dialysis time 3 hours, UFR= 1.33 L/hr. Slower refill rate than of 1.5L/hr
Lower risk of hypotension

FLUID MOVEMENTS IN RELATION TO ULTRAFILTRATION

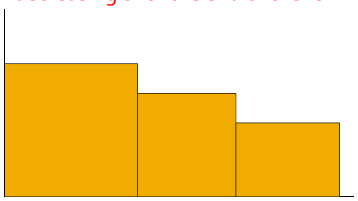


70Kg patient with normal fluid distribution, gains 8 kg in between dialyses.
Dialysis time 3 hours, UFR= 2.6 L/hr. Faster than the refill rate of 1.5L/hr
Consequently increased risk of hypotension

ULTRAFILTRATION PROFILES

Profile One

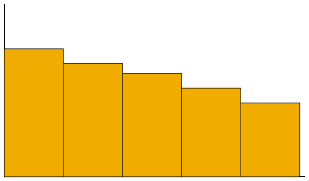
- Provides relatively high level UF for almost half the run, then begins gradually decreasing until the end of the run



ULTRFILTRATION PROFILES

Profile Two

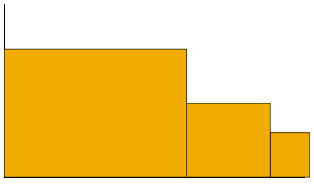
- Gives a gradual decline in removal, but again, starting with aggressive UF in the early part of dialysis. These work well with a patient with high weight gains, possibly symptomatic (SOB, HTN) and with a tolerance for rapid fluid removal



ULTRAFILTRATION PROFILES

Profile <u>THREE</u>

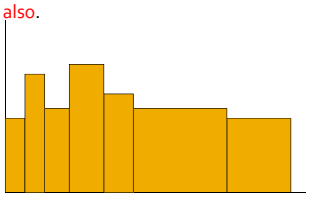
- Moderate UF throughout 2/3rd , followed by a more dramatic decrease in last portion. This would work well with the patient who becomes hypotensive in the last hour or comes off the machine with a low BP



ULTRAFILTRATION PROFILES

Profile FOUR

- Starts low UF & moves into series of decreasing peaks & valleys for the first 2/3rds. This profile will facilitate the patient with poor vascular response who drops BP early and needs time for plasma refill. This patient would probably benefit from sodium variation also.



Evaluating Individual Fluid Removal Plan

- There are a few basic rules to apply when evaluating a patient that will help to develop an individual fluid removal plan
  - Dry weight evaluation
  - Physical Assessment
  - All patients do not need modeling and/or profiling
  - Some may need a combination of both
  - Others may use only UF profile or only NA modeling

Other Factors that effect Ultrafiltration

- Low serum albumin levels
- Poor Heparinization
- Increased HCT (>36%)
- Poor blood flow rates
- Multiple Alarms
- Failing Vascular Access

Red Blood Cell

Conclusion: Prevention

"By designing an adequate treatment program and refining ultrafiltration, *fluid overload* is a *preventable and correctable risk factor in dialysed patients*"

Canaud B & Lertdumrongluk P
Probing 'dry weight' in HD pts: 'back to the future'.
NDT 2012 Jun;27(6):2140-3

Most Important Role.....