Sodium and ultrafiltration profiling: impact of an alternative model in hemodialysis hypotension

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Introduction

Symptomatic hypotension is the most frequent acute complication of hemodialysis[1,2]. Beyond the discomfort that causes to the patient, it is a common reason of reducing dialysis time, which results in inadequate solute clearence and difficulty in achieving ideal body weight (IBW). Moreover, intradialytic hypotension is considered to be an important risk factor that influences mortality in hemodialysis patients[3]. The most important cause of intradialytic hypotension is slow refilling of blood compartment from surrounding tissue spaces, especially when high ultrafiltration rate (UFR) is required[1]. Among others, increased sodium concentration in dialysate and controlled UFR have been variably used for its prevention[4,5,6].

Aim

The aim of the present study was to compare the impact of two different models of dialysate sodium and UFR in intradialytic hemodynamic instability.

Materials and methods

Six patients, which experienced frequent episodes of hypotension during haemodialysis, were included in the study. Two models were scheduled, each one for four sessions. The first one with constant sodium concentration in dialysate (=145meq/L) and constant ultrafiltration rate (UFR). The second one with linearly increasing sodium concentration (from 140 to 150meq/L) and linearly decreasing UFR (sodium and ultrafiltration profiling). Initial UFR in the second model was 125% of UFR if it was to remain constant. Patients were controls of themselves. There was no wash out period. Antihypertensive medication, erythropoietin dosage and the rest of dialysis conditions remained unchanged for each patient during the whole study. Exclusion criteria during the study were the following: thrombosis or dysfunction of vascular access, active bleeding, cardiovascular events and extreme changes in hemoglobin levels (<10 or >13gr/dl). For each session, exclusion criteria from the statistical analysis were the following: (a) ultrafiltration (UF)< 1.5% of ideal body weight (IBW) or need for UF>8% of IBW (or >6lit), (b) extreme blood flows (<250 or >350 ml/min), and (c) bacteremia.
During every session, blood pressure (BP) and heart rate (HR) were measured every 30 minutes. Only hourly measures were recorded on data. First measure was before the begining of dialysis (hour 0) and the last one was just before the disconnection (hour 4). At the same intervals, patients were closely monitored for the presence of symptoms (feel of weakness, sweating, headache, dizziness, nausea, blurred vision, cramps, yawning). Depending on findings, the presence and gravity of hypovolemic events was estimated. Every event that required intervention was graded based on gravity (Table 1). Total score was summed at the end of every session. Before entering next session, patients were answering questions for the subjective assesment of their thirst after last session (scale 1 to 5, from minimum to extreme). Weight gain and BP were recorded at the same time. All data were expressed as mean value ± standard deviation or median value with 25-75th percentiles. P-value <0.05 was considered to be statistically significant.

Table 1: Gravity of hypovolemia (clinical evaluation) and treatment

	Gravity	Score	Treatment[1]
Symptoms, SBP>90mmHg, DSBP<20mmHg	Mild	0.5	1 amp NaCl 15%
Symptoms, SBP<90mmHg or DSBP>20mmHg	Moderate	1.0	100 ml NaCl + 1 amp NaCl 15%
No symptoms, SBP<90mmHg and DSBP>20mmHg	Moderate	1.0	100 ml NaCl + 1 amp NaCl 15%
Symptoms, SBP<90mmHg and DSBP>20mmHg	Moderate to severe	2.0	250 ml NaCl + 1 amp NaCl 15%
Loss of consciousness or shock (SBP<70mmHg)	Severe	3.0	500 ml NaCl + 1 amp NaCl 15%

SBP: Systolic Blood Pressure, DSBP: Reduction of Systolic Blood Pressure, [1]: always with stopping of UF for 5 minutes

Results

Patients' mean age was 71.7 years (range: 63-77) and mean duration on dialysis was 46.2 months (range: 5-219). Sixty two (62) sessions were conducted during the whole study. Fourteen (14) of them were excluded. The remaining fourty eight (48) were analysed (Table 2).
Clinically estimated gravity of hypovolemia was minor in profiling model, but not significantly (p=0.081). The number of nursing interventions during the session was signifficantly lesser in profiling group (p=0.035). The rate of sessions without intervention was 29% (n=7) in constant sodium concentration group, and 50% (n=12) in profiling group. Considering the impact of two models in patients' thirst, it seems to be significantly more when profiling model was used (p=0.030). However, this difference was not associated with incresed weight gain (p=0.923) or higher SBP in next session (p=0.843) (Table 2).
Variations of systolic BP (SBP) in two models are depicted in figure 1. The percentage difference reduction of SBP between the two models was significant only in hour 4 (DSBP%=22.6 in constant sodium model versus 11.5 in profiling model, p=0.039).

Table 2: Comparison of two methods

Variable	Contsant $[Na^+]$dialysate	Profiling of $[Na^+]$dialysate and UF	t	z	p
Ideal Body Weight (kg)	71.51±13.78	71.18±13.84	1.960		0.935
UFR (Lit/h)	0.946±0.295	0.917±0.276	0.482		0.634
Serum hemoglobin (gr/dl)	11.37±1.14	10.67±0.95	1.609		0.122
Serum albumin (gr/dl)	4.02±0.29	3.83±0.17	1.859		0.076
Gravity of hypovolemia	2 (0.25-2.75)	0.25 (0-2)		-0.456	0.081
Number of interventions	1(0.25-2)	0.5 (0-1)		-2.109	0.035
Time to first hypovolemic event (min)	168.3+65.2	154.2+81.8	0.503		0.603
Post-dialysis body weight difference (kg)	0.050 (0-0.375)	0.100 (0-0.350)		-0.456	0.648
Thirst	2.71±1.20	3.13±1.15		-2.318	0.030
Interdialytic weight gain (kg)	3.12±1.21	3.10±1.30	0.098		0.923
SBP before next session (mmhg)	131.5+24.8	130.6+25	0.200		0.843

P-value was calculated using t-test for variables with normal distribution or wilcoxon test for variables with ubnormal distribution.

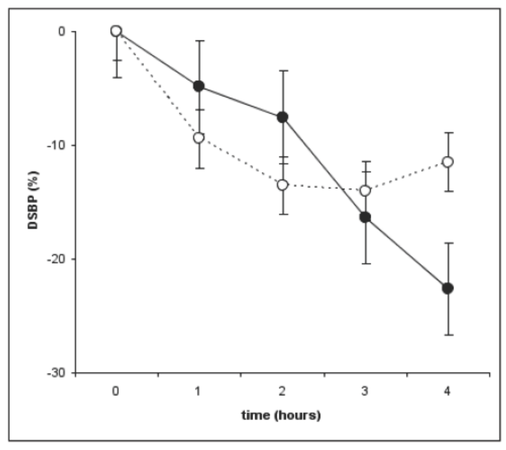

Figure 1: Percentage changes in hourly SBP. Continuous line: constant dialysate sodium concentration (145meq/L) and UFR. Dotted line: profiling of dialysate sodium concentration (140-150meq/L) and UFR. Statistically significant difference is noted in 4th hour (p=0.039).

Conclusions

Sodium and UFR profiling, with linearly increasing sodium concentration and linearly decreasing UFR, is a safe and efficient method for the prevention of blood volume reduction and hypotension during hemodialysis in ESRD patients.

Bibliography

1. Bregman H, Daugirdas JT, Ing TS. Complications during hemodialysis. In: Daugirdas JT. Handbook of dialysis. Philadelphia: Lippincott Williams and Wilkins, 2001: 148-168.
2. Donauer J, Kolblin D, Bek M, Krause A, Bohler J. Ultrafiltration profiling and measurement of relative blood volume as strategies to reduce haemodialysis- related side effects. Am J Kidney Dis 2000; 36: 115-123.
3. Tatsua S, Tsubakihira T, Fujii M, Imai E. Haemodialysis – associated hypotension as an independent risk factor for two years mortality in haemodialysis patients. Kidney Int 2004;66: 1212-1220.
4. Yi Lun Zhou, Hui Lan Liu, Xiao Feng Duan, Ying Yao, Yi Sun, Qun Liu. Impact of sodium and ultrafiltration profiling on haemodialysis- related hypotension. Nephrol Dial Transplant 2006; 21: 3231-3237.
5. Stiller S, Bonnie-Schorn E, Grassmann A, Uhlenbusch-Korwer I, Mann H. A Critical Review of Sodium Profiling for Haemodialysis. Semin Dial 2001; 14: 337-347.
6. Anonymous. NKF.K/DOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients. Am J Kidney Dis 2005; 45 (suppl 3): S1- S154.

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