Spital Thurgau

How to deal with hypotension on dialysis?

CME Basics in Nephrology
SGN-SSN Interlaken 2016

PD Dr. med. Andreas Kistler
Leitender Arzt
Nephrologie und Dialyse
Kantonsspital Frauenfeld
www.spital-thurgau.ch

Intradialytic hypotension is a frequent problem...

...yet there is no simple solution to it....

...and the evidence-base for most preventive measures is scarce.

Mr. Ivo Dieter Höfler (I.D.H.)

- 68 yo male patient with DNP on HD for 4y
- with a number of comorbidities...
  - Diabetic retinopathy
  - Ischemic heart disease (nSTEMI 6y ago)
  - Peripheral arterial disease
  - Right calf amputee for infected diabetic ulcer
  - Obesity (BMI 33)

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Mr. Ivo Dieter Höfler (I.D.H.)

Time	BP
13:05	152/68
13:10	146/65
13:40	139/67
14:10	126/61
14:40	128/59
15:10	125/60
15:40	103/61
15:45	99/56
15:48	93/54
15:53	114/63
16:02	108/60
15:17	112/62
16:32	109/60
16:47	113/63

lightheaded,
nausea

Does this patient have intradialytic hypotension?

- ☐ Yes
- ☐ No
- ☐ Don‘t know
- ☐ It depends

Why bother about IDH?

- ☐ Because of the annoying alarms
- ☐ Because it causes dyscomfort to the patient
- ☐ Because the nurse asks me to change the prescription
- ☐ Because it negatively affects dialysis efficacy
- ☐ All of the above

Definition of IDH

- **KDOQI:**
  - decrease in systolic blood pressure by ≥20 mmHg or MAP by ≥ 10 mmHg
  - associated with symptoms that include: abdominal discomfort; yawning; sighing; nausea; vomiting; muscle cramps; restlessness; dizziness or fainting; and anxiety
- **HEMO:**
  - Fall in BP resulting in intervention of UF reduction, bood flow reduction or saline administration
- **EBPG guidelines on hemodynamic instability:**
  - ...no evidence based recommendation regarding the definition of IDH can be given
  - ...both a reduction in BP, as well as clinical symptoms with need for nursing intervention should be present in order to accept the presence of IDH
- **Many different definitions in different studies...**

CLINICAL EPIDEMIOLOGY www.jasn.org

Association of Mortality Risk with Various Definitions of Intradialytic Hypotension

Jennifer E. Flythe,*†‡ Hui Xue,§ Katherine E. Lynch,*† Gary C. Curhan,*†‖ and Steven M. Brunelli*¶

*Renal Division and ‖Channing Division of Network Medi
Boston, Massachusetts; †Harvard Medical School, Bosto
Chapel Hill, North Carolina; §Divisions of Hospital Medi
Medicine, University of California, San Diego, California;

J Am Soc Nephrol 26: 724–734, 2015.

Table 1. *A priori* IDH definitions

Term	Definition
Nadir90	Minimum intradialytic SBP<90 mmHg
Nadir100	Minimum intradialytic SBP<100 mmHg
Fall20	(Pre-HD SBP−minimum intradialytic SBP) ≥20 mmHg
Fall30	(Pre-HD SBP−minimum intradialytic SBP) ≥30 mmHg
Fall20Nadir90	(Pre-HD SBP−minimum intradialytic SBP) ≥20 mmHg and minimum intradialytic SBP<90 mmHg
Fall30Nadir90	(Pre-HD SBP−minimum intradialytic SBP) ≥30 mmHg and minimum intradialytic SBP<90 mmHg
KDOQI	(Pre-HD SBP−minimum intradialytic SBP) ≥20 mmHg and symptoms of cramping, headache, lightheadedness, vomiting, or chest pain during HD
HEMO	Fall in SBP resulting in intervention of UF reduction, blood flow reduction, or saline administration

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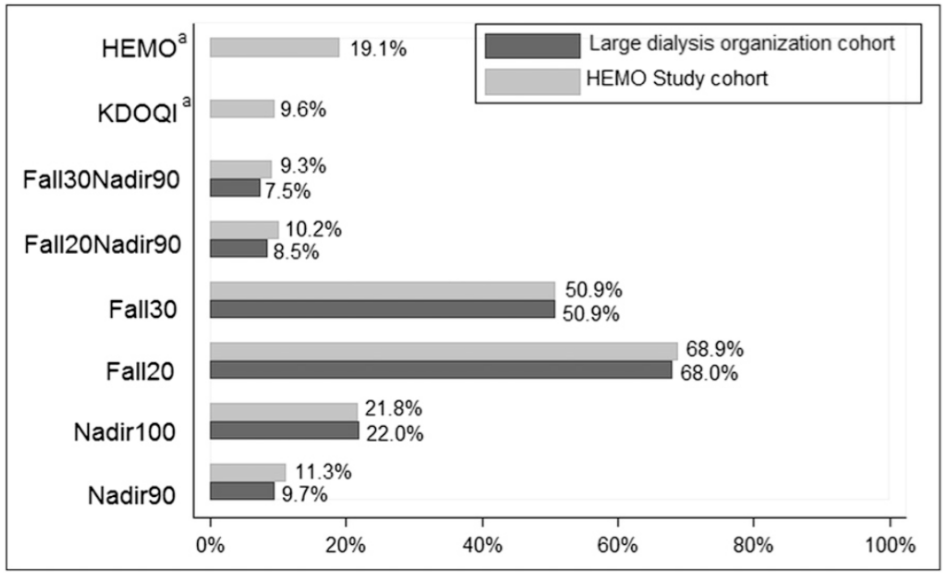

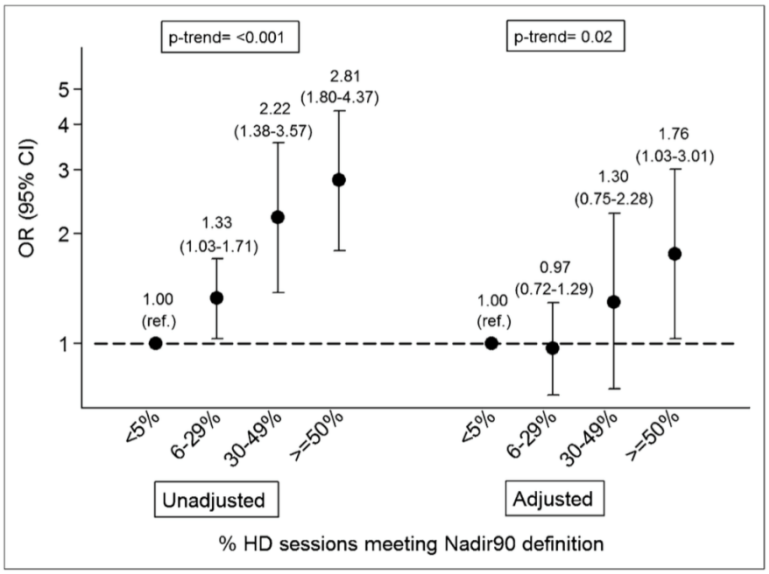

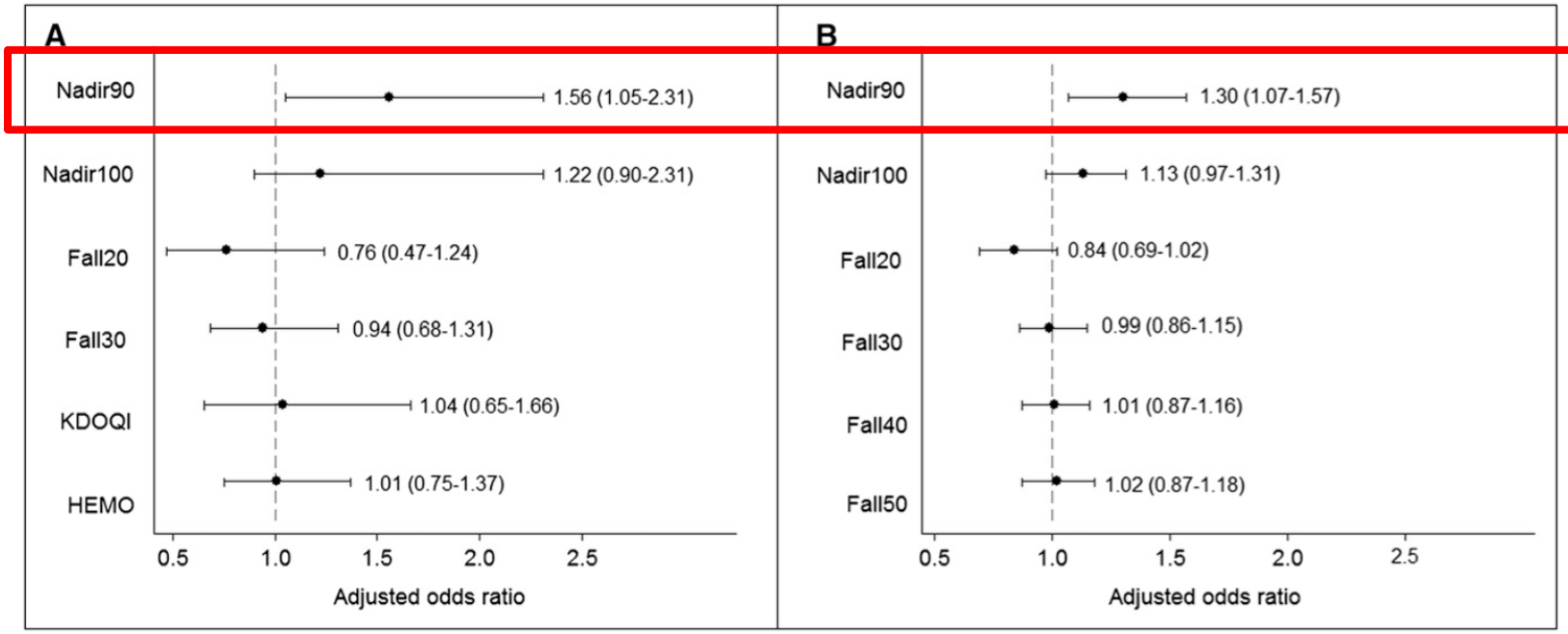

Does this patient have intradialytic hypotension?

- ☐ Yes
- ☐ No
- ☐ Don‘t know
- ☑ It depends *...on the definition*

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Mr. Ivo Dieter Höfler (I.D.H.)

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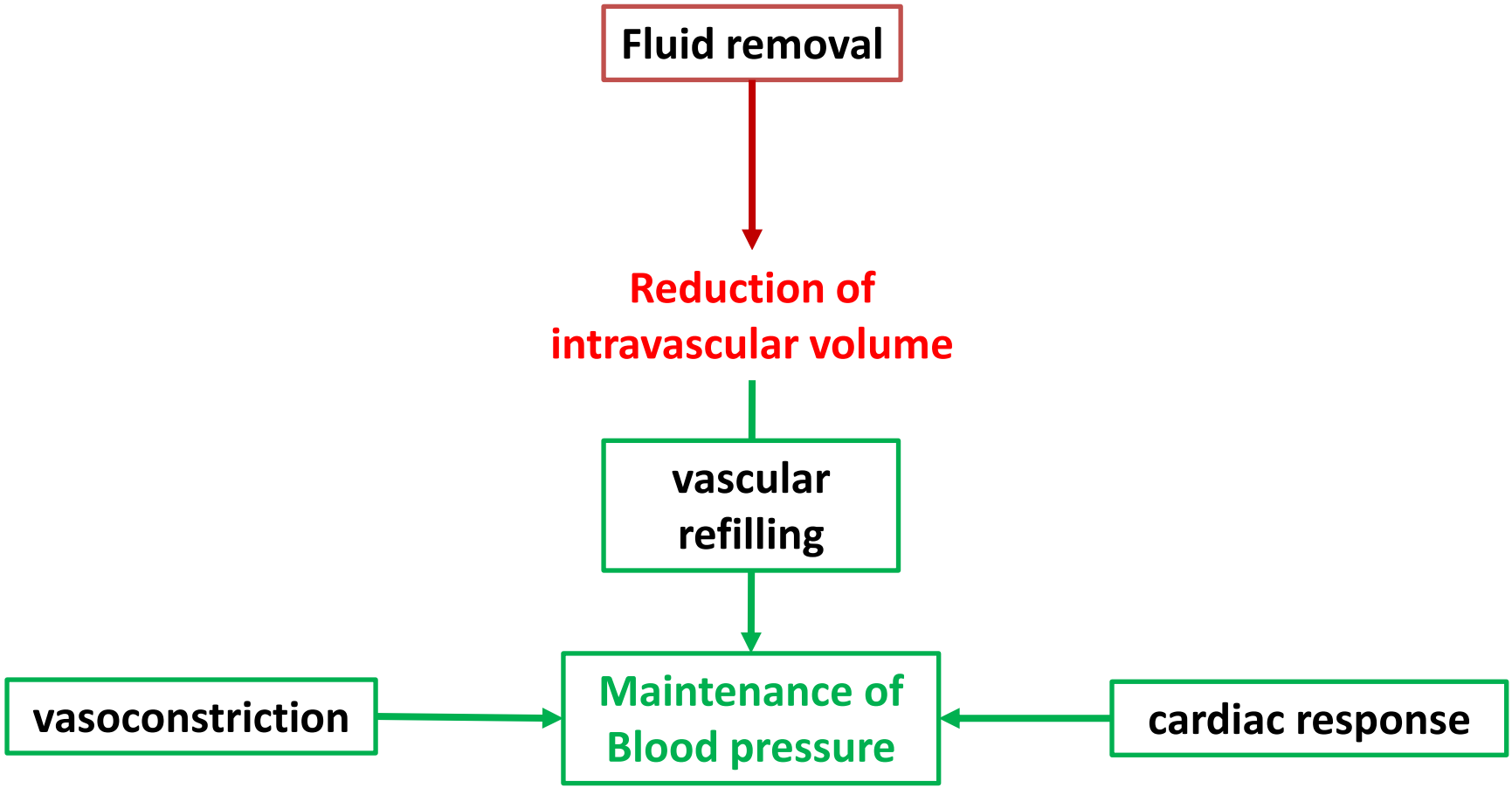
lightheaded,
nausea

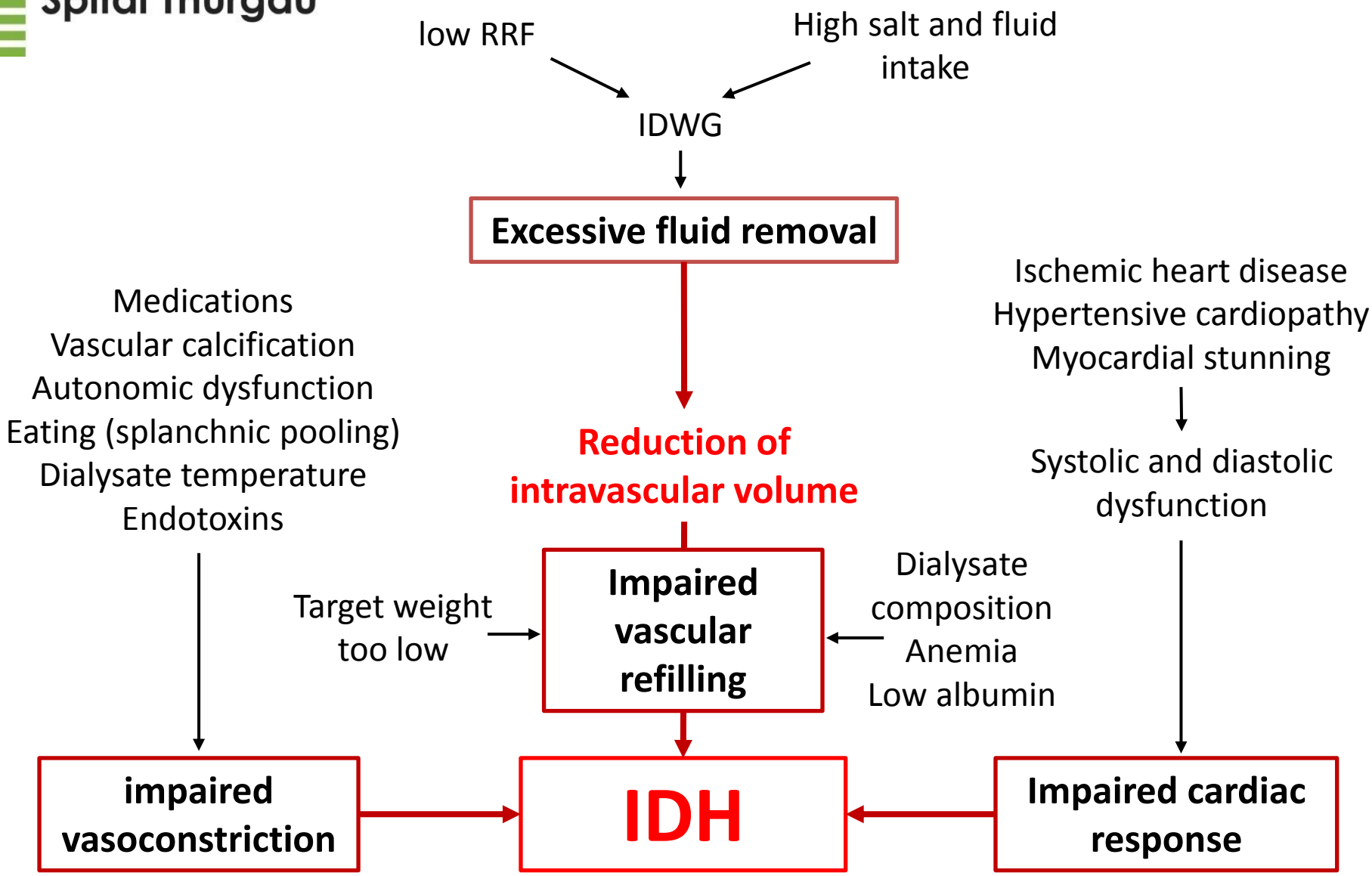
Why bother about IDH?

- ☐ Because of the annoying alarms
- ☐ Because it causes dyscomfort to the patient
- ☐ Because the nurse asks me to change the prescription
- ☐ Because it negatively affects dialysis efficacy
- ☐ All of the above
- ☑ All of the above ***plus...***

...because of the consequences of IDH

Pathophysiology

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IDWG
Excessive fluid removal
Medications
Vascular calcification
Autonomic dysfunction
Eating (splanchnic pooling)
Dialysate temperature
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Reduction of intravascular volume
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Myocardial stunning
Systolic and diastolic dysfunction
Target weight too low
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Anemia
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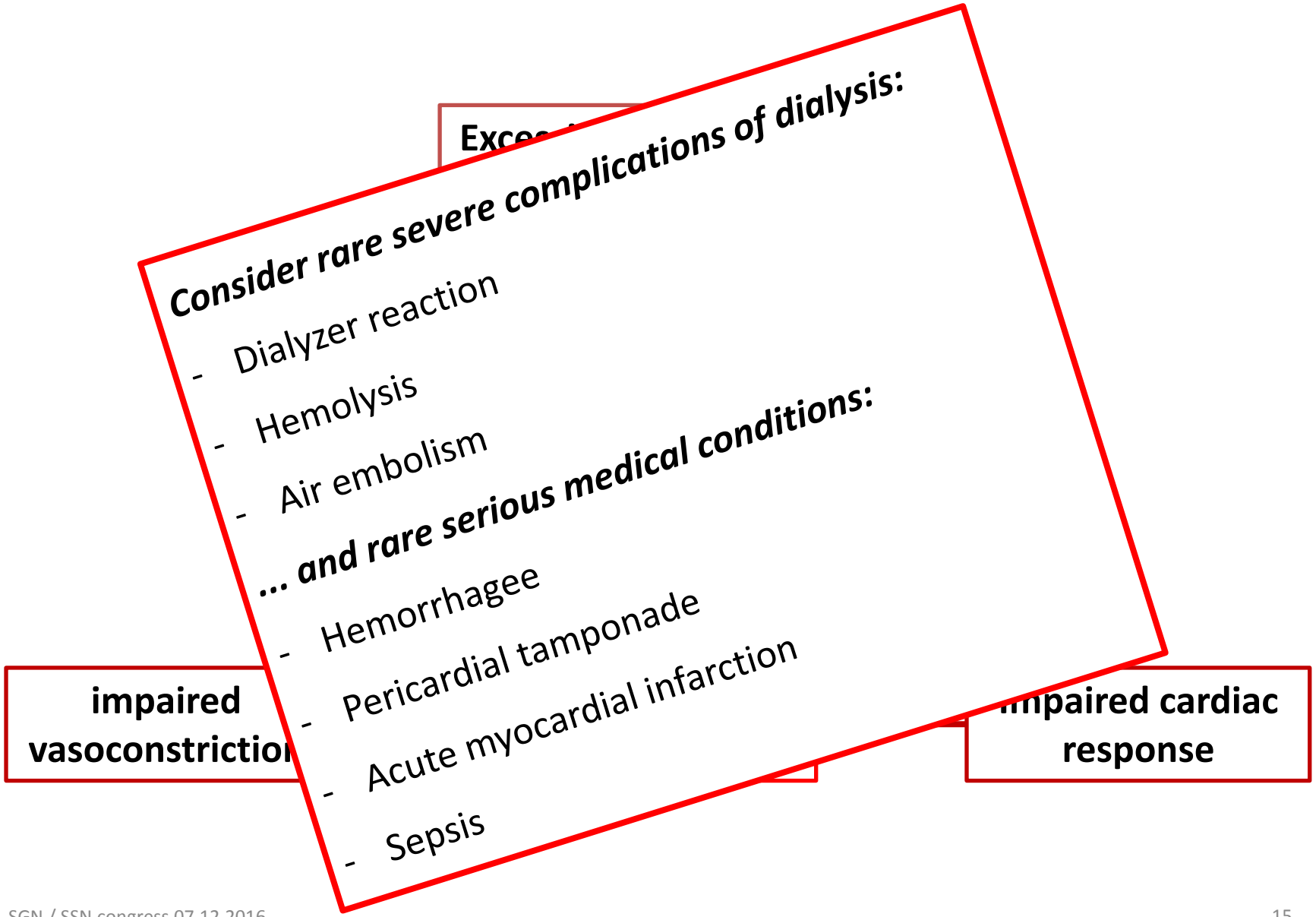
IDH
Impaired cardiac response

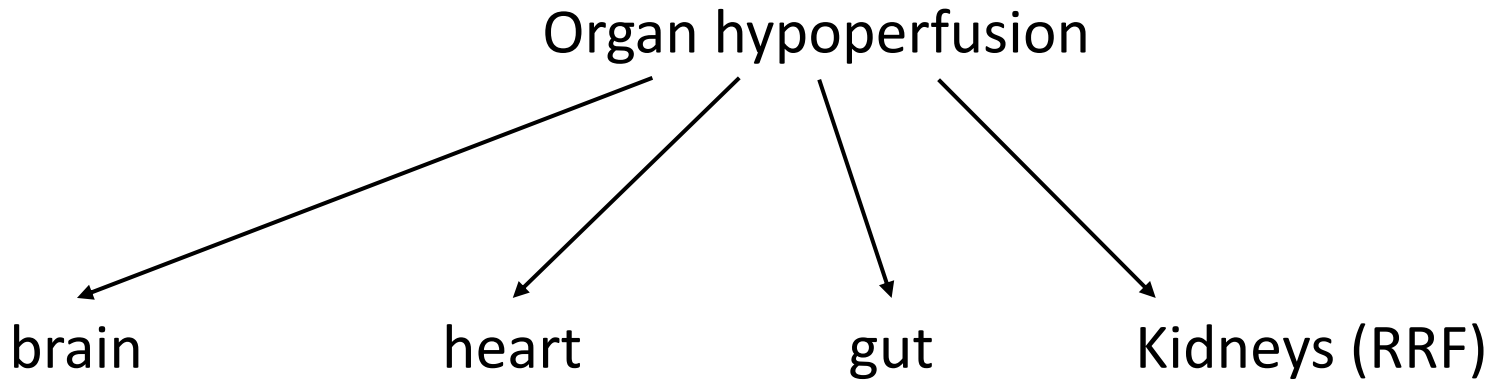

Exce
impaired vasoconstrictio
impaired cardiac response
Consider rare severe complications of dialysis:
- Dialyzer reaction
- Hemolysis
- Air embolism
... and rare serious medical conditions:
- Hemorrhagee
- Pericardial tamponade
- Acute myocardial infarction
- Sepsis

Consequences of IDH

Mortality

Access thrombosis

Inadequate dialysis



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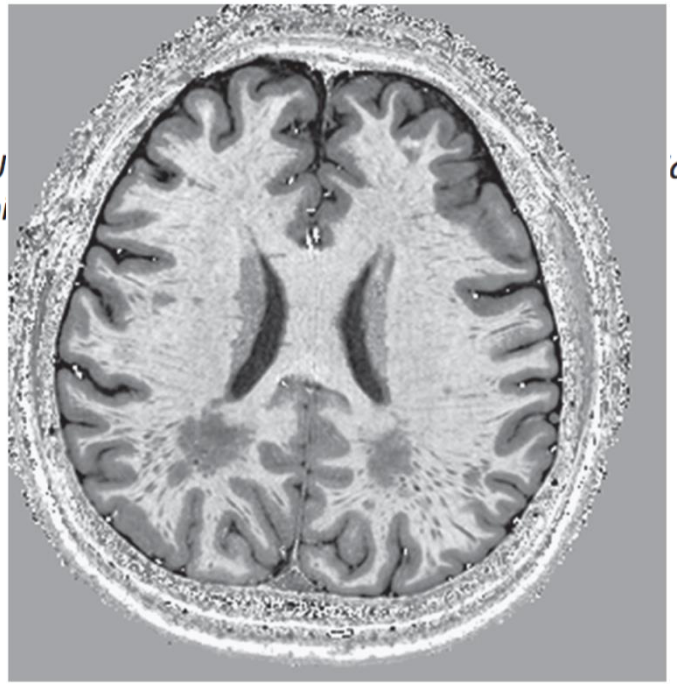
Consequences of IDH: brain

http://www.kidney-international.org review

Ischemic brain injury in hemodialysis patients: which is more dangerous, hypertension or intradialytic hypotension?

Christopher W. McIntyre[1] and David J. Goldsmith[2]

[1]Division of Nephrology, Schulich School of Medicine and Dentistry, U anada and
[2]Guy's and St. Thomas' NHS Foundation Trust, King's College Academi



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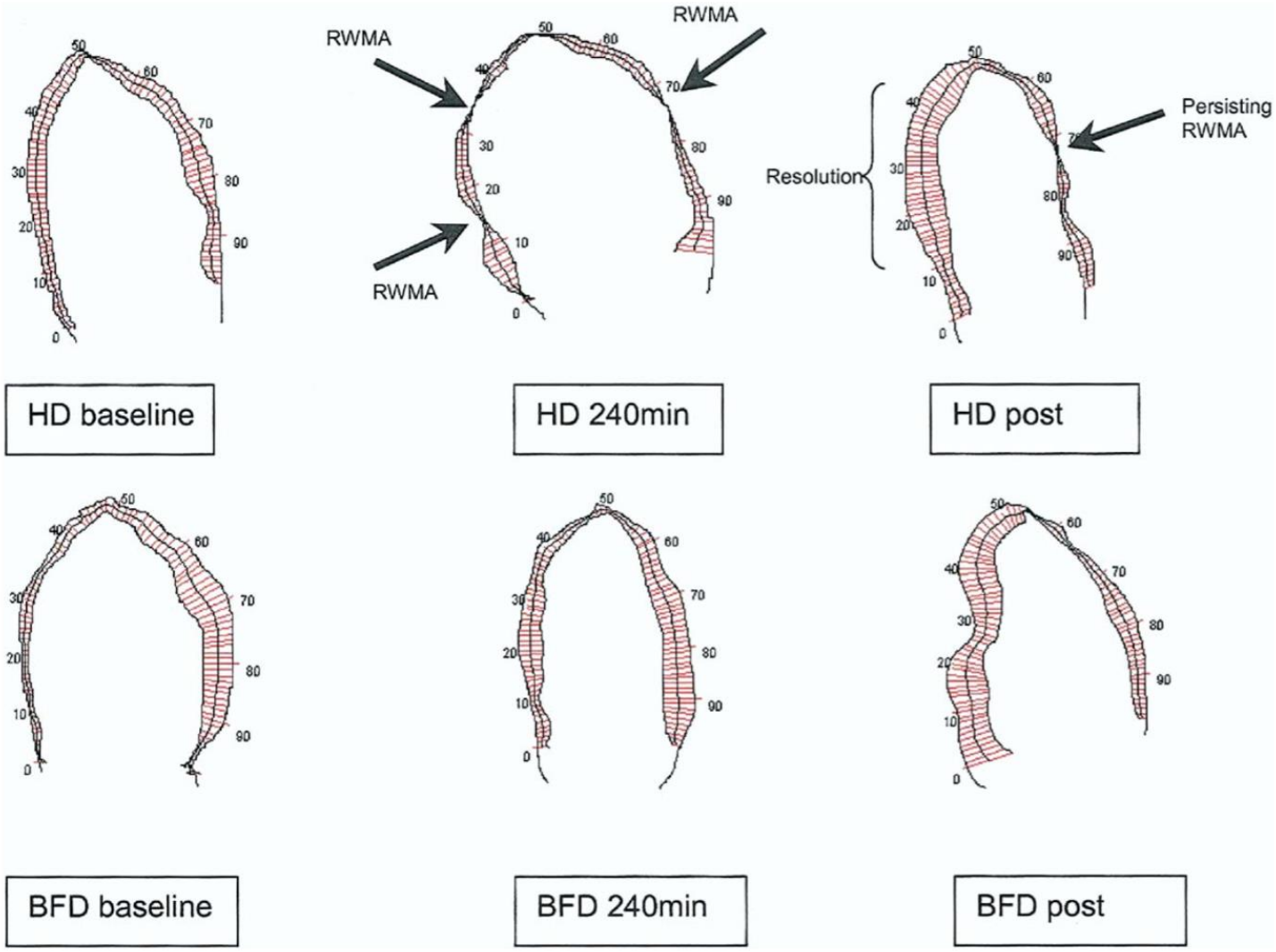
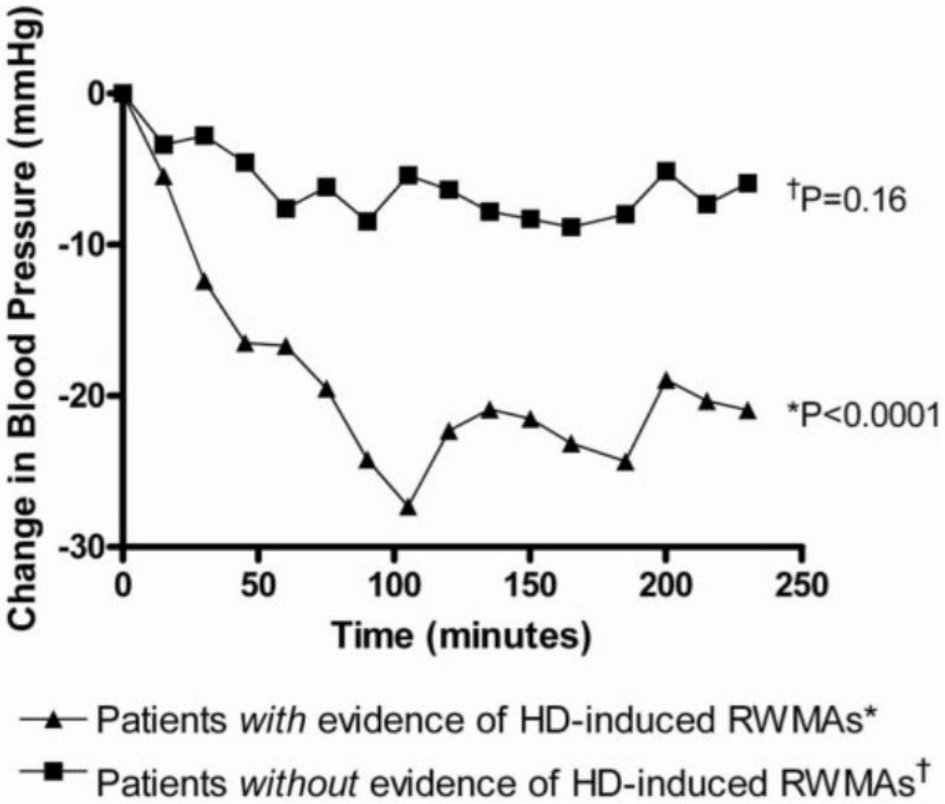
Consequences of IDH: heart



American Journal of Kidney Diseases, Vol 47, No 5 (May), 2006: pp 830-841

Consequences of IDH: heart



Clin J Am Soc Nephrol 4: 914–920, 2009.

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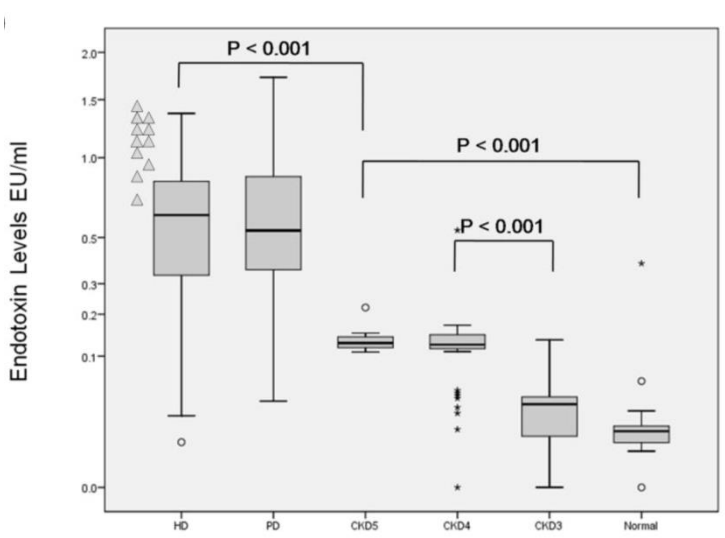
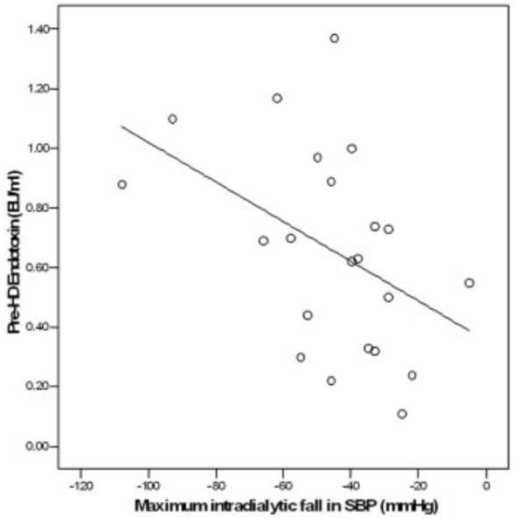
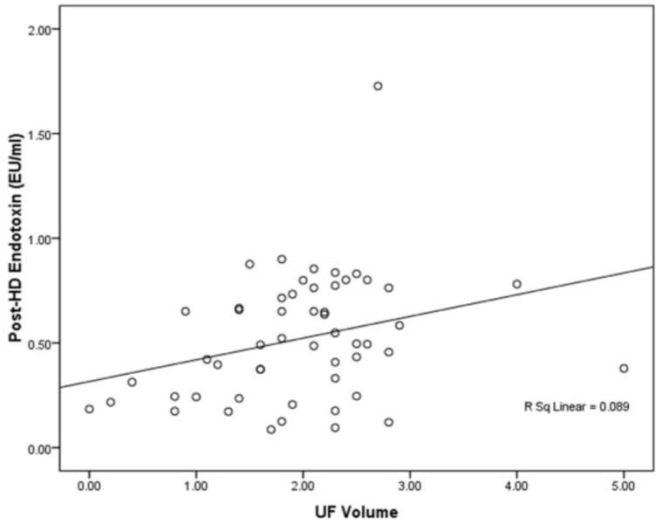
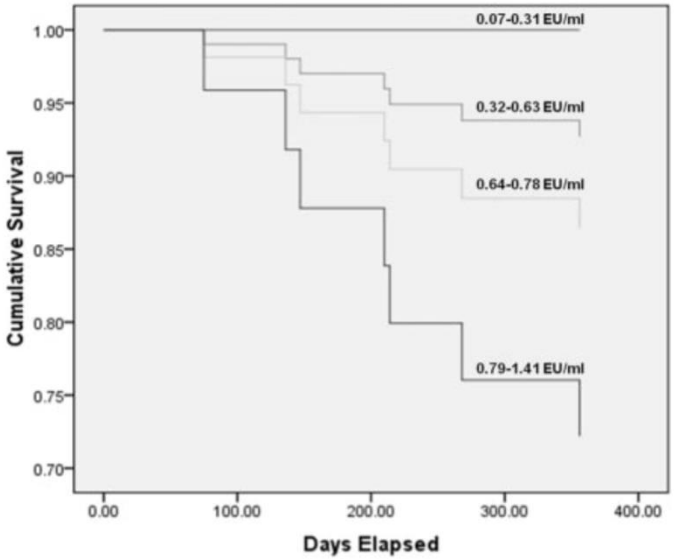
Gut and beyond: endotoxinemia

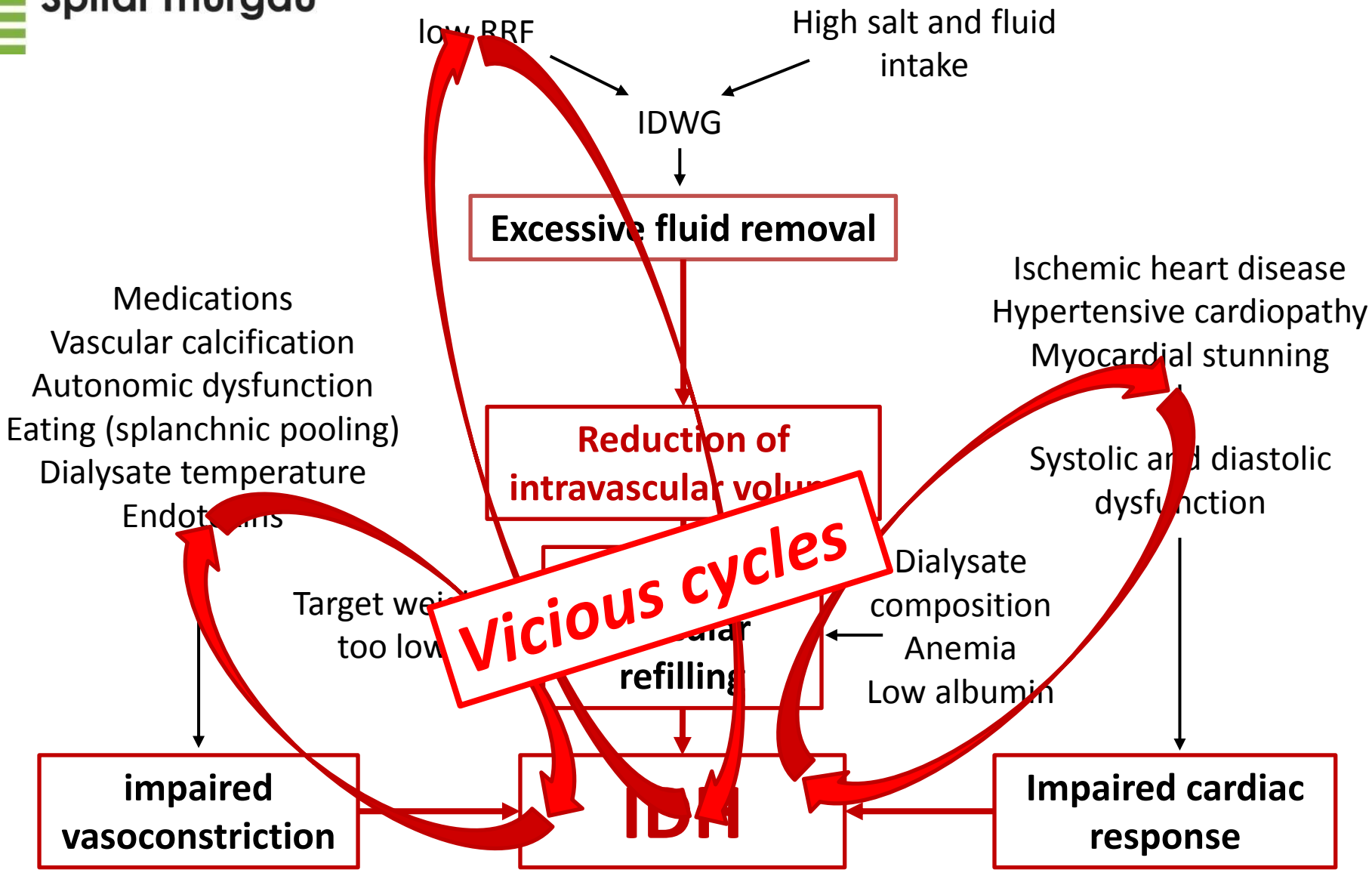








Clin J Am Soc Nephrol 6: 133–141, 2011.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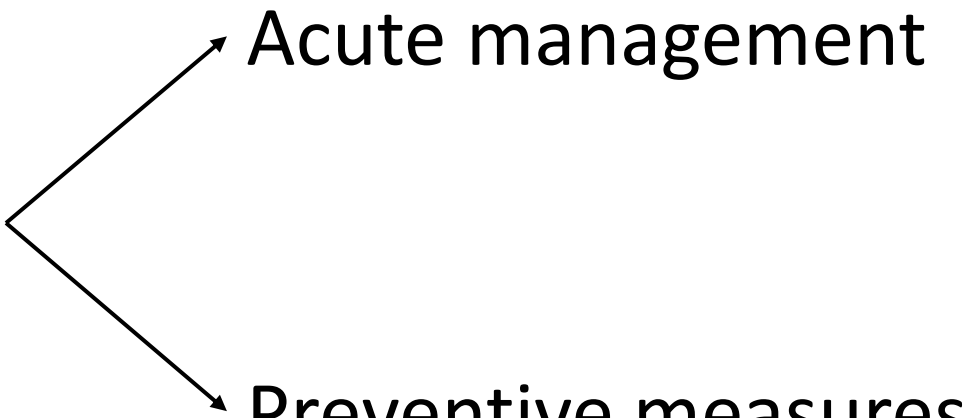
How to deal with IDH?



Mr. Ivo Dieter Höfler (I.D.H.)

Before calling you, the nurse reacted to the hypotensive episode by:

- ☐ Stopping ultrafiltration
- ☐ Placing the patient in Trendelenburg position
- ☐ Slowig blood flow rate to 100ml/min
- ☐ Infusing a bolus of 250ml substituate

Did she react correclty?

Mr. Ivo Dieter Höfler (I.D.H.)

Before calling you, the nurse reacted to the hypotensive episode by:

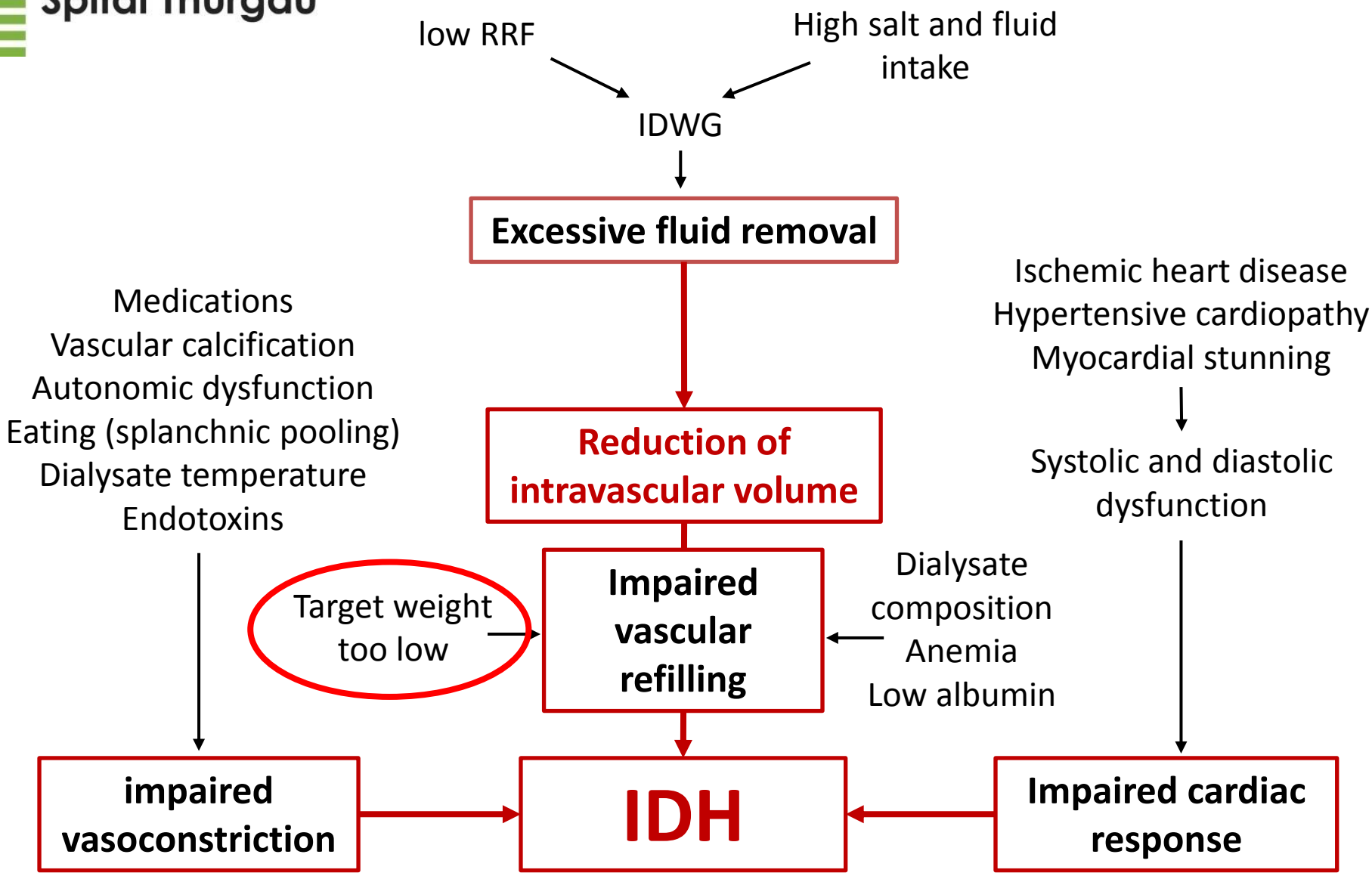
- [x] Stopping ultrafiltration
- [x] Placing the patient in Trendelenburg position
- [x] Slowig blood flow rate to 100ml/min
- [x] Infusing a bolus of 250ml substituate
- [ ] Oxygen!

Why is blood flow often lowered with IDH?

- Misconception that access flow depends on dialyzer blood flow
- In parallel plate dialyzers, extracorporeal blood volume depended on blood flow
- BF reduction lowered TMP and hence UF rate in the era before UF control was standard
- BF reduction reduced acetate delivery to the patient in the era of acetate buffering
- With cuprophane membranes, slowing BF reduced contact to the bio-incompatible, complement activating membrane
- When higher dialysate temperatures and lower dialysate Na were standart, a reduction of BF lowered temperature and increased Na of blood returning to the patient

What actions will you take at this point?

- [ ] You raise the dialysis Na concentration in the prescription
- [ ] You raise the target weight by 1 kg
- [ ] You raise the target weight if there is no edema
- [ ] You adjust dry weight depending of BCM results
- [ ] You tell the patient to drink less
- [ ] You limit the ultrafiltration rate to 10ml/h/kg
- [ ] You stop antihypertensives before dialysis
- [ ] You prescribe Midodrine (Gutron) 10 drops before dialysis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Impaired cardiac response

Dry weight

"the lowest tolerated postdialysis weight achieved via gradual change in postdialysis weight at which there are minimal signs or symptoms of hypovolemia or hypervolemia"

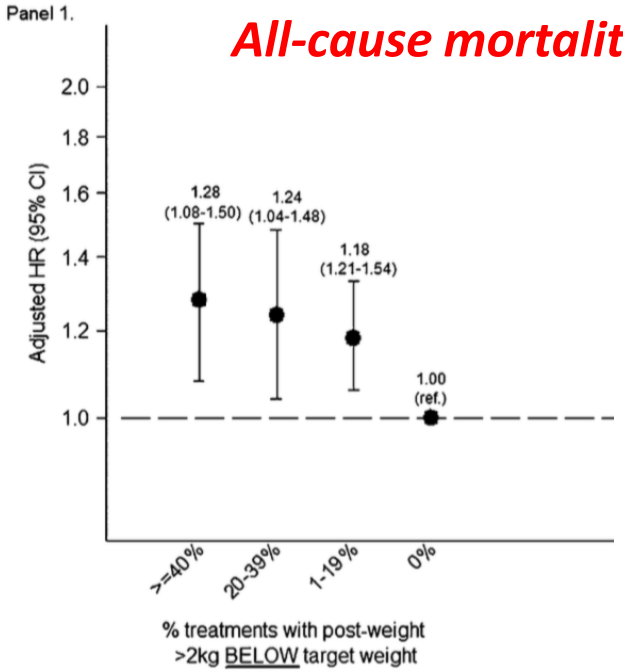
Agarwal and Singh

Associations of Posthemodialysis Weights above and below Target Weight with All-Cause and Cardiovascular Mortality

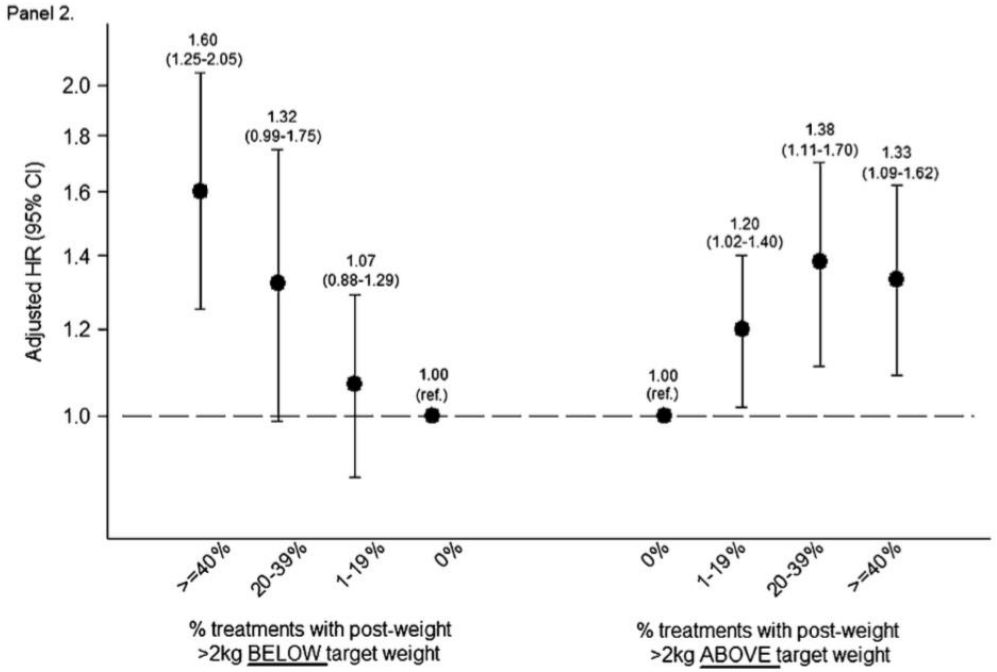
Jennifer E. Flythe,[†] Abhijit V. Kshirsagar,* Ronald J. Falk,* and Steven M. Brunelli*[†‡]

Clin J Am Soc Nephrol 10: 808–816, May, 2015

All-cause mortality



Cardiovascular mortality



How to assess dry weight?

→Clinical assessment

The Agreement between Auscultation and Lung Ultrasound in Hemodialysis Patients: The LUST Study

Claudia Torino, Luna Gargani, Rosa Sicari, Krzysztof Letachowicz, Robert Ekart, Danilo Fliser, Adrian Covic, Kostas Siamopoulos, Aristeidis Stavroulopoulos, Ziad A. Massy, Enrico Fiaccadori, Alberto Caiazza, Thomas Bachelet, Itzchak Slotki, Alberto Martinez-Castelao, Marie-Jeanne Coudert-Krier, Patrick Rossignol, Faikah Gueler, Thierry Hannedouche, Vincenzo Panichi, Andrzej Wiecek, Giuseppe Pontoriero, Pantelis Sarafidis, Marian Klinger, Radovan Hojs, Sarah Seiler-Mussler, Fabio Lizzi, Dimitrie Siriopol, Olga Balafa, Linda Shavit, Rocco Tripepi, Francesca Mallamaci, Giovanni Tripepi, Eugenio Picano, Gérard Michel London, and Carmine Zoccali

Table 3. Agreement (weighted-κ [95% confidence interval]) between ultrasound B lines and pulmonary crackles, peripheral edema, and a combination thereof considering the individual average number of ultrasound B lines in the 79 patients and the simultaneous average grading of crackles and peripheral edema or the whole series of measurements considered one by one (n=1106)

Clinical Signs	Individual Average US-B Lines Values, n=79 Patients	Whole Series of US-B Lines, n=1106
Pulmonary crackles	0.10 (0.01 to 0.20)	0.16 (1.13 to 1.20)
Peripheral edema	−0.01 (−0.11 to 0.09)	0.02 (−0.01 to 0.04)
Crackles/edema	−0.00 (−0.02 to 0.01)	0.07 (0.05 to 0.09)

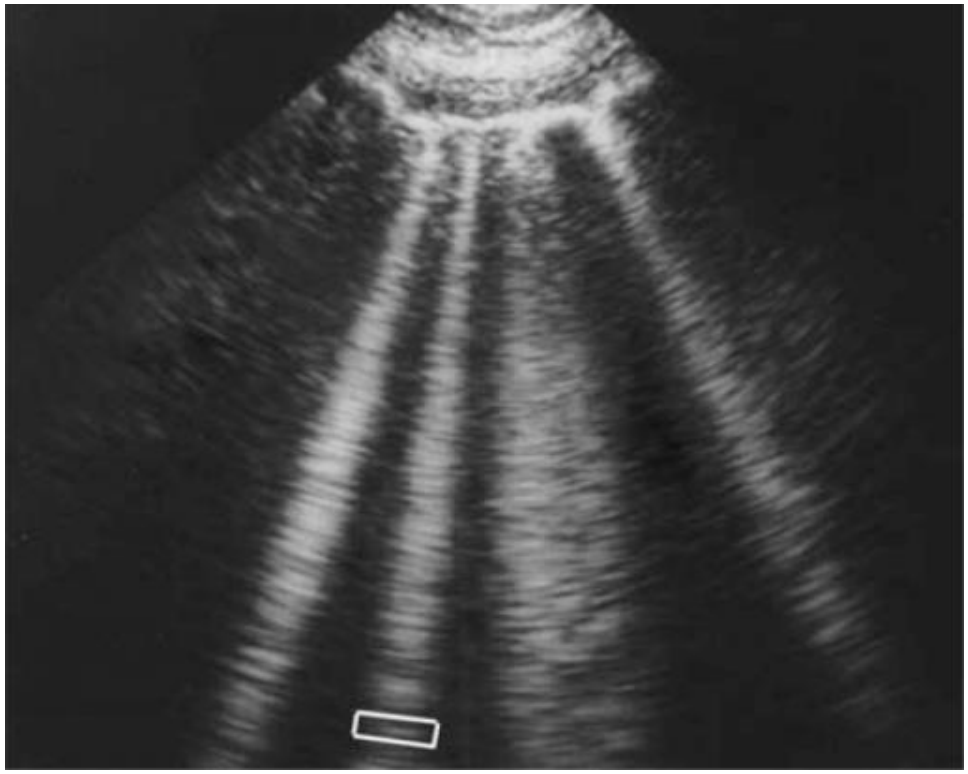
US-B, ultrasound B.

Clin J Am Soc Nephrol 11: 2005–2011, 2016.

How to assess dry weight?

→Clinical assessment

→Lung ultrasound



How to assess dry weight?

→Clinical assessment

→Lung ultrasound

→Chest X-ray

How to assess dry weight?

→Clinical assessment

→Lung ultrasound

→Chest X-ray

→Inferior vena cava ultrasound

How to assess dry weight?

→Clinical assessment

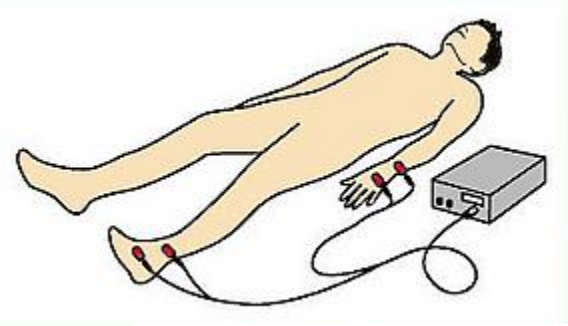
→Lung ultrasound

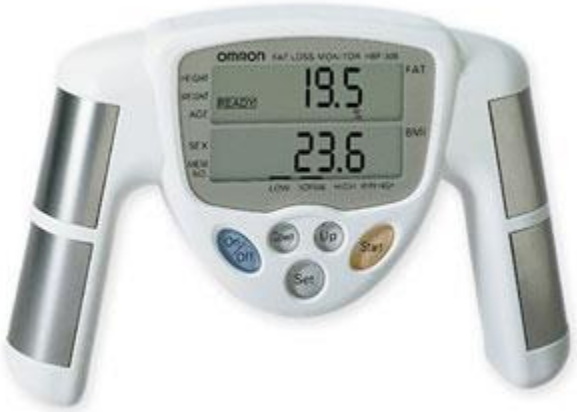
→Chest X-ray

→Inferior vena cava ultrasound

→Bioimpedance

Bioimpedance





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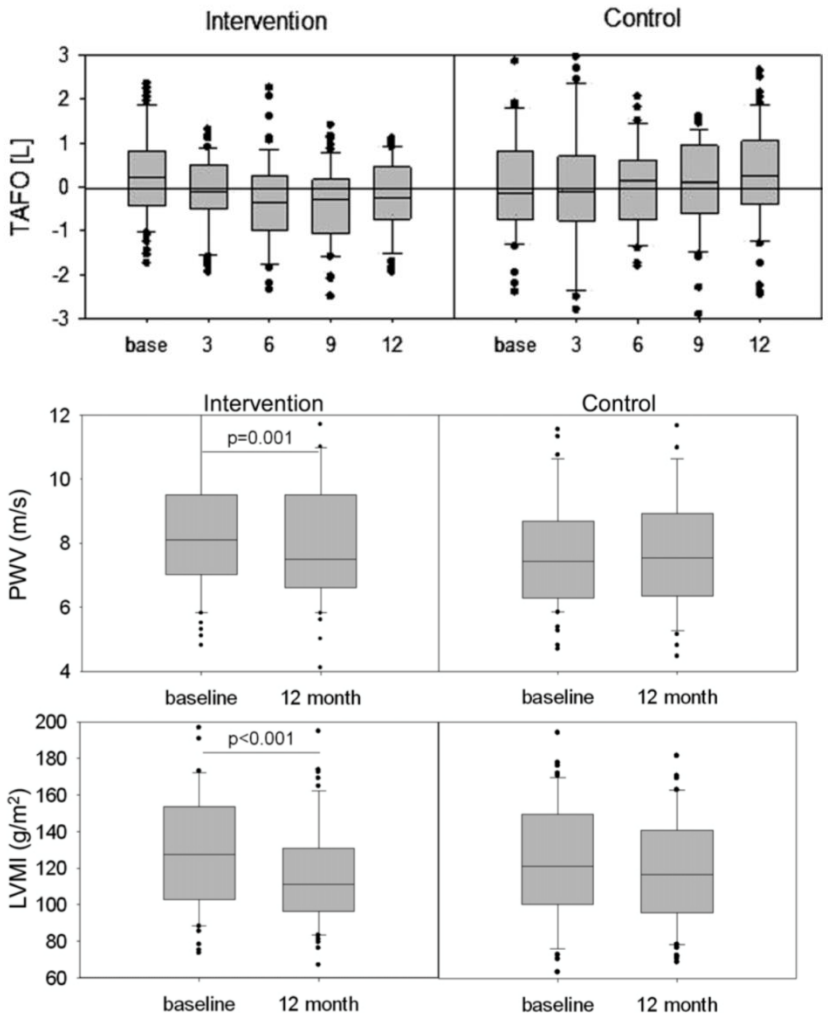
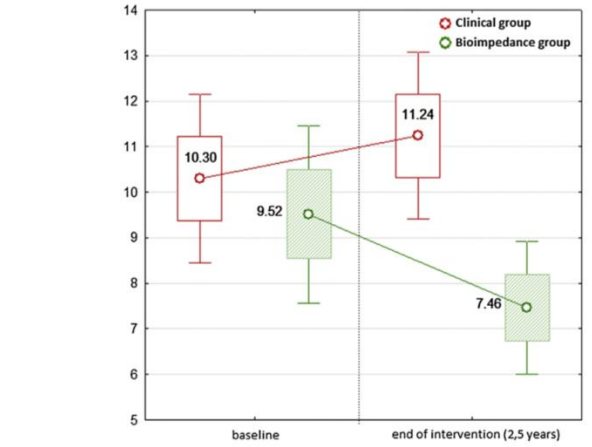
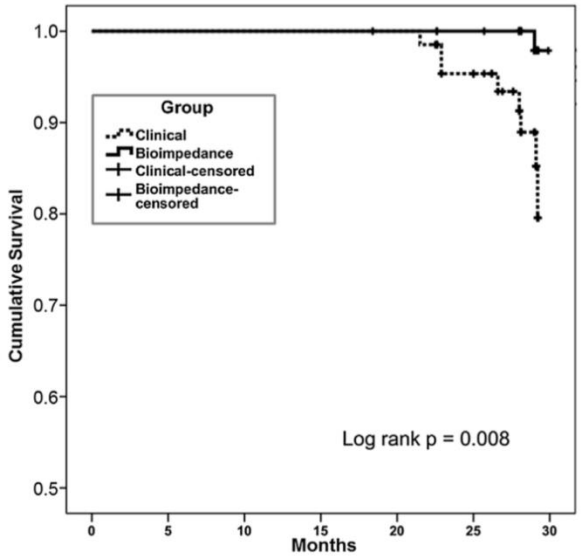
BCM-guided treatment and outcomes

Am J Kidney Dis. 2013;61(6):957-965



Am J Kidney Dis. 2014;64(1):111-118





How to assess dry weight?

→Clinical assessment

→Lung ultrasound

→Chest X-ray

→Inferior vena cava ultrasound

→Bioimpedance

→Online blood volume monitoring

Blood volume monitoring

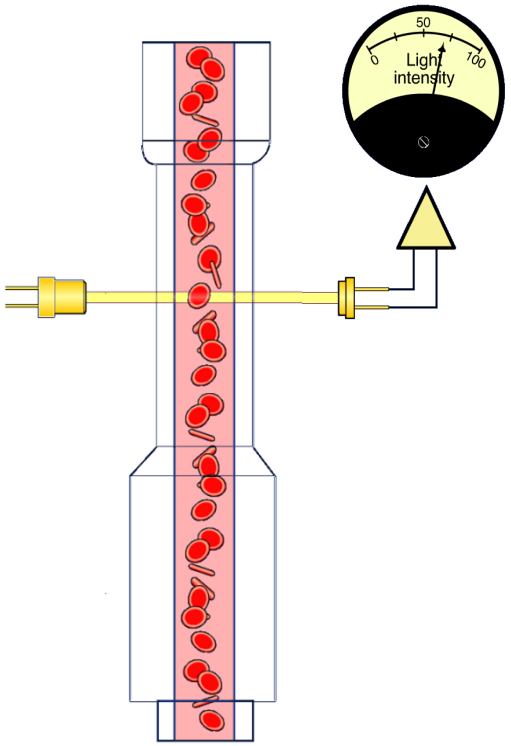


Table 3. RR for hospitalization (adjusted[a])

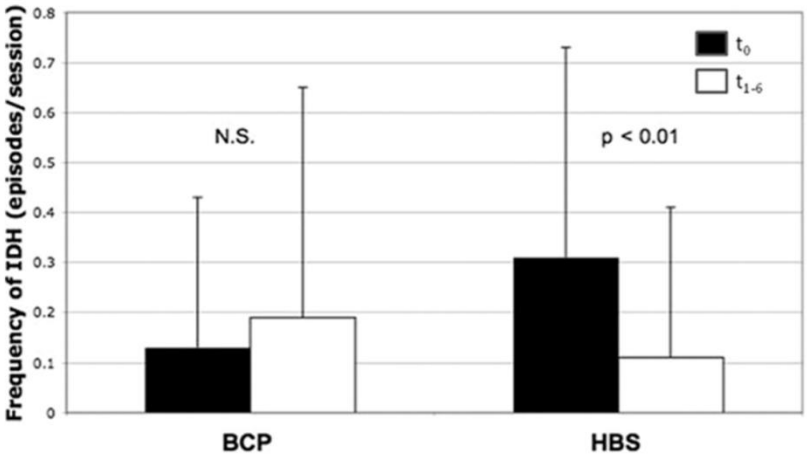
Hospitalization Type	RR		
	Estimate	95% CI	*P* Value
Non–access-related	1.61	1.15 to 2.25	0.01
cardiovascular	1.85	1.19 to 2.86	0.006
other	1.53	1.07 to 2.19	0.02
Access-related	1.52	1.02 to 2.28	0.04

Table 7. Comparison of mortality by treatment groups with US Renal Data System data

	Crit-Line Group	Usual Care Group
Patients	227	216
Deaths		
observed	19	7
expected	24.7	26.8
Deaths/100 patient-years at risk		
observed	17.4	6.4
expected	22.6	24.6
Standardized mortality ratio	0.77	0.26
χ^2	1.3	14.6
P value	NS	<0.001

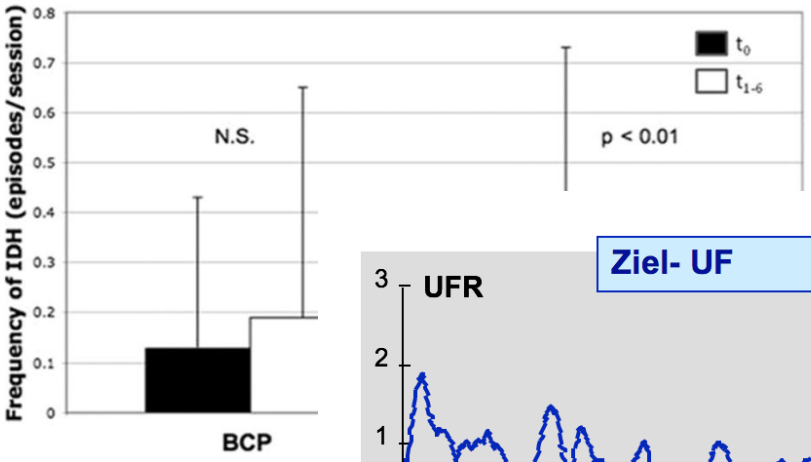
J Am Soc Nephrol 16: 2162–2169, 2005.

Blood volume monitoring

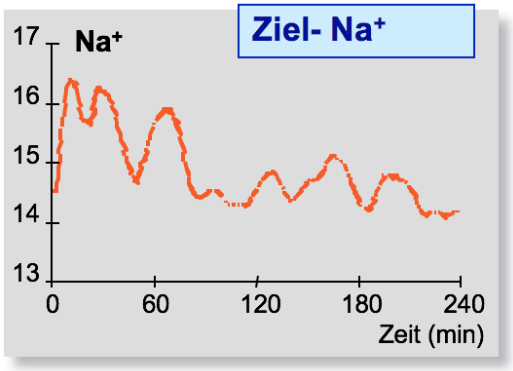


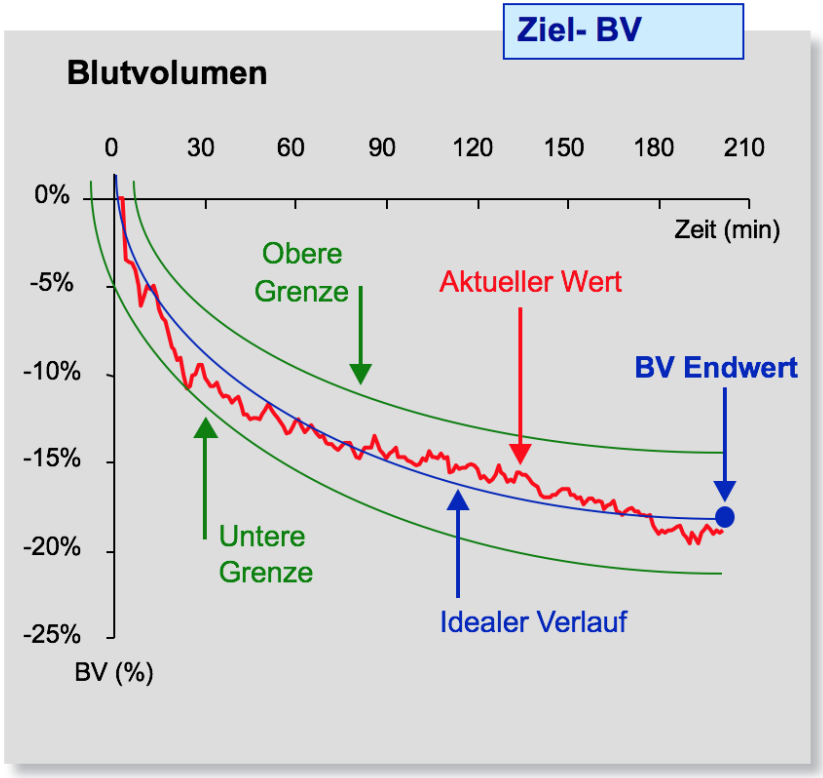
Nesrallah, ASAIO Journal 2008; 54:270–274.

Blood volume monitoring

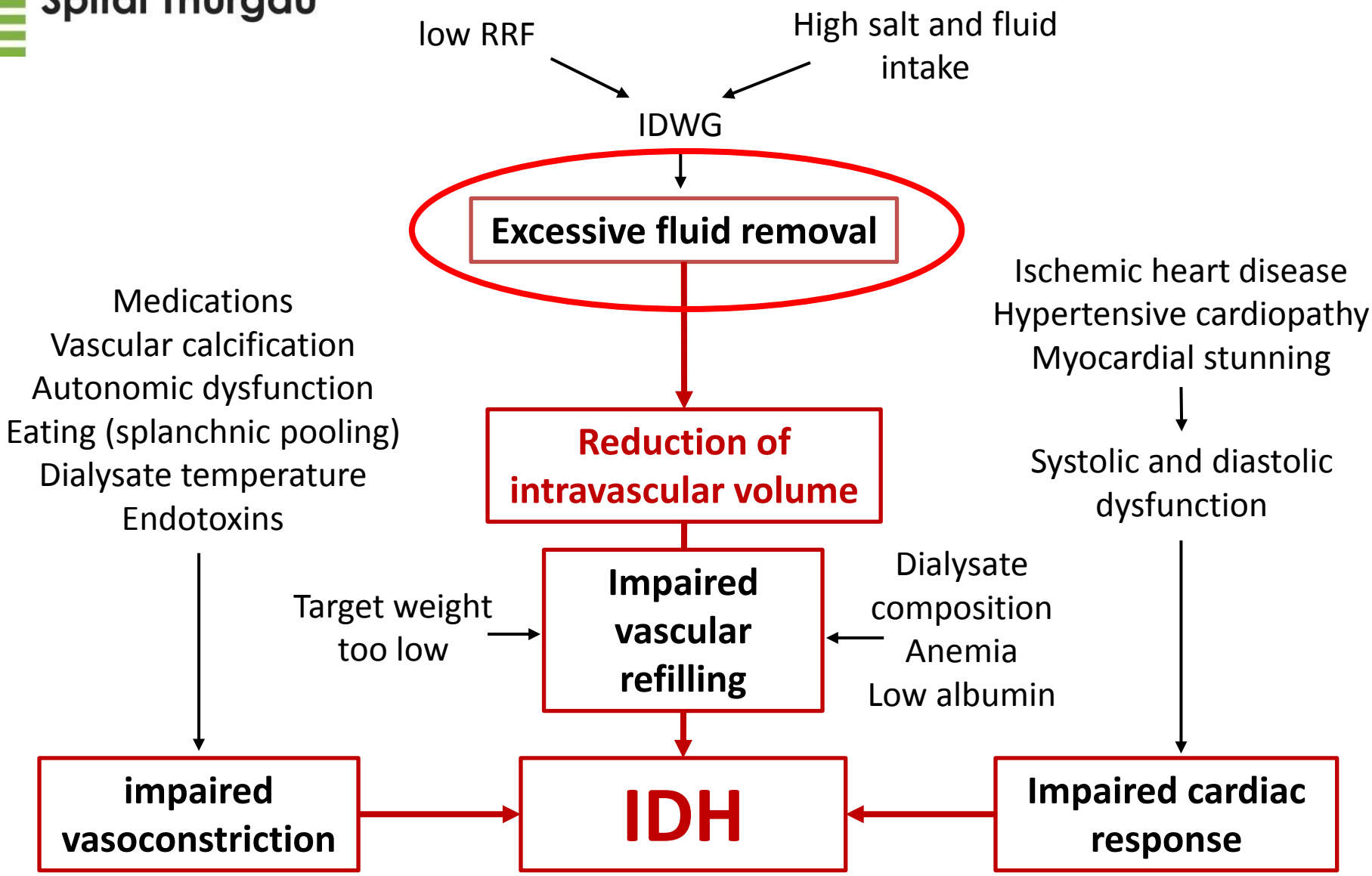


Nesrallah, ASAIC





Assessment of dry weight will usually rely on a combination of clinical assessment, history taking, technical tools as available and some trial and error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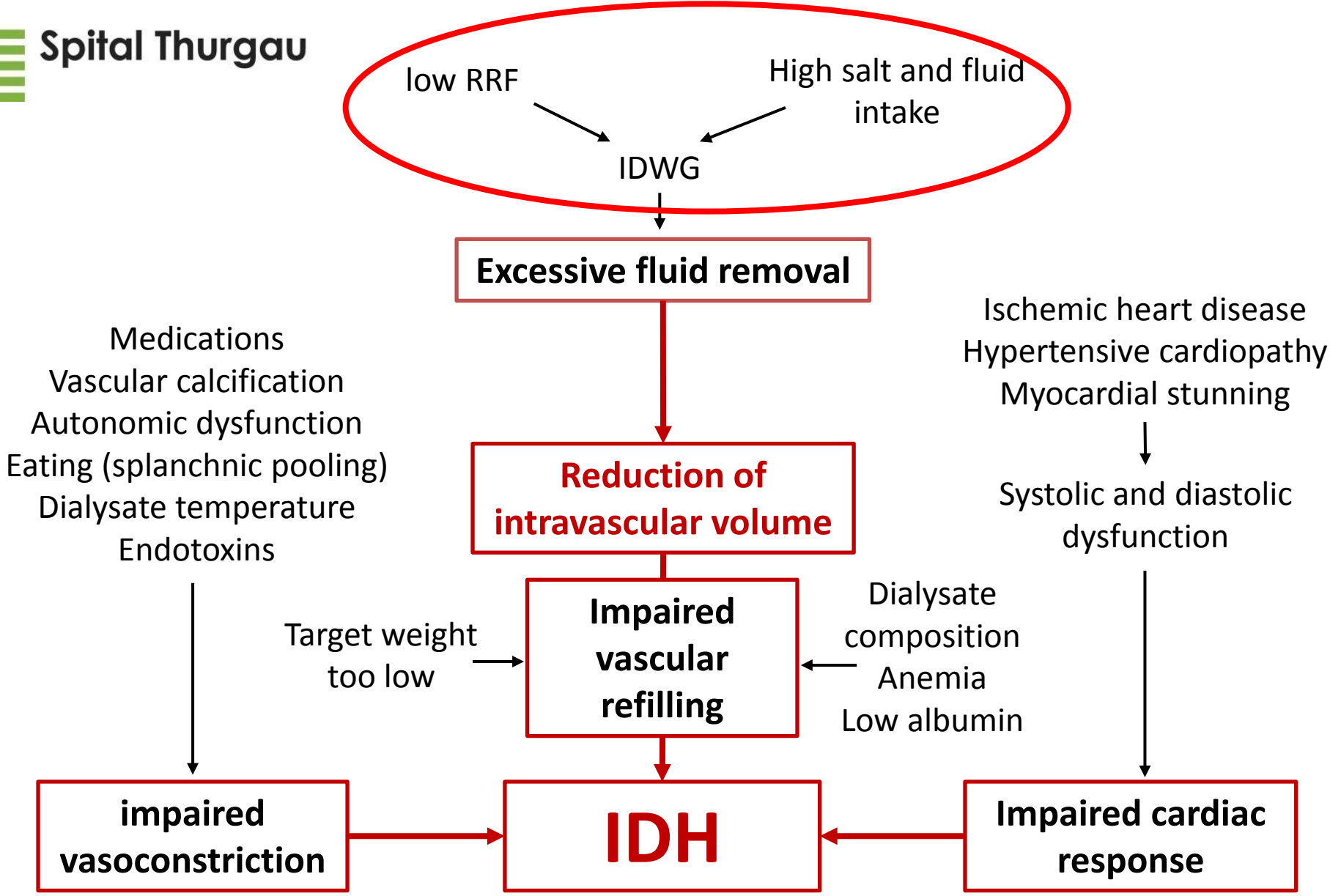
IDH
Impaired cardiac response


low RRF
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IDWG
Excessive fluid removal
Medications
Vascular calcification
Autonomic dysfunction
Eating (splanchnic pooling)
Dialysate temperature
Endotoxins
Ischemic heart disease
Hypertensive cardiopathy
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Systolic and diastolic dysfunction
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Target weight too low
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Anemia
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IDH
Impaired cardiac response

Seminars in Dialysis

Are Diuretics Underutilized in Dialysis Patients?

Emilie Trinh and Joanne M. Bargman
Division of Nephrology, University Health Network, Toronto, Ontario, Canada

ABSTRACT

While oral diuretics are commonly used in patients with chronic kidney disease for the management of volume and blood pressure, they are often discontinued upon initiation of dialysis. We suggest that diuretics are considerably underutilized in peritoneal dialysis and haemodialysis patients despite numerous potential benefits and few side effects. Moreover, when diuretics are used, optimal doses are not always prescribed. In peritoneal dialysis, the use of diuretics can improve volume status and minimize the need for higher glucose-containing solutions. In patients on haemodialysis, diuretics can help lessen interdialytic weight gain, resulting in decreased ultrafiltration rates and fewer episodes of intradialytic hypotension. This paper will review the mechanism of action of diuretics in patients with renal insufficiency, quantify the risk of side effects and elaborate on the potential advantages of diuretic use in peritoneal dialysis and hemodialysis patients with residual kidney function.

200ml x 3 = 600ml

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While oral diuretics are commonly used in patients with chronic kidney disease for the management of volume and blood pressure, they are often discontinued upon initiation of dialysis. We suggest that diuretics are considerably underutilized in peritoneal dialysis and haemodialysis patients despite numerous potential benefits and few side effects. Moreover, when diuretics are used, optimal doses are not always prescribed. In peritoneal dialysis, the use of diuretics can improve volume status and minimize the need for higher glucose-containing solutions. In patients on haemodialysis, diuretics can help lessen interdialytic weight gain, resulting in decreased ultrafiltration rates and fewer episodes of intradialytic hypotension. This paper will review the mechanism of action of diuretics in patients with renal insufficiency, quantify the risk of side effects and elaborate on the potential advantages of diuretic use in peritoneal dialysis and hemodialysis patients with residual kidney function.

Nephrol Dial Transplant (2001) 16: 1538–1542

Advising dialysis patients to restrict fluid intake without restricting sodium intake is not based on evidence and is a waste of time

Charles R. V. Tomson

Department of Renal Medicine, Southmead Hospital, Bristol, UK

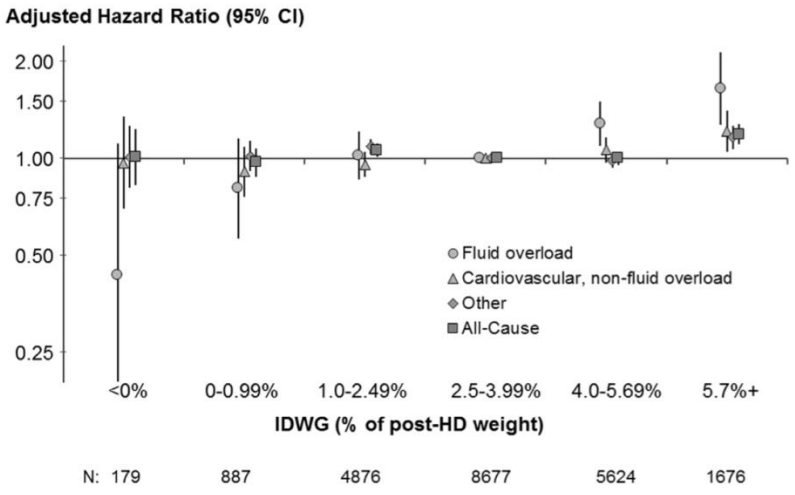
ARTICLE IN PRESS

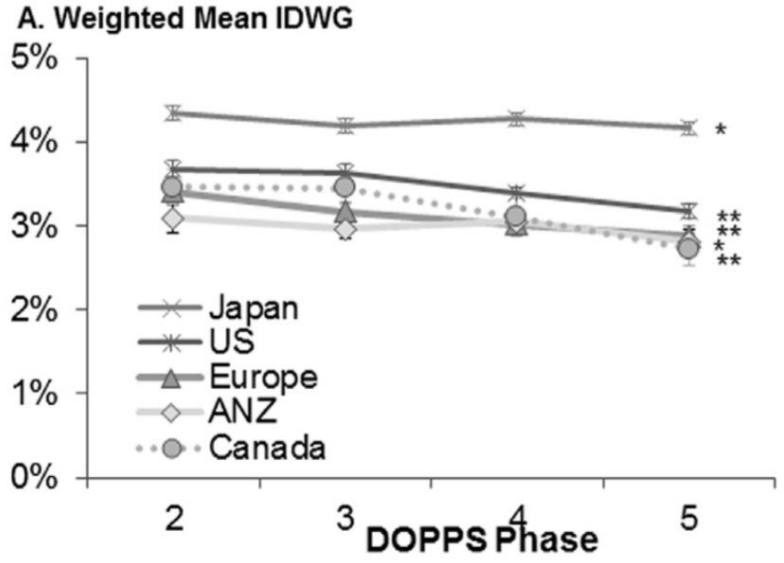
AJKD

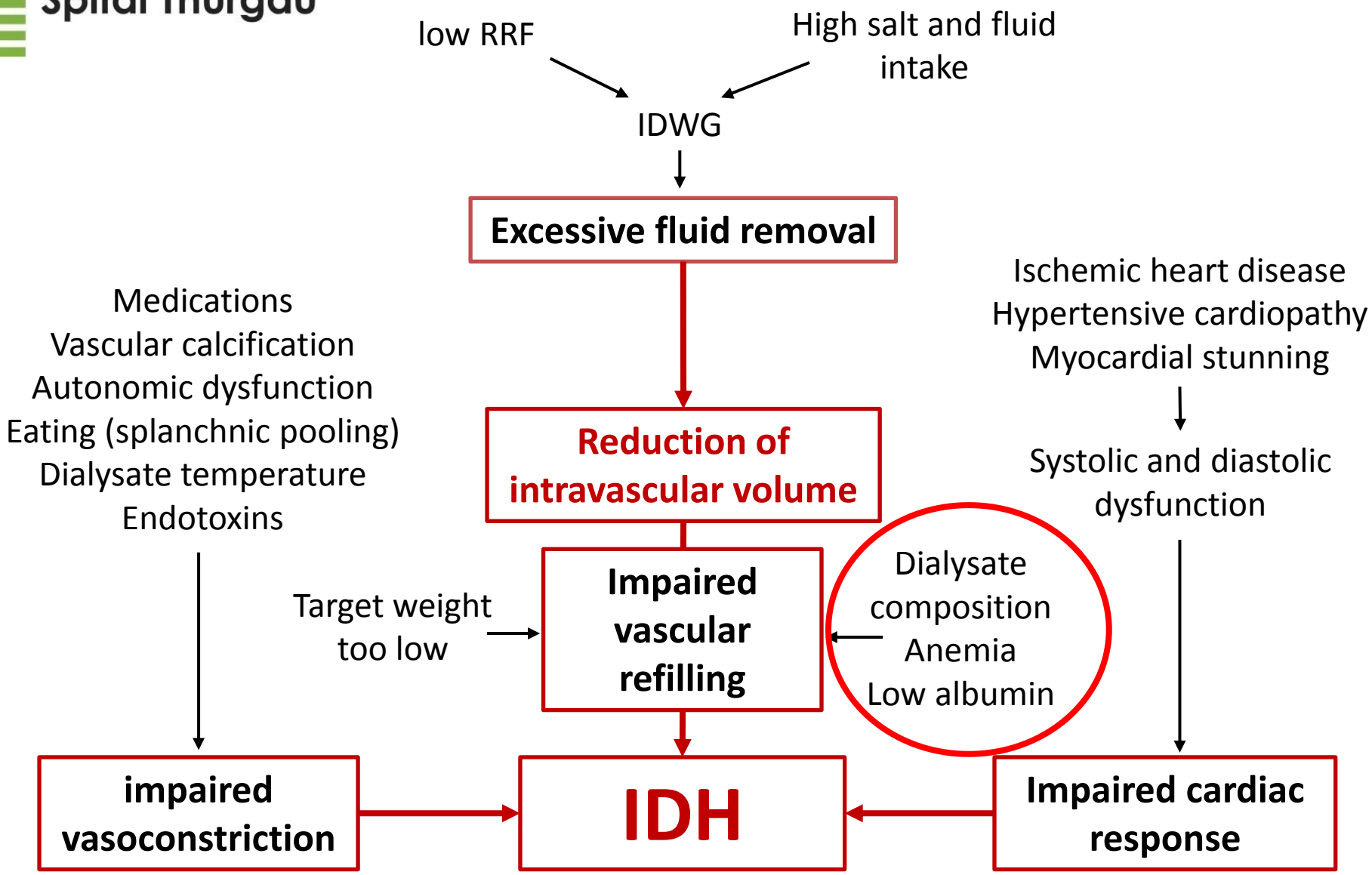
Original Investigation

Interdialytic Weight Gain: Trends, Predictors, and Associated Outcomes in the International Dialysis Outcomes and Practice Patterns Study (DOPPS)

Michelle M.Y. Wong, MD, MSc, FRCPC,[1,2] Keith P. McCullough, MS,[1] Brian A. Bieber, MPH, MS,[1] Juergen Bommer, MD,[3] Manfred Hecking, MD,[4] Nathan W. Levin, MD,[5] William M. McClellan, MD, MPH,[6,7] Ronald L. Pisoni, PhD, MS,[1] Rajiv Saran, MD, MRCP, MS,[8,9] Francesca Tentori, MD, MS,[1] Tadashi Tomo, MD,[10,11] Friedrich K. Port, MD, MS,[1,12] and Bruce M. Robinson, MD, MS[1,8]



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Impaired cardiac response

Dialysate composition

- (Acetate)
- Na^{+}
- Ca^{2+}
- Mg^{2+}

Dialysate composition

- (Acetate)
- Na^+
- Ca^{2+}
- Mg^{2+}

Acute effect:

- hemodynamic stability

Chronic effect:

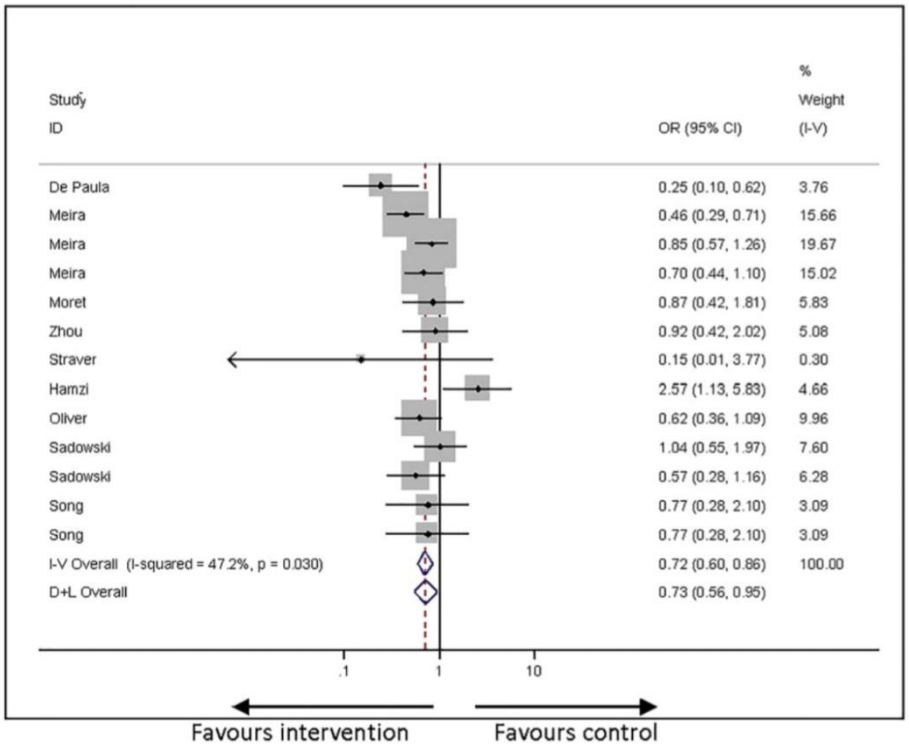
- Na loading
- Thirst
- Higher IDWG

Hemodialysis International 2016; **00**:00–00

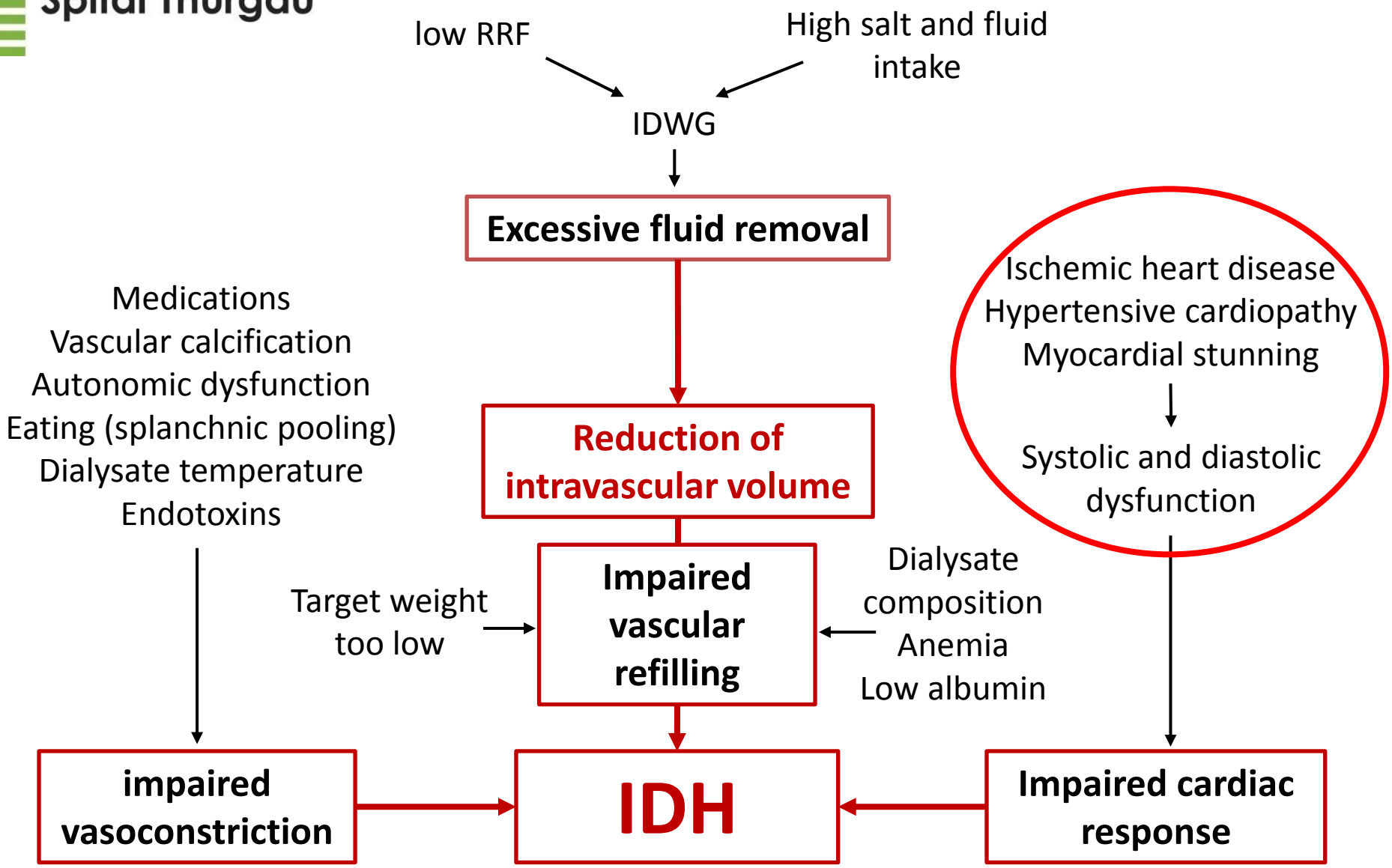
A meta-analysis of sodium profiling techniques and the impact on intradialytic hypotension

Nina DUNNE

University of Brighton, Brighton, UK



- *Endpoint: IDH*
- *Advantage only for stepwise profiling*
- *Considerable heterogeneity of studies*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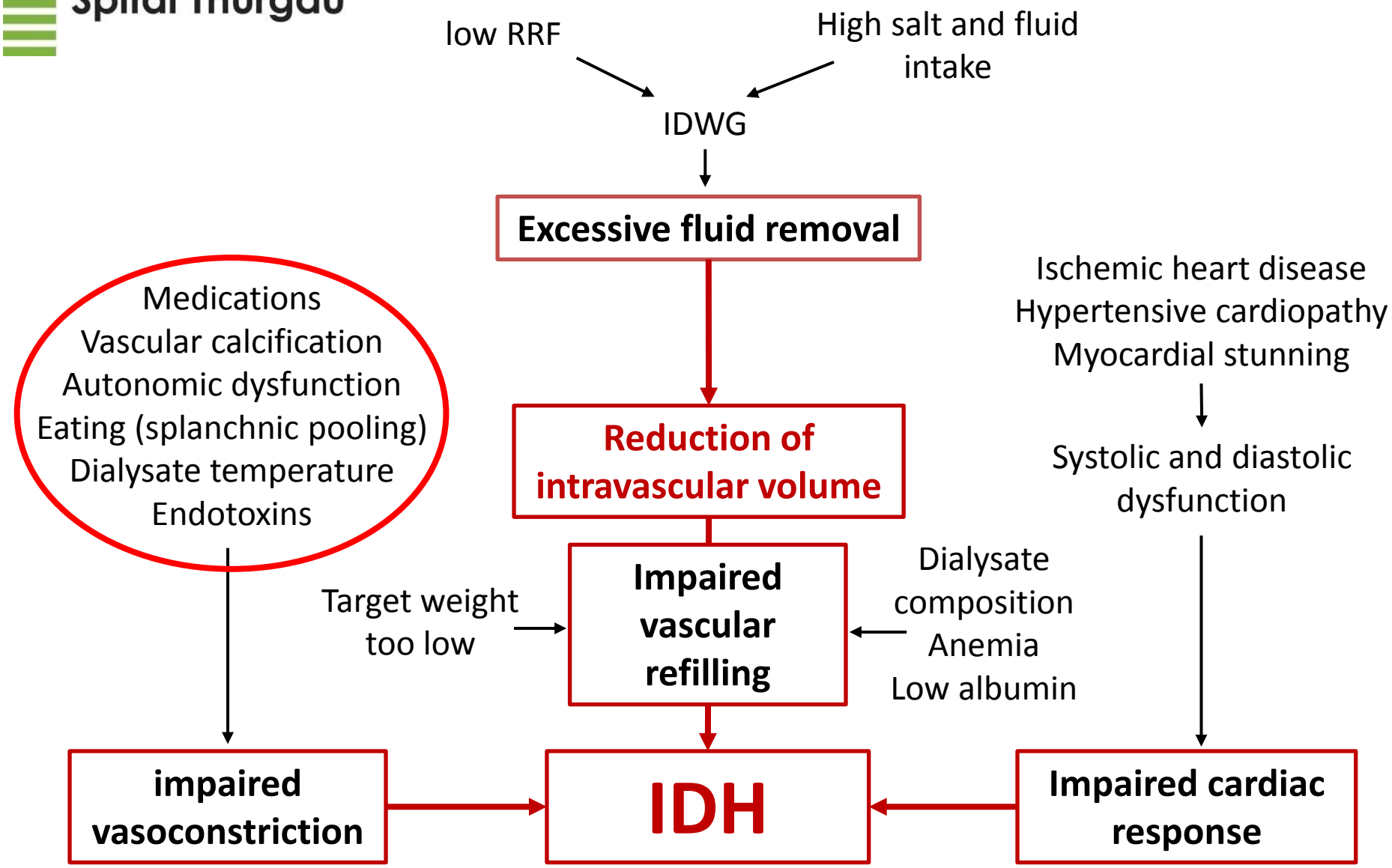
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Impaired cardiac response

Eating on HD

Am J Kidney Dis. 1988 Jul;12(1):37-9.

Postprandial blood pressure changes during hemodialysis.

Sherman RA[1], Torres F, Cody RP.

Author information

Abstract

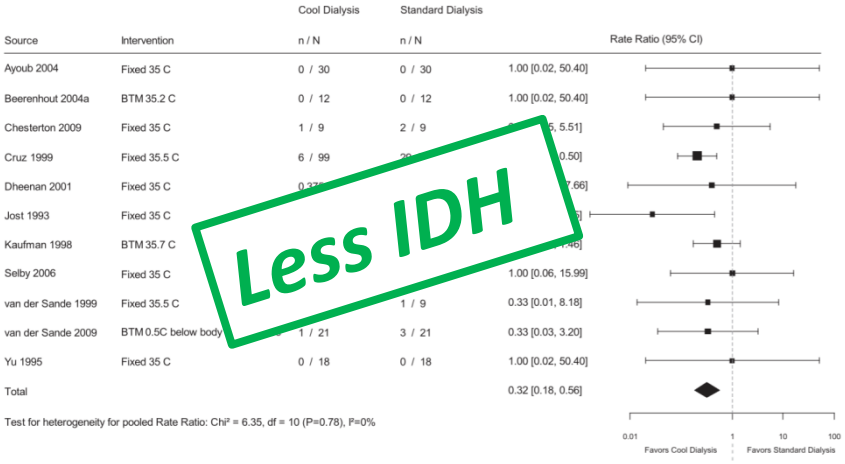
The effect of eating on BP during hemodialysis was examined in nine nondiabetic end-stage renal disease (ESRD) patients. A standard meal was given during 62 of 125 dialysis treatments in a prospectively controlled study. Diastolic (P = 0.01) and mean (P = 0.03) BPs fell significantly faster in the 45-minute postprandial period in the fed treatments compared with equivalent times in the fasting treatments. In this period, symptomatic hypotension occurred 13 times in five patients fed during dialysis compared with two episodes in one patient while fasting (P less than 0.05). Consumption of meals during hemodialysis should be avoided in patients at risk for hypotension during treatment.

Eating before or during HD should be discouraged in IHD prone patients...

... But consider the risk of malnutrition!

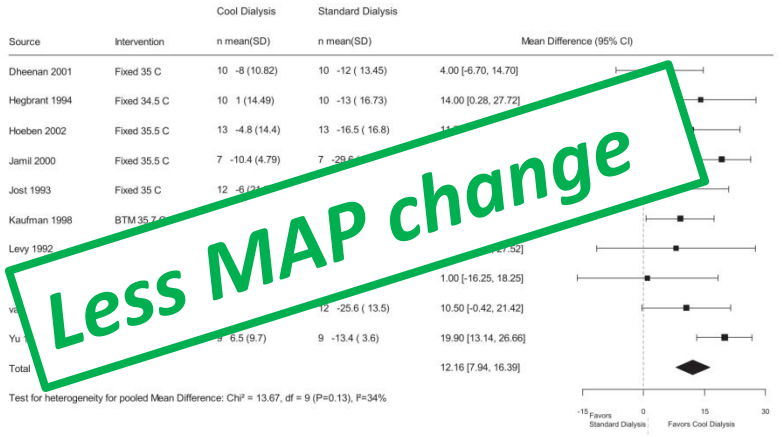
Spital Thurgau

Dialysate temperature



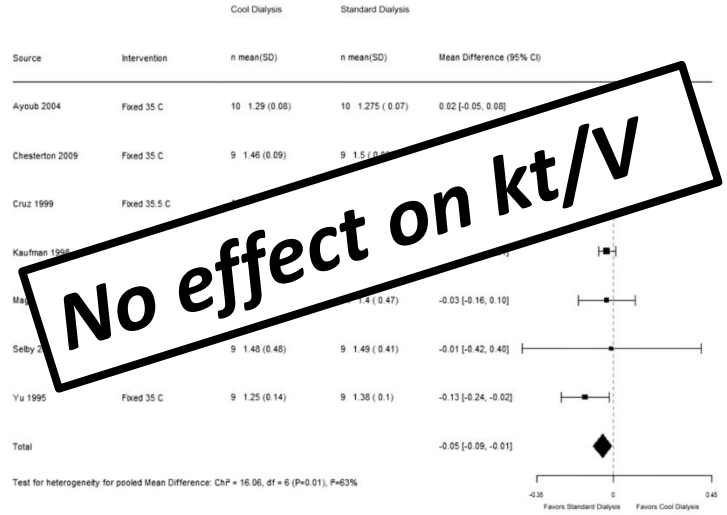
Less IDH

Figure 2. | **Effect of low temperature dialysis on intradialytic hypotension.** 95% CI, 95% confidence interval; BTM, biofeedback temperature monitoring.



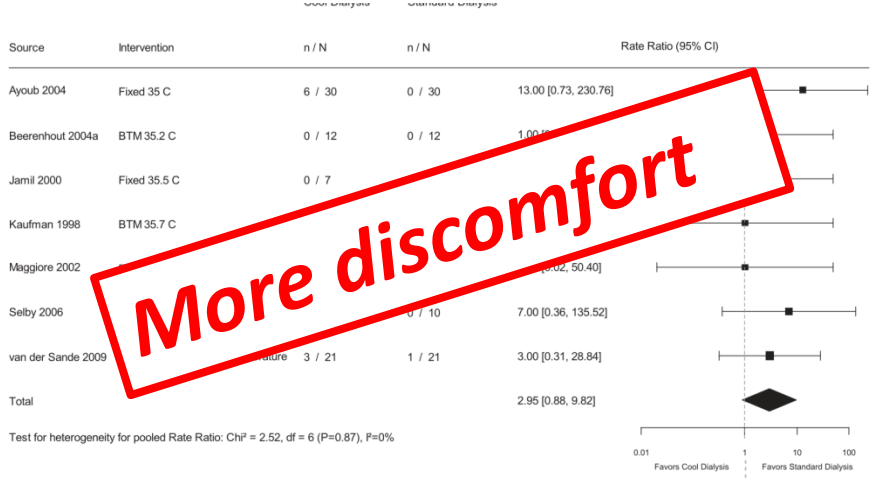
Less MAP change

Figure 5. | **Effect of low temperature dialysis on change in mean arterial pressure.** 95% CI, 95% confidence interval; BTM, biofeedback temperature monitoring.



No effect on kt/V

Figure 4. | **Effect of low temperature dialysis on dialysis adequacy.** 95% CI, 95% confidence interval; BTM, biofeedback temperature monitoring.



More discomfort

Figure 3. | **Effect of low temperature dialysis on symptoms of discomfort.** 95% CI, 95% confidence interval; BTM, biofeedback temperature monitoring.

Clin J Am Soc Nephrol 11: 442–457, March, 2016

Spital Thurgau

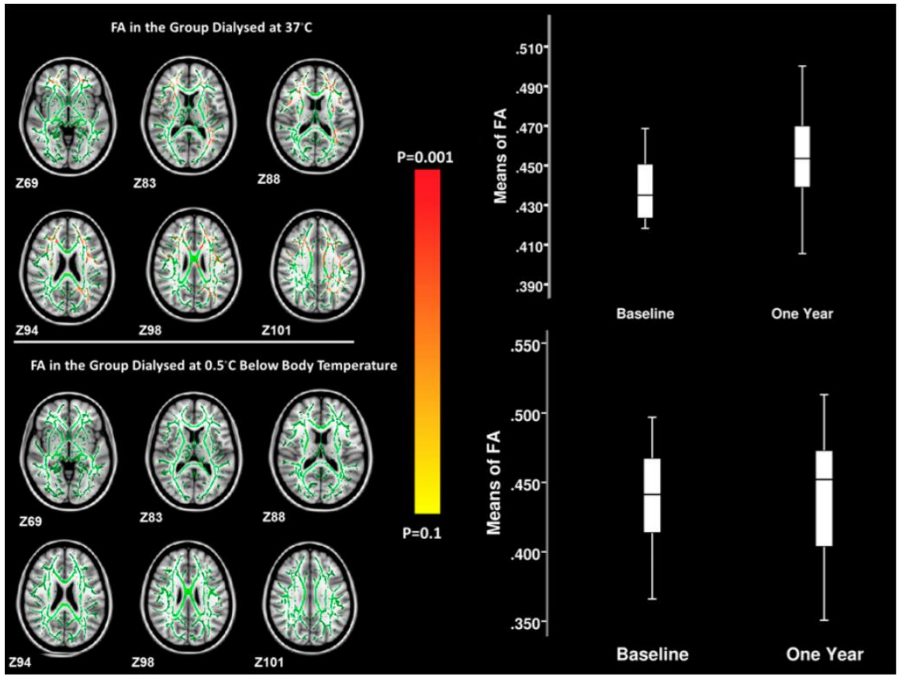
CLINICAL RESEARCH www.jasn.org

Randomized Clinical Trial of Dialysate Cooling and Effects on Brain White Matter

Mohamed T. Eldehni, Aghogho Odudu, and Christopher W. McIntyre

Division of Medical Sciences and Graduate Entry Medicine, School of Medicine, University of Nottingham, Nottingham, United Kingdom

J Am Soc Nephrol 26: 957–965, 2015.



Medication review

Aspirin cardio	100mg	1-0-0
Calcitriol	0.5mcg	1-0-0
Ca-acetate	400mg	1-1-1
Sevelamer	800mg	1-2-2
Fluvstatin	80mg	0-0-1
Bisoprolol	5mg	1-0-0
Losartan	100mg	1-0-0
Amlodipin	10mg	1-0-0
Doxazosin	4mg	1-0-1
Insulin		Special Scheme
Gabapentin	300mg	After Dialysis

Blood pressure in HD patients

- *IDH is just part of the story...*
- *...We measure BP only during 12 of 168 hours*
- *Consider orthostatic effects (particularly in DM)*
- *We have to make many trade offs when treating HD patients...*
- *Consider pharmacokinetics of antihypertensive medications!*

Lisinopril Therapy for Hemodialysis Hypertension: Hemodynamic and Endocrine Responses

Rajiv Agarwal, MD, Rebecca Lewis, RN, BSN, Joyce L. Davis, NP, MSN, and Bruce Becker, NP

• To evaluate the antihypertensive effects of lisinopril, a renally excreted angiotensin-converting enzyme inhibitor, we assessed supervised administration of the drug after hemodialysis (HD) three times weekly. Blood pressure (BP) was assessed by interdialytic 44-hour ambulatory BP (ABP) monitoring, and endocrine responses were assessed by plasma renin activity (PRA) before and after dialysis. Lisinopril dose was titrated at biweekly intervals. If this was not effective after full titration (lisinopril to 40 mg three times weekly), ultrafiltration was added to reduce dry weight. The primary outcome variable was change in BP from the end of the run-in period to the end of the study. No change in mean ABP was noted during run-in. However, mean 44-hour ABP decreased from 149 ± 14 (SD)/84 ± 9 to 127 ± 16/73 ± 9 mm Hg, a decrease of 22/11 mm Hg ($P < 0.001$) at final evaluation. Of 11 patients who completed the trial, only 2 patients had systolic hypertension (≥135 mm Hg) and 1 patient had diastolic hypertension (≥85 mm Hg) at the final visit. Four patients were administered 10 mg of lisinopril; 5 patients, 20 mg; and 2 patients, 40 mg; only 1 of these patients required ultrafiltration therapy. There was a persistent antihypertensive effect over 44 hours. BP reduction was achieved without an increase in intradialytic symptomatic or asymptomatic hypotensive episodes. PRA increased in response to dialysis, as well as lisinopril. In conclusion, supervised lisinopril therapy is effective in controlling hypertension in chronic HD patients. This may be related to blockade of angiotensin II generation by kidneys despite the loss of excretory function.

INDEX WORDS: Hemodialysis (HD); hypertension; angiotensin-converting enzyme (ACE) inhibitors; renin-angiotensin system; ambulatory blood pressure monitoring (ABPM); antihypertensive therapy.

Medication adjustments: suggestion

Aspirin cardio	100mg	1-0-0
Calcitriol	0.5mcg	1-0-0
Ca-acetate	400mg	1-1-1
Sevelamer	800mg	1-2-2
Fluvstatin	80mg	0-0-1
Bisoprolol	5mg	1-0-0
Lisinopril	10mg	0-0-1
Amlodipin	10mg	0-0-1
Doxazosin	4mg	1-0-1 (0-0-1 on HD days)
Insulin		Special Scheme
Gabapentin	300mg	After Dialysis

Nephrol Dial Transplant (2004) 19: 2553–2558
doi:10.1093/ndt/gfh420
Advance Access publication 27 July 2004

Nephrology
Dialysis
Transplantation

Takeda Pharma AG QAP

GUTRON Tropfen 10 mg/ml

Midodrin
C01CA17
Antihypotonikum, Sympathomimetikum

10mg = 30 drops

Zusammensetzung

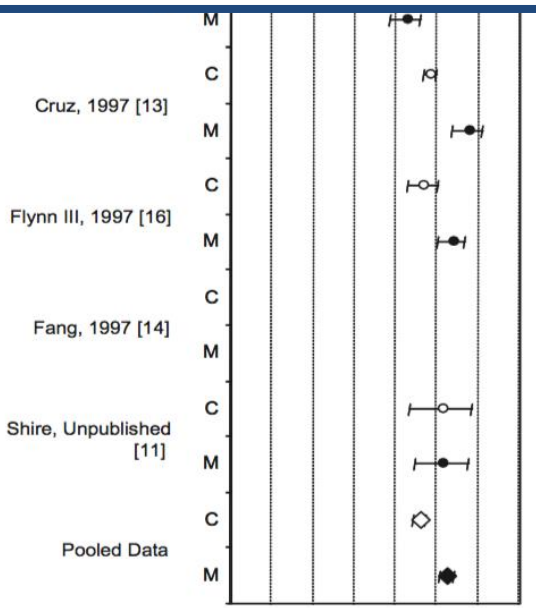
Midodrin hydrochlorid (10 mg)

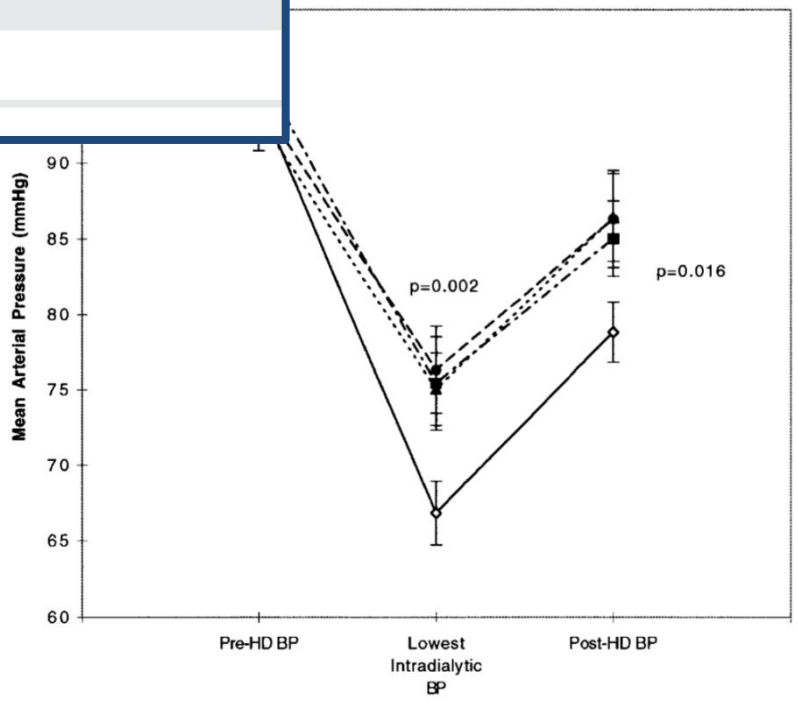
effective for dialysis-induced

eim and Andrew A. House

es Centre, Ontario, Canada

rature dialysate or both





American Journal of Kidney Diseases, Vol 33, No 5 (May), 1999: pp 920-926

What actions will you take at this point?

- [ ] You raise the dialysis Na concentration in the prescription
- [ ] You raise the target weight by 1 kg
- [ ] You raise the target weight if there is no edema
- [ ] You adjust dry weight depending of BCM results
- [ ] You tell the patient to drink less
- [ ] You limit the ultrafiltration rate to 10ml/h/kg
- [ ] You stop antihypertensives before dialysis
- [ ] You prescribe Midodrine (Gutron) 10 drops before dialysis

Summary: how to deal with IDH?

First line interventions:

- Reassess target weight
  - But don‘t rely on clinical signs of hypervolemia only!
- Review and adjust antihypertensive agents
  - But keep in mind BP between dialyses!
- Try to lower IDWG
  - Max out diuretics if RRF
  - Salt restriction
- No eating during dialysis

Summary: how to deal with IDH?

Second line interventions:

- Assess for cardiac disease
- Cool dialysate
- Consider Na profiling
- Consider online blood volume measurement
- Consider HDF
- Consider Midodrine
- Consider longer dialysis time

Summary: how to deal with IDH?

Third line interventions:

- Consider frequent HD (some consider it first line, but ask the patient and the SVK...)
- Consider modality change

Questions?

andreas.kistler@stgag.ch

www.nephrologie-thurgau.ch