SODIUM GRADIENT AND ITS CONSEQUENCES

Vieira P, Gonçalves AM, Guimarães Rosa N, Resende L, Durães JM, Teixeira A, Silva G
Hemodialyis Unit, Nephrology Department, Hospital Central do Funchal, Madeira

Introduction

Hemodialysis (HD) patients lack normal homeostatic mechanisms to regulate body water volume and osmolality. However they too seem to have its own individual's osmolar set point, and being dialysed against a positive sodium gradient, coupled with diffusive gain, might be associated, as previous studies support, with increased interdialytic weight gain (IDWG) and blood pressure. Therefore, considering the possible associated morbi-mortality, we've looked for clinical outcomes associated to positive sodium gradient.

Methods

We conducted a cross-sectional study at a hospital based HD unit, from March 1st, 2013 to April 31st 2013, comprising 40 clinically stable patients undergoing conventional thrice-weekly HD. A descriptive analysis of each patient sodium dialysis prescription and analytical/clinical data was assessed for statistical analysis.

Standard dialysate prescriptions were composed as follows: potassium 2.0 mEq/L; bicarbonate, 32-34 mEq/L; and calcium, 2.5–3.5 mEq/L. The prescription included a session length of 180–240 minute, blood flow of 300–450 mL/minute, and dialysate flow of 450–650 mL/minute. The sodium gradient was defined by the prescribed dialysate Na^+ minus the average plasma Na^+, the latter calculated as the mean of the plasma Na^+ assessments during the study. IDWG was calculated as the average value between the post-dialysis body weight and the next dialysis session's pre-dialysis body weight. Considering the necessary adjustment to the body dry weight, we've calculated IDWG as a percentage of body weight (IDWG%BW). The dialysate sodium and dry weight were prescribed by the patient's treating nephrologist based upon clinical evaluation. HD-related adverse events including cramps and hypotension were recorded by the nursing staff. We defined intradialytic hypotension as at least one episode of a fall in systolic BP >20 mmHg associated with symptoms or with any intervention during the last treatment. Plasma Na+ concentration was measured using ion selective electrodes. Dialysate Na+ concentration was determined using online conductivity measurements built into the Fresenius H series hemodialysis machine, used for all patients.

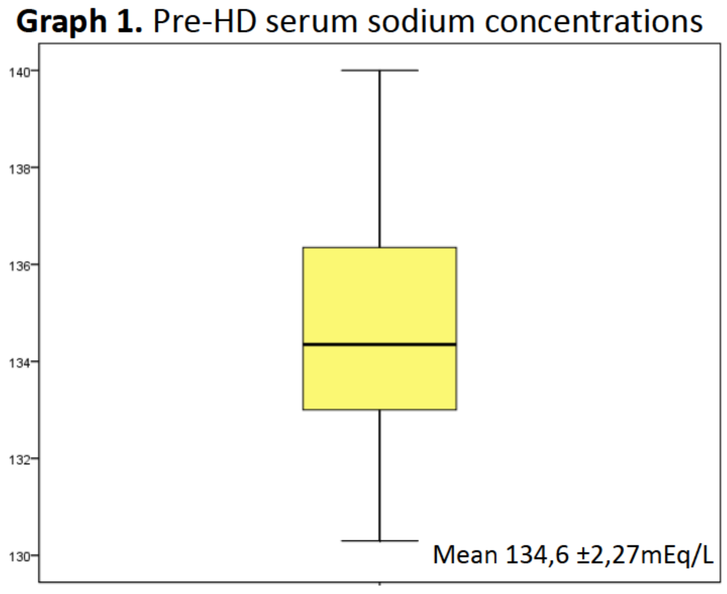
Results

The patient characteristics are shown in Table 1. From the analysis of both the prescription and clinical data of the patients comprised in the study we found that the dialysate sodium prescription ranged from 138-140mEq/L (median of 140 mEq/L) while the mean pre-HD serum sodium was 134,6 ±2,27mEq/L (Graph 1). This resulted in a mean sodium gradient of 5,0 ±2,3mEq/L (Graph 2) with the majority of patients (n=39, 97,5%) being dialysed against a positive sodium gradient.

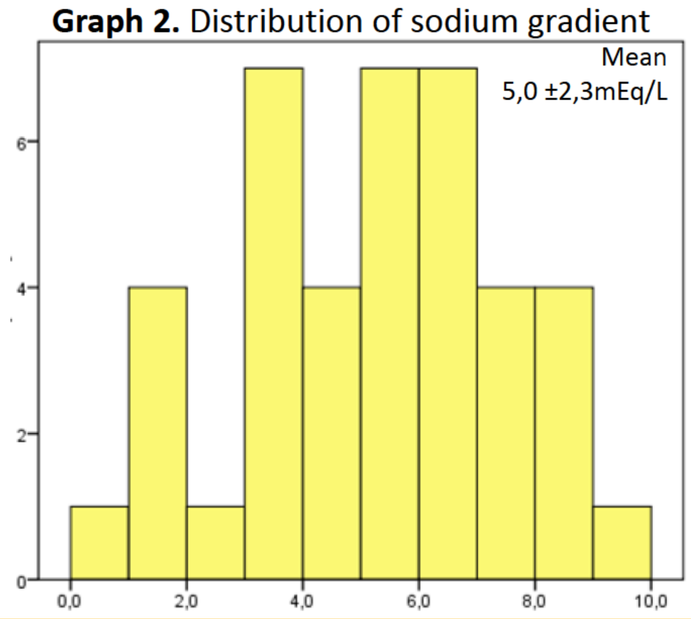
Table 1. Clinical characteristics of patient population

	n=40
Age (years)	63,1 ±19,68
Male	19 (47,5%)
Co-morbilities	39 (97,5%)
HD vintage (months)	48,1 ±68,57
Vascular acess	
AVF	12 (30%)
PTFE graft	2 (5%)
CVC HD	26 (65%)
spKT/V	1,40 ±0,35
$Na^+_{dialysate}$ (mEq/L)	139,60 ±0,81
$[Na^+]_{plasma\ pre\ HD}$ (mEq/L)	134,6 ±2,27
Na^+ gradient (mEq/L)	5,0 ±2,34
IDWG (Kg)	1,74 ±0,77

Graph 1. Pre-HD serum sodium concentrations

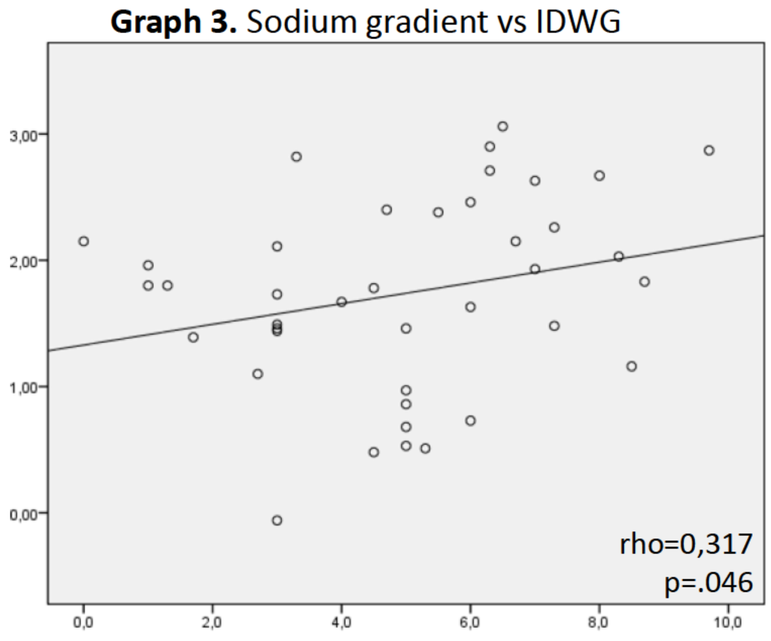


Graph 2. Distribution of sodium gradient

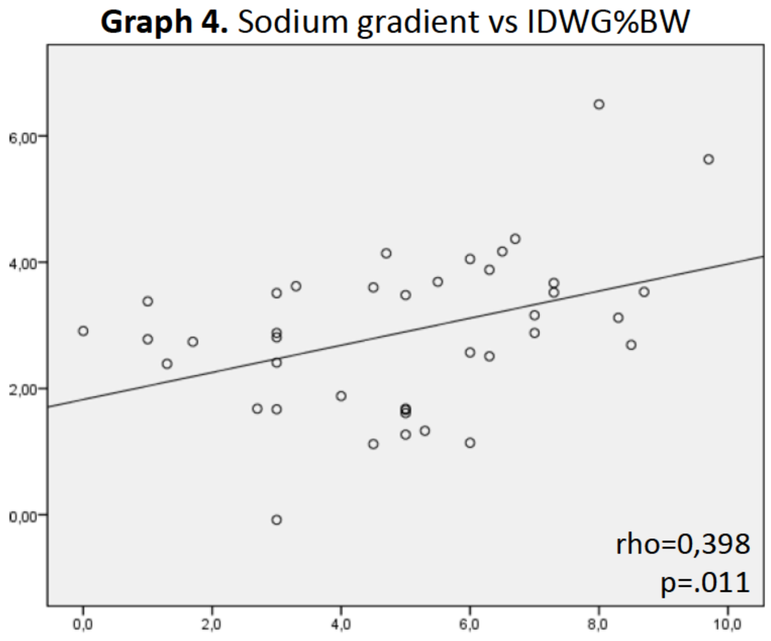


We found a direct correlation between sodium gradient and IDWG (ρ=0,317, p<.05) (Graph 3), sodium gradient and IDWG%BW (ρ=0,398, p<.05) (Graph 4) and sodium gradient and number of intradialytic hypotensive episodes (ρ=0,540, p<.01) (Graph 5), being R^2 linear= 0,31 meaning that >30% of the latter events were due to positive sodium gradient. After adjustment for confounders (age, dialysis vintage, dry weight), the sodium gradient was independently associated with number of intradialytic hypotensive episodes (p=.022). Co-variance analysis failed to isolate significative differences between sodium gradient and IDWG (p=.208) e IDWG%BW (p=.0113) after previously mentioned confounders adjustment.

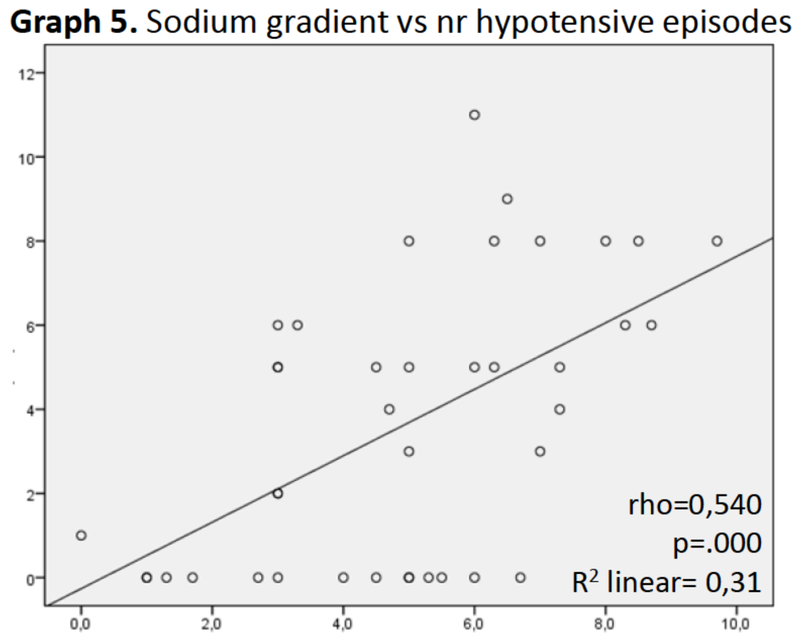
Graph 3. Sodium gradient vs IDWG



Graph 4. Sodium gradient vs IDWG%BW



Graph 5. Sodium gradient vs nr hypotensive episodes



Despite positive trends we found no significant associations either between sodium gradient and blood pressure control, number of antihypertensive agents, hospitalizations, medical complications or death (Table 2):

Sodium gradient vs	Non-parametric correlation	Sodium gradient vs	Linear Logistic regression
blood pressure profile	p=.172	Hospital admissions	p=.065
Number of hypotensive agents	p=.879	Medical complications	p=.118
		Death	p=.150

Table 2. Furher statistical analysis on sodium gradient and clinical outcomes

Conclusions

Increased IDWG and its adverse short and long-term effects are extensively described, and considering that despite the small sample, it was possible to find statistical significance between the sodium gradient and IDWG, %IDWG apart from intradialytic hypotensive episodes, we add to the importance of individual hemodialysis sodium prescription in order to look for alignment between the dialysate sodium with the serum sodium concentration.

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