Intradialytic Hypertension

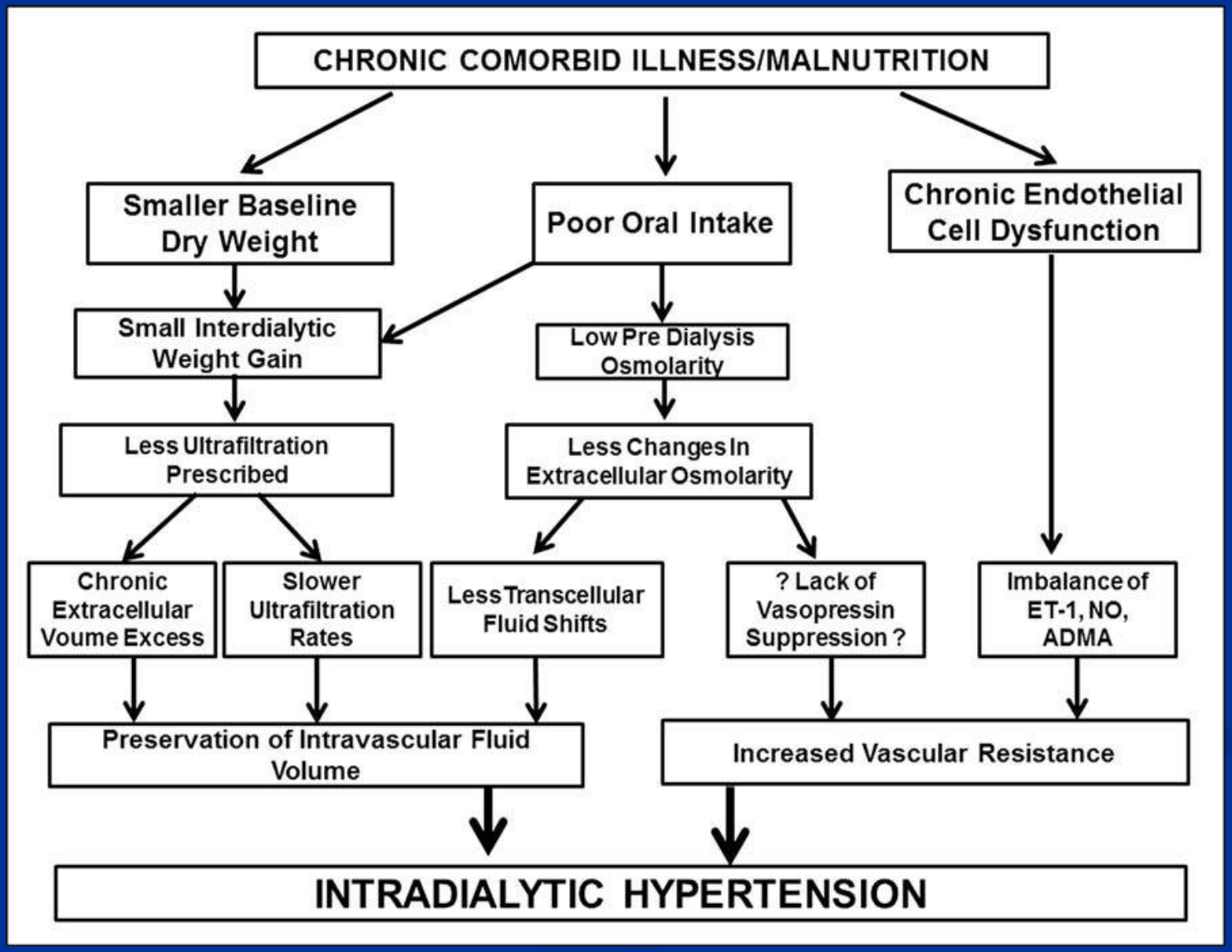
Introduction

- 76 % of dialysis patients are on anti- hypertensive medications.
- Only close to 25% of patients have controlled BP.
- Intradialytic HTN is observed in at least 10% of the maintance hemodialysis patients.(range of 5-15%)
- The relationship between HTN and cardiovascular morbidity and mortality in dialysis patients is complex.
- (KDOQI) has defined HTN as **predialysis SBP of 140 mm Hg or greater, postdialysis SBP of 130 mm Hg or greater, predialysis DBP of 90 mm Hg or greater, or postdialysis DBP of 80 mm Hg or greater.**

Definitin

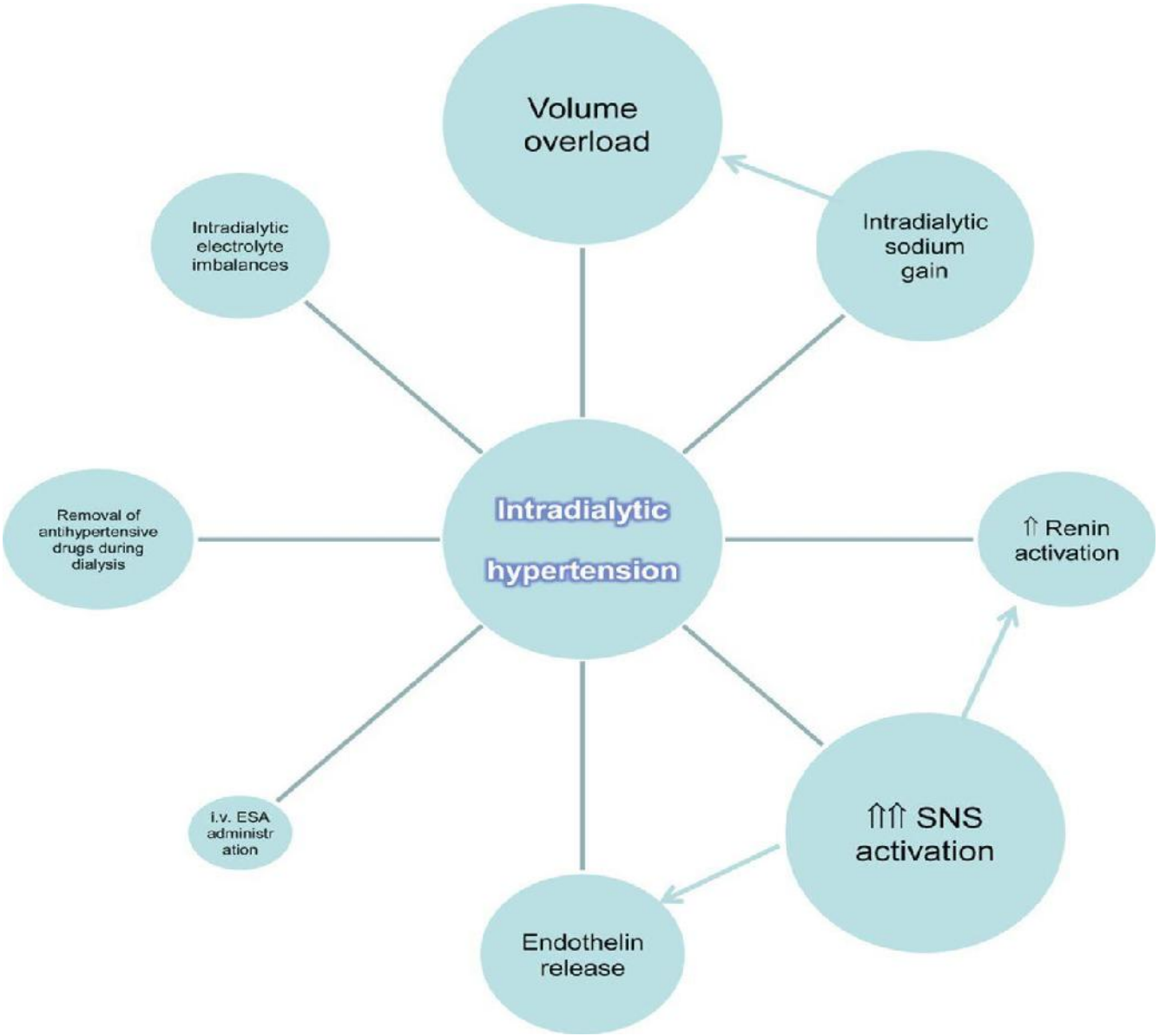
- Increase in MAP of 15 mm Hg during or immediately after HD.
- Increase SBP of 10 mm Hg from pre- to post dialysis.
- Hypertension during the second or third hour of HD after significant ultrafiltration has taken place.
- Increase in BP that is resistant to ultrafiltration

proposed pathophysiology of intradialytic hypertension



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Pathogenesis of Intradialytic Hypertension



pathophysiology of intradialytic hypertension

Pt factots
- Renin- angiotensin-aldosterone system over-activity
- Sympathetic nervous system over-activity

Endothelial cell dysfunction
- Increasing Endothelin-1
- Decreasing Nitric oxide

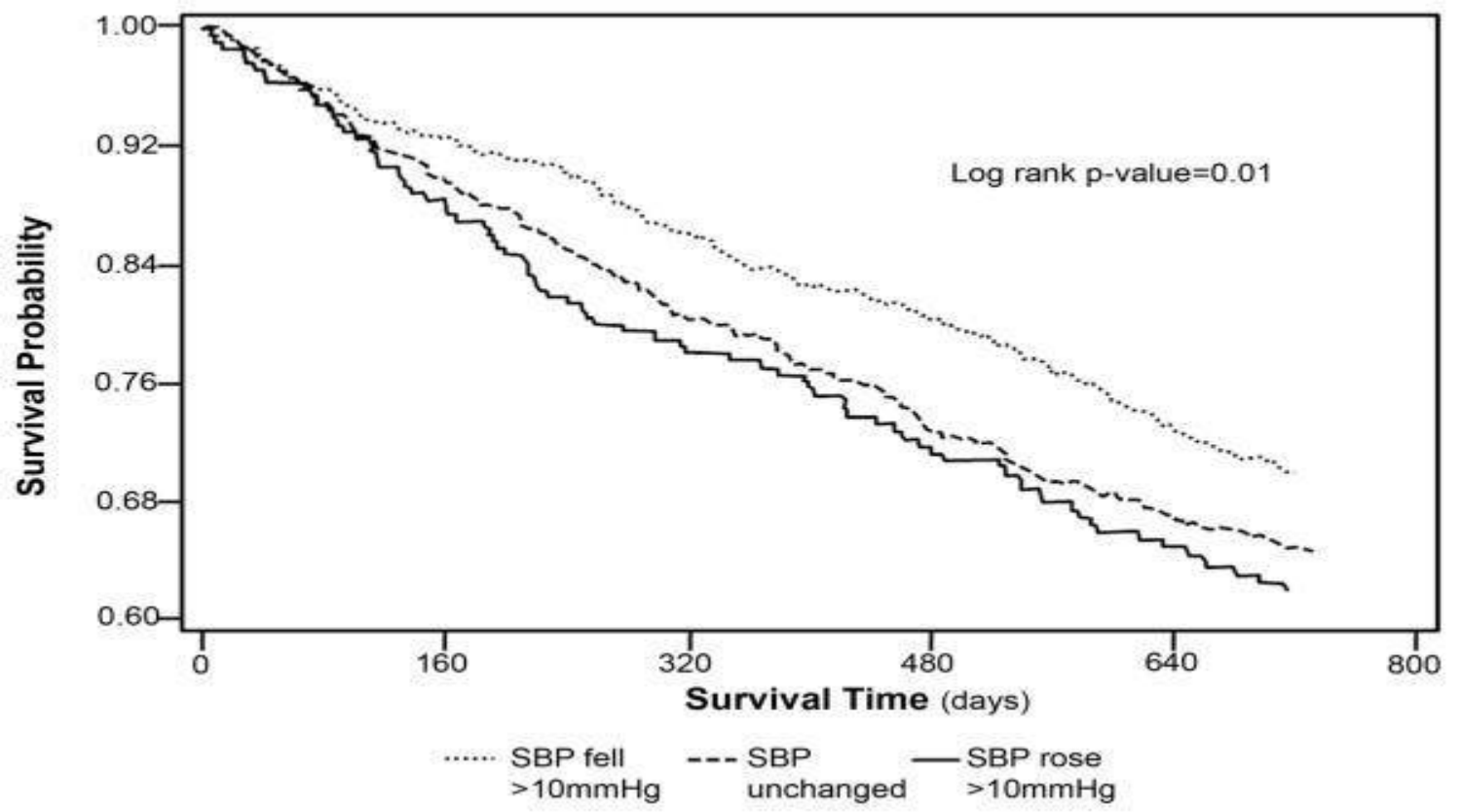
HD treatment factors
- Increasing dialysate sodium
- Increasing dialysate calcium
- Increasing plasma osmolality
- Erythropoientin stimulating agents
- Removal of antihypertensives(atenolol,metoprolol and AEC inhibitors)

Volume/fluid factors
- Increasing weight gain
- Inaccurate target weight

All above factors → **Increasing vasoconstriction and/or Increasing Cardiac output** → **IDH**

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Association of Blood Pressure Increases During Hemodialysis With 2-Year Mortality in Incident Hemodialysis Patients: A Secondary Analysis of the Dialysis Morbidity and Mortality Wave 2 Study



	SBP Decreased > 10 mm Hg During HD (n = 744)	SBP Unchanged ±10 mm Hg During HD (n = 791)	SBP Increased > 10 mm Hg During HD (n = 213)
2-Year all-cause mortality	218 (29.3)	273 (34.5)	79 (37.1)
Cardiovascular related*	126 (57.8)	161 (59.0)	49 (62.0)

American Journal of Kidney Diseases, Vol 54, No 5 (November), 2009: pp 881-890

Patient Characteristics

Patient with intradialytic HTN had

- Lower dry weight
- Smaller body mass index
- Lower interdialytic weight gain
- Lower Hb,serum albumin, serum creatinine ,serum Ca,serum phosphorus,serum ferritin and TIBC level
- Tend to be on more anti HTN meds.
- older age
- nonambulatory status
- male gende

Seminars in Dialysis2017;30:548

Am J Nephral 2015;42:338

Causes of Intradialytic HTN

- Volume overload
- Sympathetic overactivity
- Activation of the renin-angiotensin-aldosterone system
- Endothelial cell dysfunction
- Dialysis-specific factors
  - Net sodium gain
  - High ionized calcium
  - Hypokalemia
- Medications
  - Erythropoietin-stimulating agents
  - Removal of antihypertensive medications
- Vascular stiffness

Treatment Options

Table 1 | Potential strategies for the treatment of intradialytic hypertension

Potential strategy	Potential methods
Reduce volume overload	Increase ultrafiltration Reduce cardiac output Restrict dietary salt
Control electrolyte changes	Ensure an adequate intradialytic sodium balance Reduce dialysate calcium concentration
Reduce sympathetic overactivity	Administer angiotensin-converting-enzyme inhibitors Administer angiotensin II receptor blockers Administer direct renin inhibitors Administer adrenergic receptor blockers (α-blockers and β-blockers) Start patient on daily dialysis Increase duration of dialysis
Inhibit the renin–angiotensin–aldosterone system	Administer angiotensin-converting-enzyme inhibitors Administer angiotensin II receptor blockers Administer direct renin inhibitors
Evaluate concurrent therapies	Consider whether the patient's antihypertensive drugs might be being removed by dialysis

Volume overload

Table 2a. Mean values of four HD sessions during control observations

Patient	BP start	BP end	Wt lost (kg)	KTi
1	175/101	226/120	−1.2	0.55
2	207/107	238/117	−2.3	0.53
3	179/95	184/112	−2.6	0.60
4	178/108	237/132	−1.8	0.57
5	134/95	169/110	−1.5	0.58
6	160/94	182/102	−1.9	0.52
7	171/90	192/106	−1.4	0.56
Mean	172±15/99±7	204±29/114±10	−1.7	0.56±0.03

Table 2b. Final values reached after intensified treatment

Patient	Days	BP	Wt lost (kg)		KTi
1	8	115/70	−5	(8%)	0.40
2	14	135/85	−10	(14%)	0.45
3	9	145/80	−5	(18%)	0.49
4	11	145/85	−6	(8%)	0.48
5	6	115/80	−5	(8%)	0.50
6	5	116/78	−5	(6%)	0.42
7	10	110/70	−11	(16%)	0.44
Mean	9±3	126±15/78±6	−6.7	(11%)	0.45±0.03

Mean systolic and diastolic blood pressure decreased by 46 ± 18 and 22 ± 9 mmHg respectively while bodyweight decreased by a mean of 6.7 ± 3.0 kg.

Nephrol Dial Transplant (1995) 10: 1417-1420 cirit et al

Intradialytic Hypotension

Clinical significance

- Increased mortality
- Access thrombosis
- Under-dialysis and volume overload
- Organs ischemia (MI , CVA and ischemic bowel)
- Increase nursing intervention

Patients at Risk of IDH

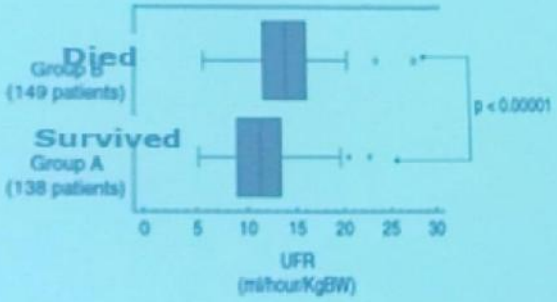
- *65 years or older age*
- *DM*
- *Patients with CVD:*
  - *LVH and diastolic dysfunction with or without CHF*
  - *LV systolic dysfunction and CHF*
  - *Valvular heart disease*
  - *Pericardial disease (constrictive pericarditis or pericardial effusion)*
- *Poor nutritional status and hypoalbuminemia*
- *Hyperphosphatemia*
- *Uremic neuropathy or autonomic dysfunction due to other causes*
- *Severe anemia*
- *Patients requiring high volume ultrafiltration; more than expected interdialytic weight gain*
- *Patients with predialysis SBP of <100 mm Hg*

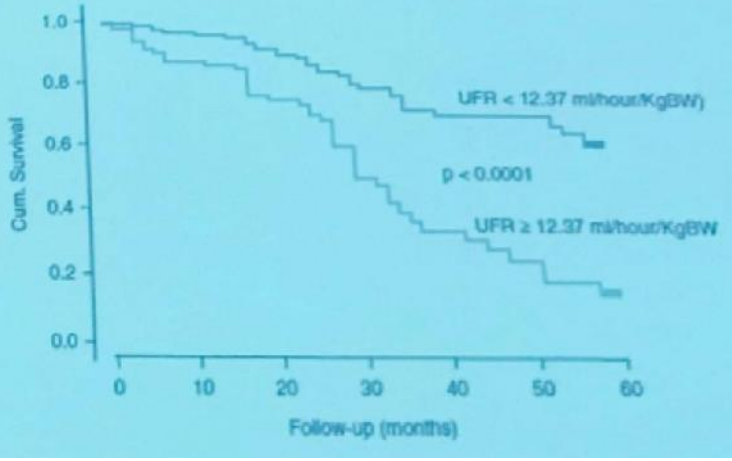
4 UFR < 12.4 ml/Kg/hr

Association between high ultrafiltration rates and mortality in uraemic patients on regular haemodialysis. A 5-year prospective observational multicentre study

4. Ezio Movilli[1], Paola Gaggia[1], Roberto Zubani[1], Corrado Camerini[1], Valerio Vizzardi[1], Giovanni Parrinello[2], Silvana Savoldi[3], Marie Stephanie Fischer[1], Francesco Londrino[1] and Giovanni Cancarini[1]

Nephrol Dial Transplant (2007) 22: 3547–3552



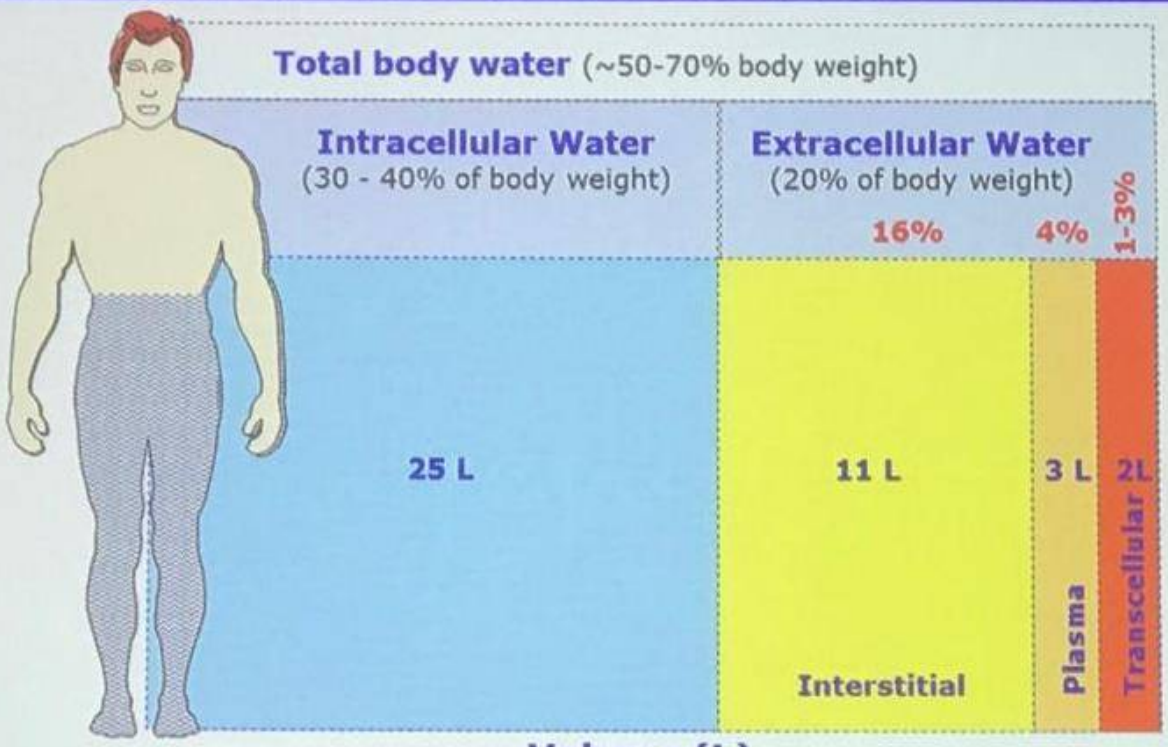


Safe Ultrafiltration Rate?

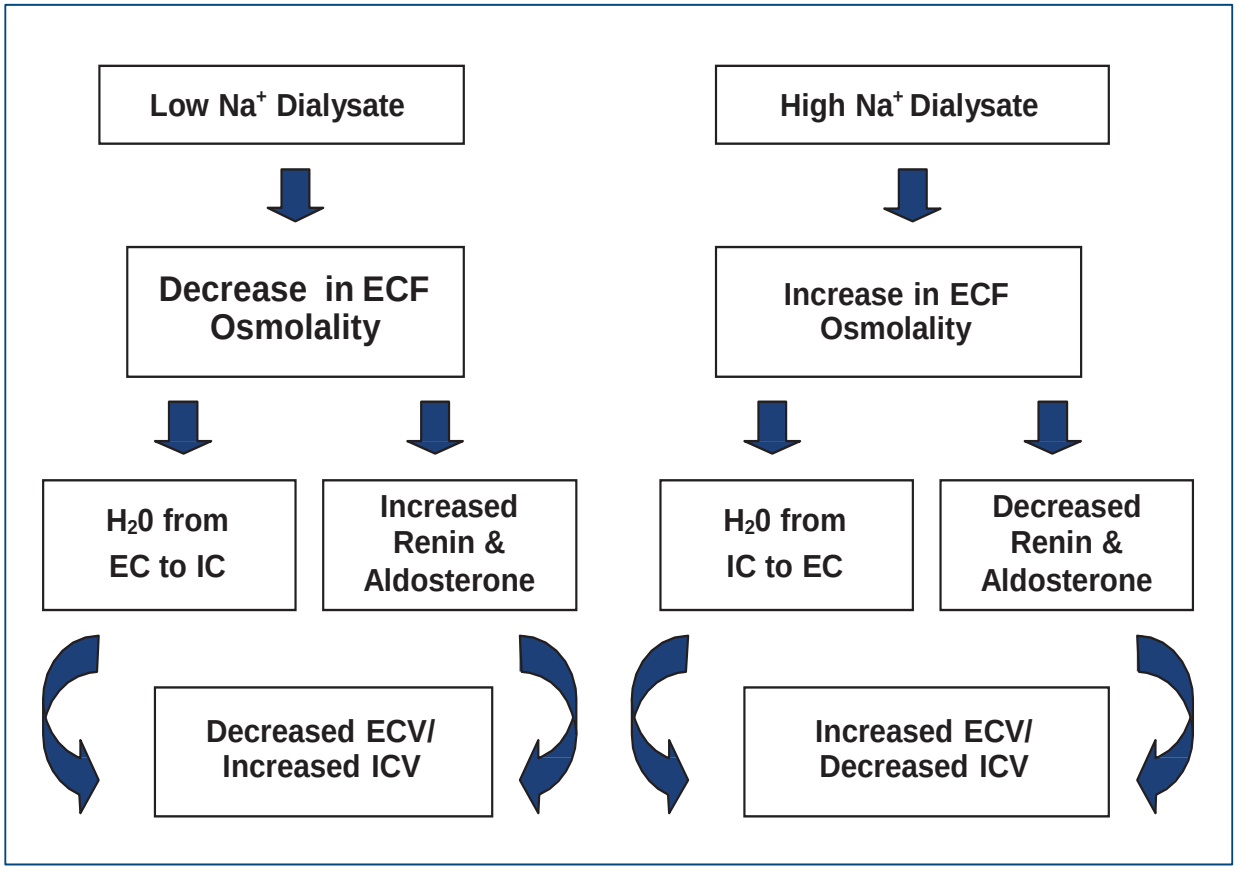
- HEMO Study data: Data from 1846 patients.
- Compared by Uf rates:
  - up to 10 ml/h/kg
    - 70kg patient, 4 hrs = <2.8 Liter target
  - 10–13 ml/h/kg
    - 70kg patient, 4 hrs = 2.8 ~3.64 Liter target
    - Higher risk of CHF without mortality risk increase seen from this point
  - over 13 ml/h/kg:
    - 70kg patient, 4 hrs = >3.64 Liter target
    - Increased risk of mortality.

- Jennifer E Flythe, et al. Rapid Fluid Removal During Dialysis is Associated With Cardiovascular Morbidity and Mortality. Kidney Int. 2011;79(2):250-257.

Body Fluid Compartments - Adult ~ 70 kg



Pathophysiological Changes Induced by Low and High Dialysate Change



Dialysate Na should be regulated based on serum Na:

Hyponatremia:

- If Na > 130: Dialysate Na: 140+(140-predialysis Na)
- If Na<130: Dialysate Na: Predialysis Na + 15-20

Hypernatremia:

- Dialysate Na: Predialysis Na-2 mmol

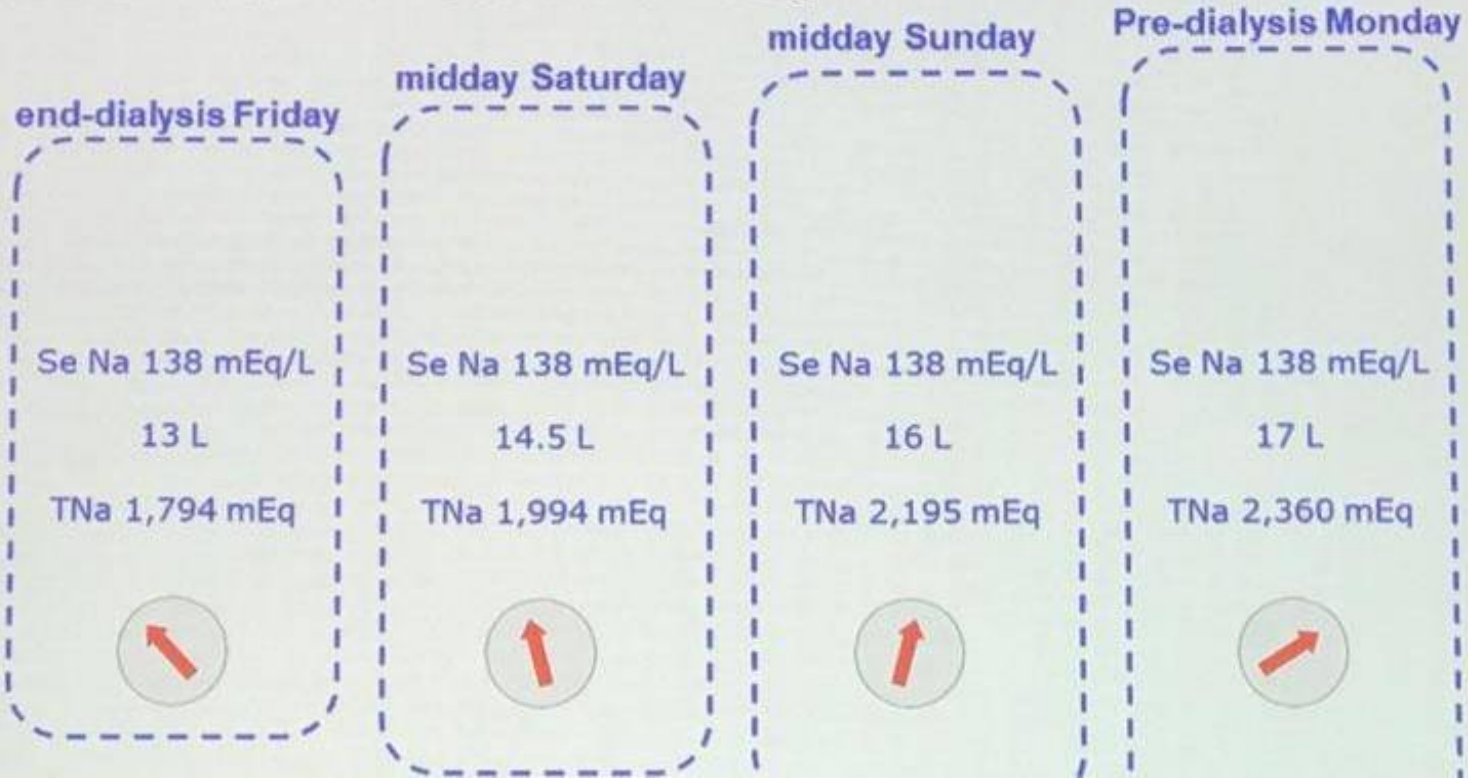
Dialysis Temperature

- **Guideline 3.4.1 Cool dialysate temperature dialysis (35–36°C) or isothermic treatments by blood temperature controlled feedback should be prescribed in patients with frequent episodes of IDH (Evidence level I).**
- **Guideline 3.4.2 With cool temperature dialysis, dialysate temperature should be gradually reduced in steps of 0.5°C from 36.5°C until symptoms are controlled (Opinion).**
- **Guideline 3.4.3 Dialysate temperatures <35°C should not be used (Opinion).**

Salt as 'drive' for fluid - *Estimating Salt intake*

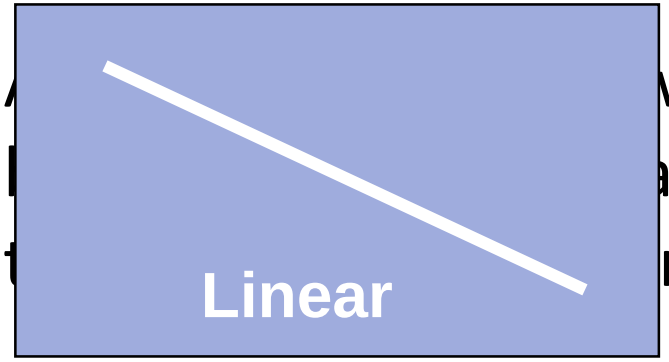
Estimate of Salt intake = weight gain x average plasma Na^{++}

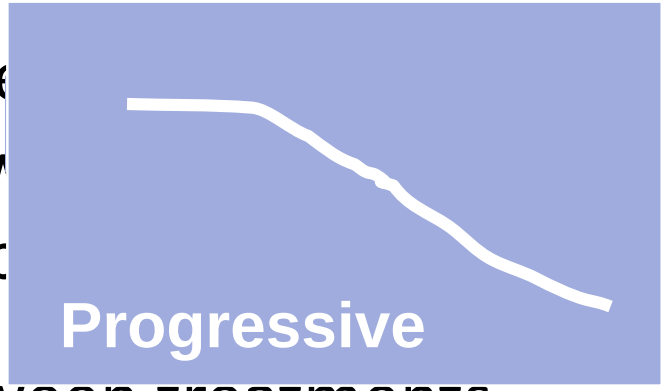
Estimate = 4 x 138 = 550 mmol ~ 32 g Salt

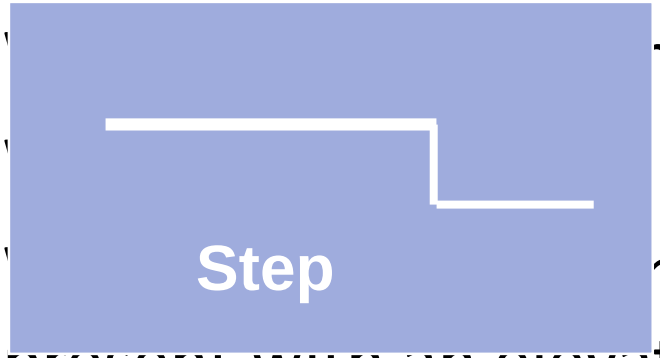


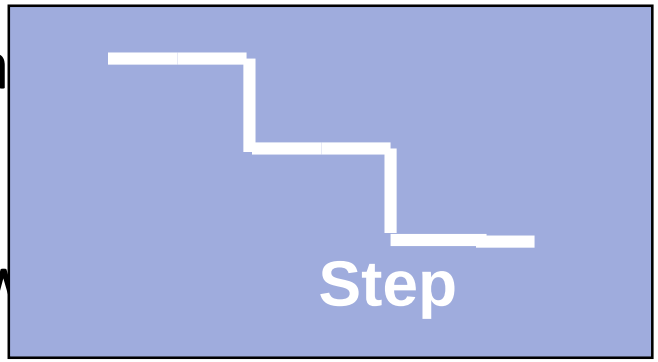
Choosing the Right UF Profiles

- A
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  t
- With large weight gains between treatments
- W
- W
- W





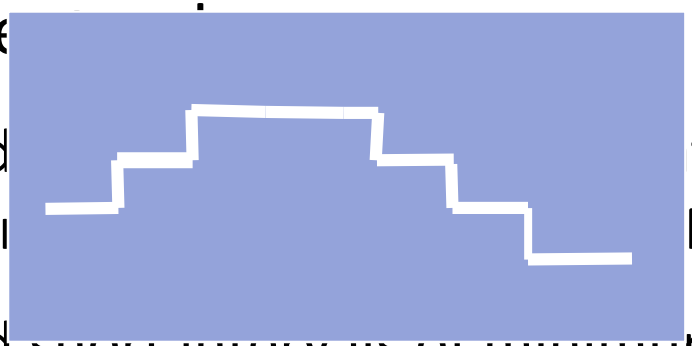


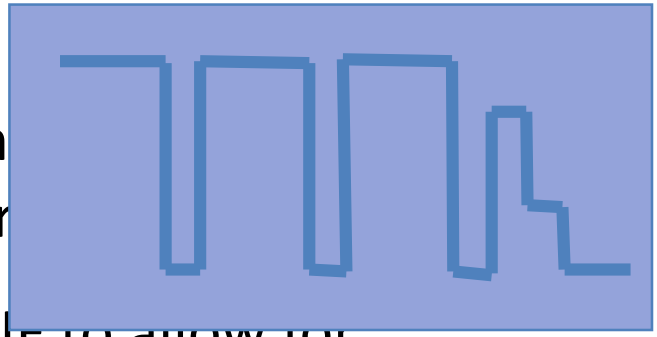


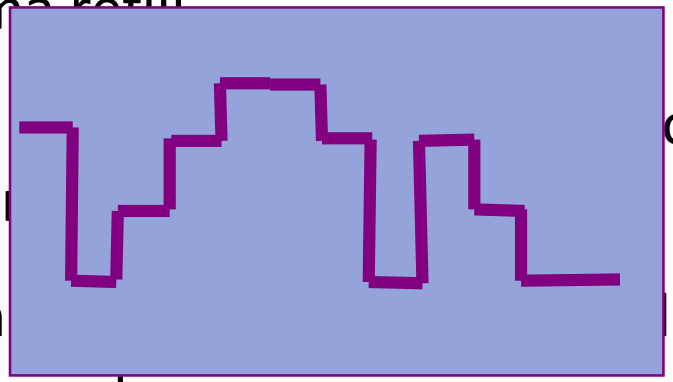
present with an elevated BP

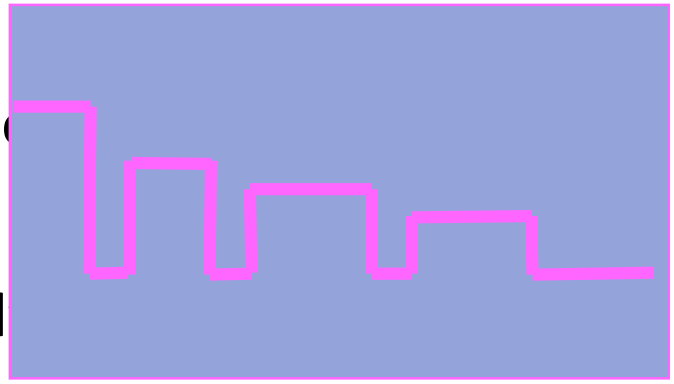
Choosing the Right UF Profiles

- Consider a profile with varying steps for patie
- Need t th
  the t P or
- Need short intervals of minimum UF to allow for plasma refill
- Have o th
  (elde
- Cram oml
  treatment





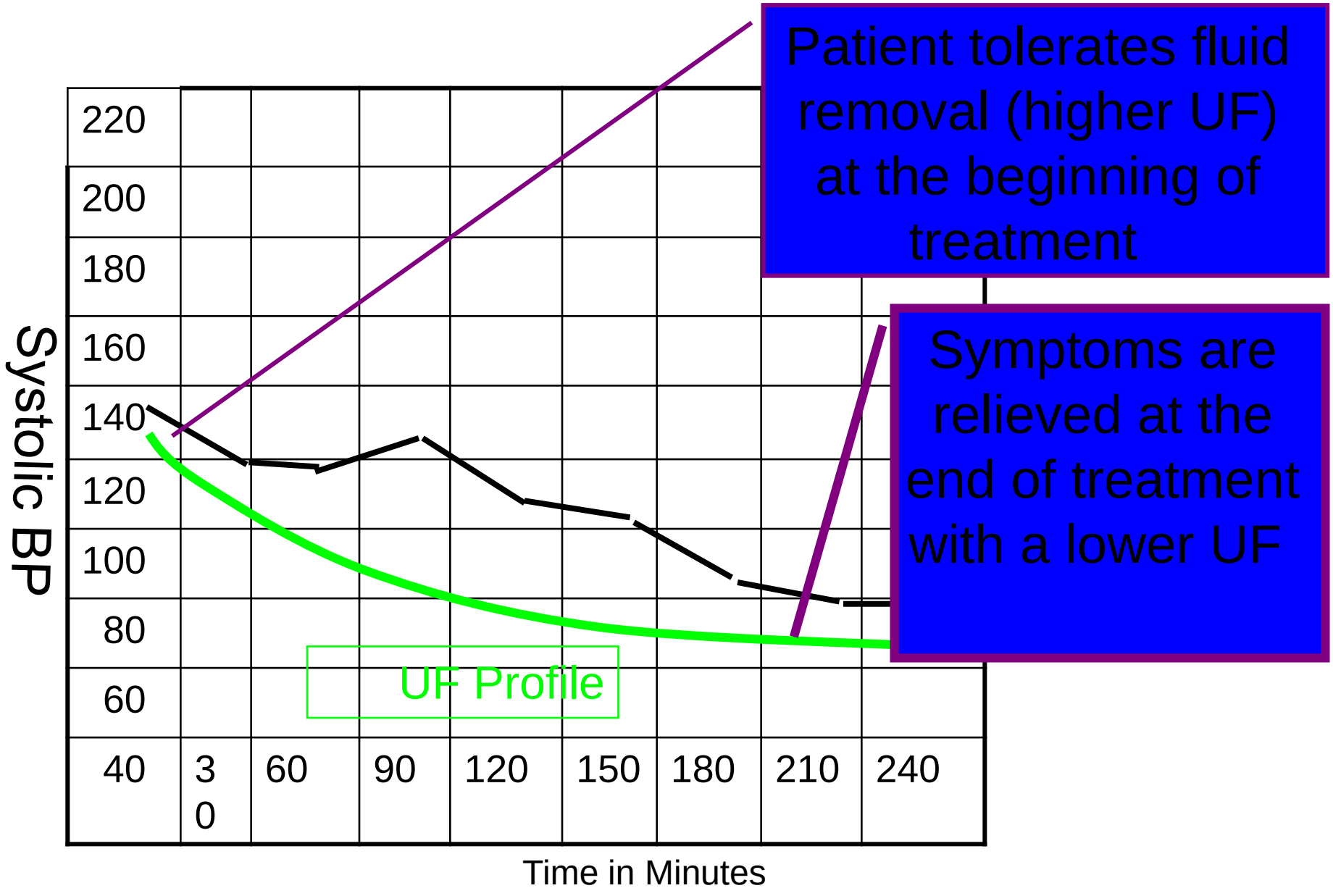




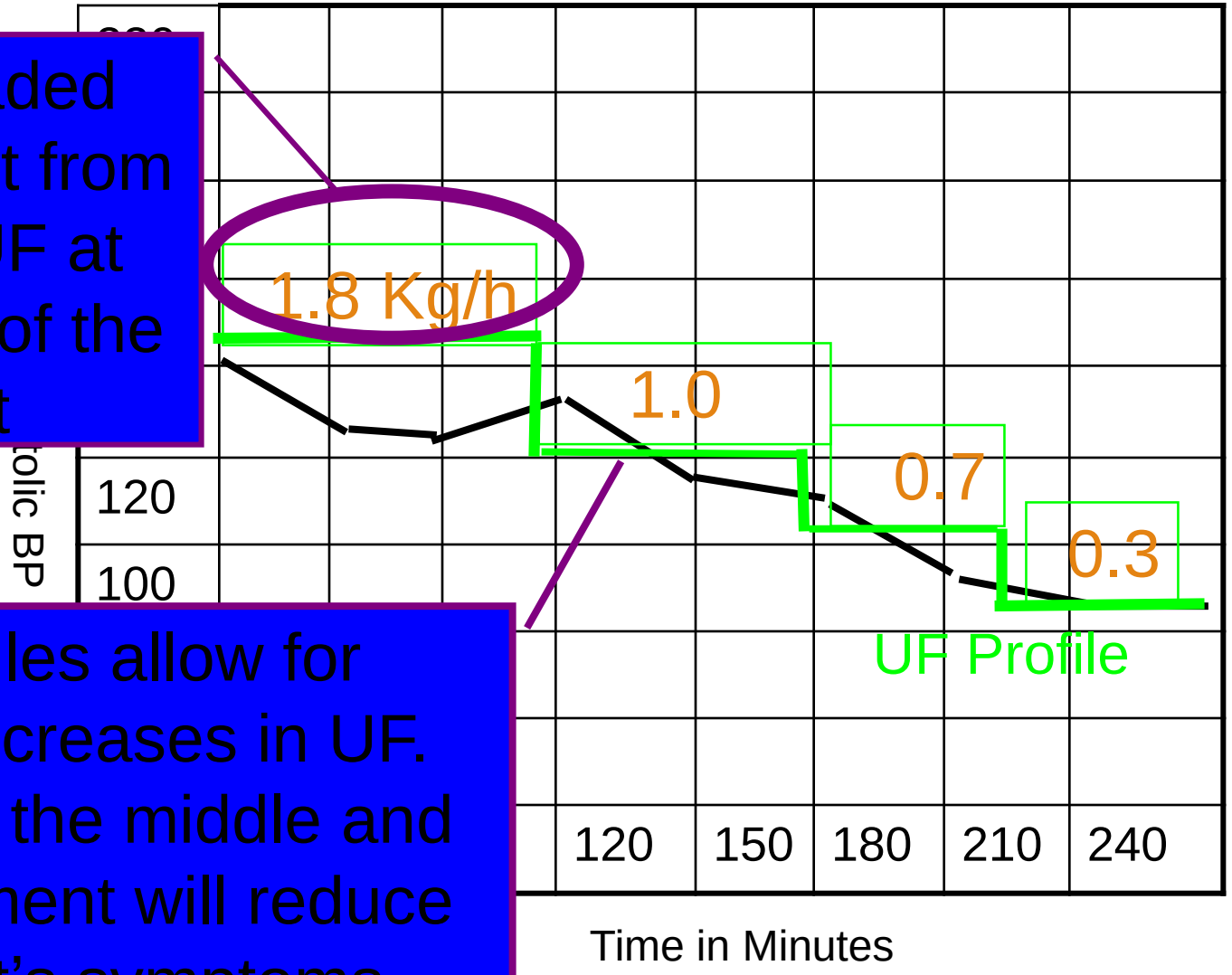
Case Studies

How to select a UF profile
for a patient

A patient weight gains typically of 3-4 kg and experiences moderate to severe leg cramps during the last 30 minutes of treatment

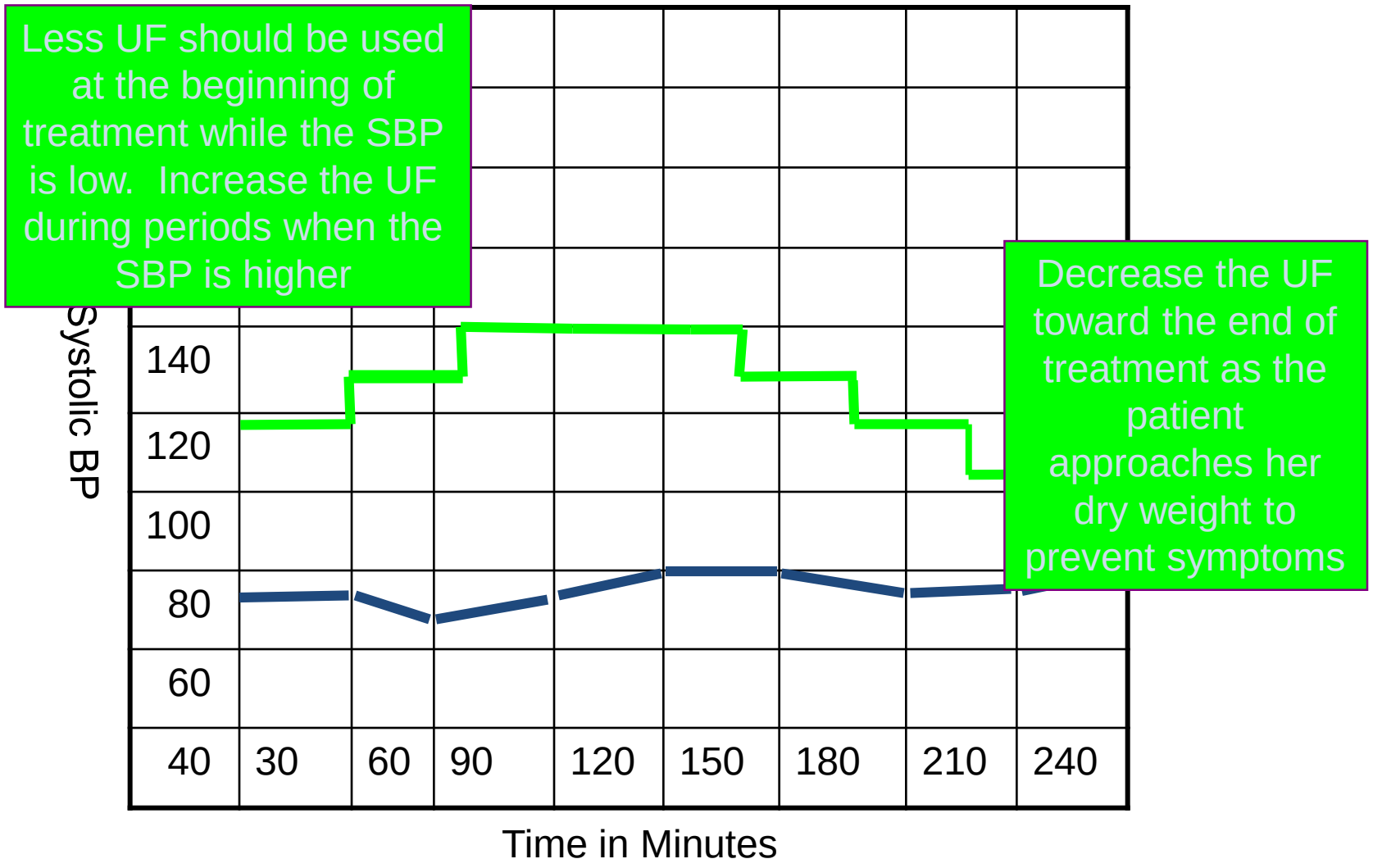

Patient tolerates fluid removal (higher UF) at the beginning of treatment
Symptoms are relieved at the end of treatment with a lower UF
UF Profile
Systolic BP
220
200
180
160
140
120
100
80
60
40
30
60
90
120
150
180
210
240
Time in Minutes

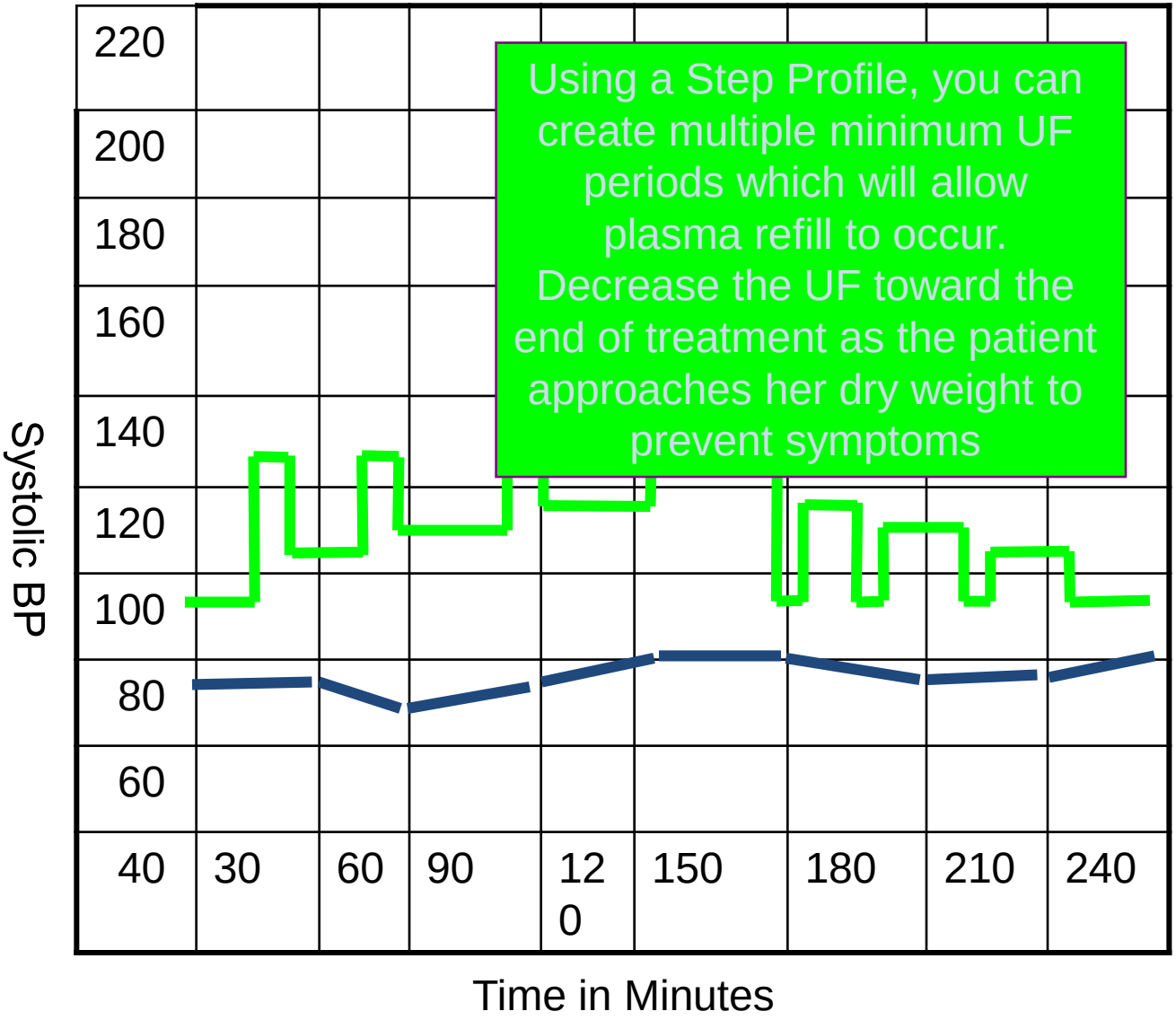
Fluid overloaded patients benefit from aggressive UF at the beginning of the treatment



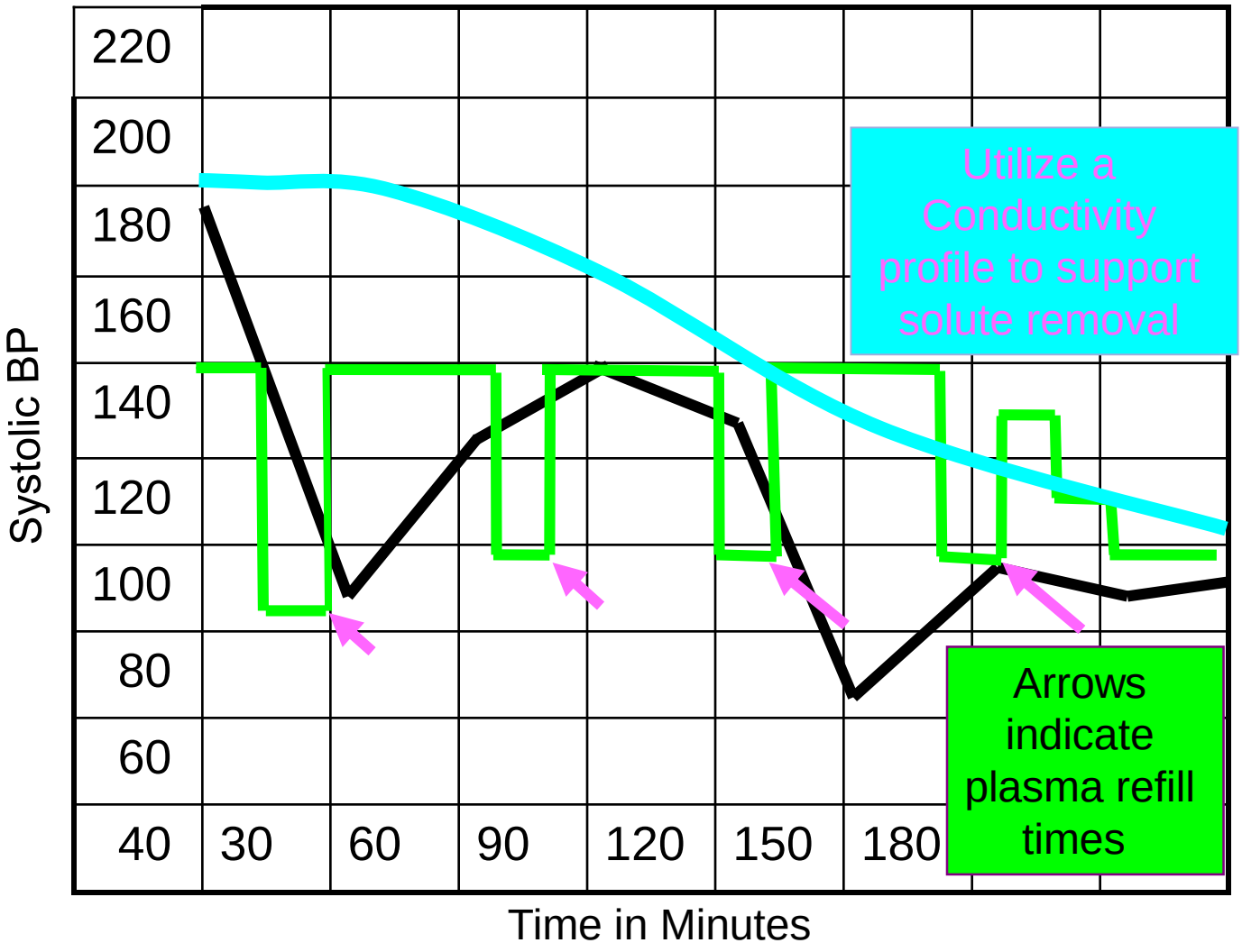
Step profiles allow for dramatic decreases in UF. Lower UF at the middle and end of treatment will reduce the patient's symptoms

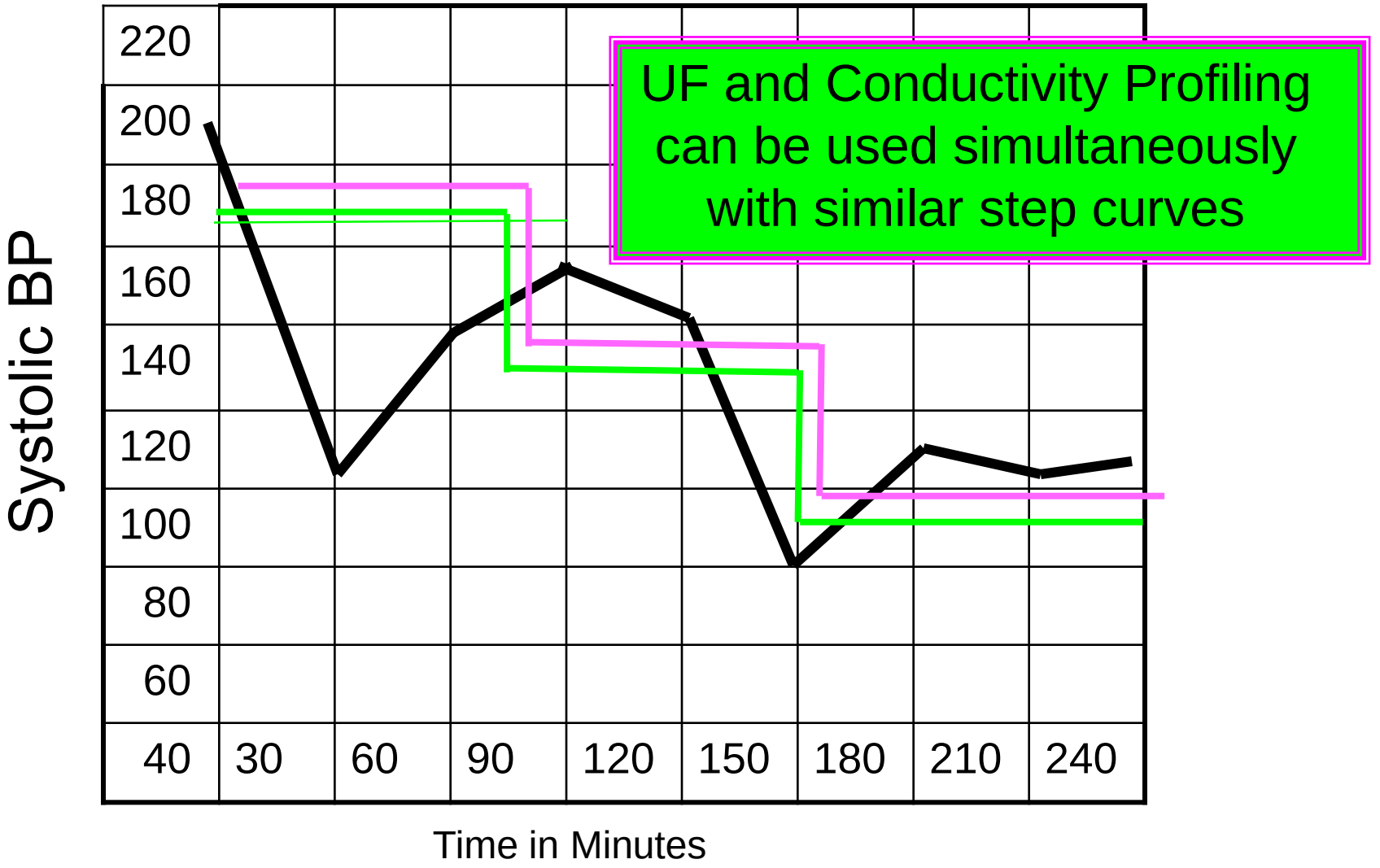
Second patient arrives with a systolic blood pressure of 85 and a weight gain of 3 Kg. If her SBP falls below 75 she becomes symptomatic

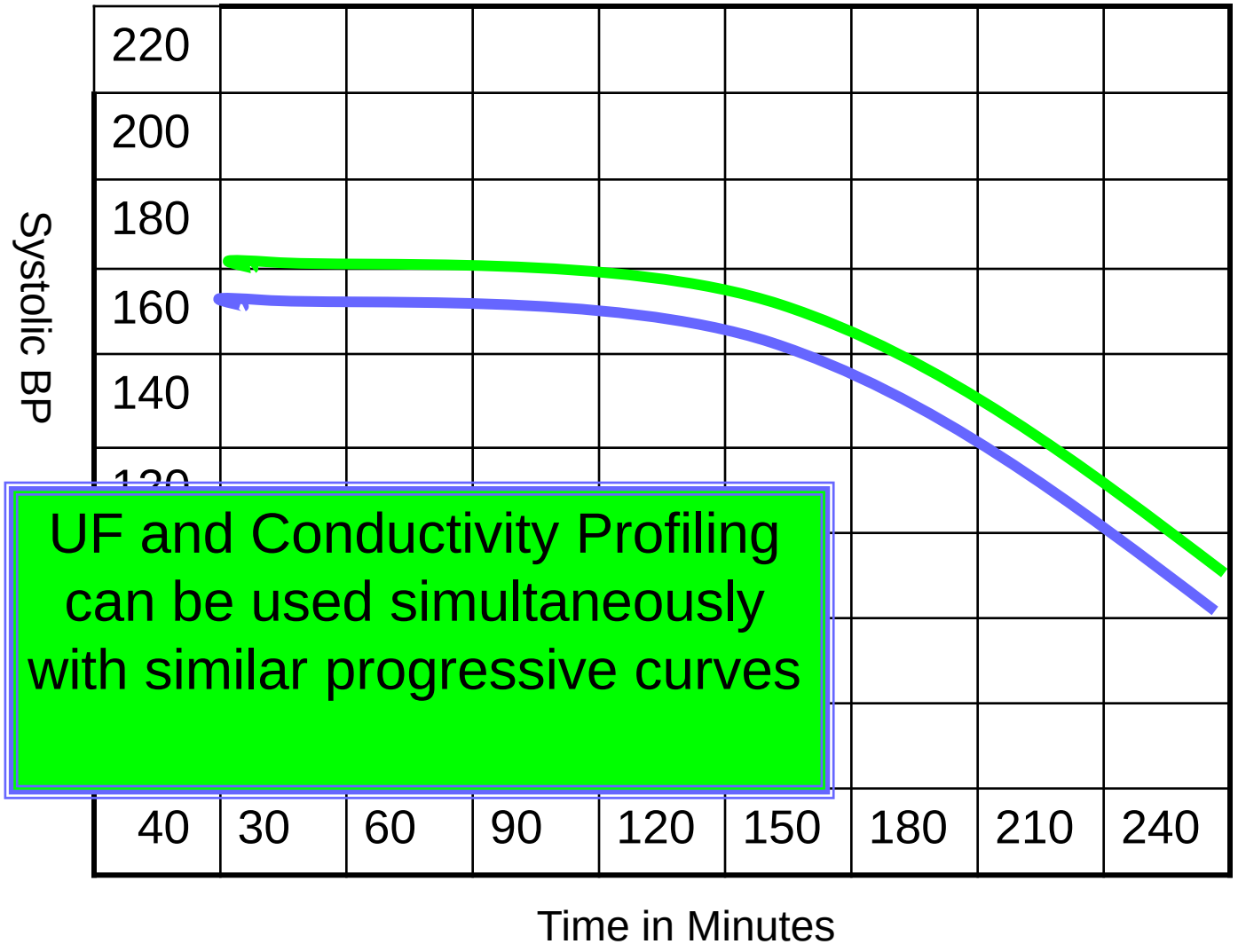

Less UF should be used at the beginning of treatment while the SBP is low. Increase the UF during periods when the SBP is higher
Decrease the UF toward the end of treatment as the patient approaches her dry weight to prevent symptoms
Systolic BP
140
120
100
80
60
40
30
60
90
120
150
180
210
240
Time in Minutes


Using a Step Profile, you can create multiple minimum UF periods which will allow plasma refill to occur. Decrease the UF toward the end of treatment as the patient approaches her dry weight to prevent symptoms
Systolic BP
220
200
180
160
140
120
100
80
60
40
30
60
90
120
150
180
210
240
Time in Minutes

A woman patient is hypertensive and diabetic. She has large fluid gains of 4-6 Kg between treatments and has symptoms of hypotension about 45 minutes into the treatment as well as mid and late treatment


220
200
180
160
140
120
100
80
60
40
30
60
90
120
150
180
Systolic BP
Time in Minutes
Utilize a Conductivity profile to support solute removal
Arrows indicate plasma refill times


UF and Conductivity Profiling can be used simultaneously with similar step curves
Systolic BP
220
200
180
160
140
120
100
80
60
40
30
60
90
120
150
180
210
240
Time in Minutes


220
200
180
160
140
40
30
60
90
120
150
180
210
240
Systolic BP
Time in Minutes
UF and Conductivity Profiling can be used simultaneously with similar progressive curves

THANK YOU!