

Brief Report

Low sodium haemodialysis reduces interdialytic fluid consumption but paradoxically increases post-dialysis thirst

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Abstract

Background. Interdialytic weight gain (IDWG) can be reduced by lowering the dialysate sodium concentration ([Na]) in haemodialysis patients. It has been assumed that this is because thirst is reduced, although this has been difficult to prove. We compared thirst patterns in stable haemodialysis patients with high and low IDWG using a novel technique and compared the effect of low sodium dialysis (LSD) with normal sodium dialysis (NSD).

Methods. Eight patients with initial high IDWG and seven with low IDWG completed hourly visual analogue ratings of thirst using a modified palmtop computer during the dialysis day and the interdialytic day. The dialysate [Na] was progressively reduced by up to 5 mmol/l over five treatments. Dialysis continued at the lowest attained [Na] for 2 weeks and the measurements were repeated. The dialysate [Na] then returned to baseline and the process was repeated.

Results. Baseline interdialytic day mean thirst was higher than the dialysis day mean for the high IDWG group (49.9 ± 14.0 vs 36.2 ± 16.6) and higher than the low weight gain group (49.9 ± 14.0 vs 34.1 ± 14.6). This trend persisted on LSD, but there was a pronounced increase in post-dialysis thirst scores for both groups (high IDWG: 46 ± 13 vs 30 ± 21 ; low IDWG: 48 ± 24 vs 33 ± 18). The high IDWG group demonstrated lower IDWG during LSD than NSD (2.23 ± 0.98 vs 2.86 ± 0.38 kg; $P < 0.05$).

Conclusions. Our results indicate that patients with high IDWG experience more intense feelings of thirst on the interdialytic day. LSD reduces their IDWG, but paradoxically increases thirst in the immediate post-dialysis period.

Keywords: thirst; weight gain; low sodium haemodialysis

Introduction

Reducing the dialysate sodium concentration ([Na]) removes excess sodium from haemodialysis patients and has produced reductions in crude thirst ratings and interdialytic weight gain (IDWG) [1]. We have previously used a palmtop computer to record serial visual analogue scores for thirst. This allowed us to produce thirst profiles and derive summary statistics to compare groups [2]. In this study, we assessed the effect of low sodium dialysis (LSD) on two groups of haemodialysis patients. One had high baseline IDWG, the other low. We sought to compare the thirst patterns of the two groups at baseline and test the hypothesis that LSD would reduce thirst and, therefore, fluid consumption.

Subjects and methods

Fifteen stable patients were recruited. Eight had initial weight gains >1 kg/day (mean: 1.55 ± 0.25 kg/day) (HiWG) and seven had initial weight gains <1 kg/day (mean: 0.48 ± 0.23 kg/day) (LoWG). Patients taking angiotensin-converting enzyme inhibitors or angiotensin receptor blockers were excluded. None were diabetic. Most patients dialysed against a sodium concentration of 137 mmol/l, but three used a 'programmed sodium' regime with a stepped reduction in sodium concentration halfway through the treatment session (e.g. 142 mmol/l for the first 2 hours then 140 mmol/l for the second 2 hours). These individuals had previously experienced intradialytic symptoms such as hypotension, headache or cramp, which had been attributed to sodium removal during treatment. Such patients were not excluded from the study because they had high weight gains and it was difficult

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to determine whether their symptoms were due to water removal or sodium removal.

During their dialysis session, the patients were instructed in the use of the palmtop computer. This was programmed to alarm at hourly intervals until 20.00 on the dialysis day and between 08.00 and 20.00 on the interdialytic day. Each time the alarm rang, the patients would open the palmtop and the question 'How thirsty do you feel?' would appear on the screen. A line accompanied this with a cursor in the middle. The ends of the line were labelled as 'not at all' and 'extremely'. The patient would then use one of two keys to move the cursor along the line, thus, providing a visual analogue rating of their thirst at that moment. The palmtop stored this data so that the complete recordings could be downloaded to a computer for analysis. The mean of each individual's daily scores was used to generate a group mean score. The mean of the recordings from the 2h immediately following the end of dialysis is shown as 'post-dialysis'. For a more detailed description of the technique, see Wright *et al.* [2,3].

The patients performed an interdialytic urine collection to quantify residual urine output. The IDWG results represent the mean weight gains from the last week of each phase of the study. The sum of the mean IDWG and urine output at each sampling point was taken to represent the interdialytic fluid consumption.

After the baseline recordings, the dialysate sodium concentration was reduced by 1mmol/l each treatment for five sessions, so, for most, LSD represented dialysis against a [Na] of 132mmol/l. Patients using 'programmed sodium' regimes reduced at a similar rate, so a starting regime of 142mmol/l for 2h followed by 140mmol/l for 2h would end as 137mmol/l for 2h and 135mmol/l for 2h. If patients experienced intradialytic symptoms, the dialysate sodium was increased by 1mmol/l per treatment until the symptoms were abolished. Dialysis continued at the lowest attained sodium concentration for 2 weeks before the thirst profiles and urine collections were repeated. All dialysate sodium concentrations returned to baseline for a month before the process was repeated (normal sodium dialysis, NSD).

Results

HiWG vs LoWG

The HiWG group was younger (mean: 42.6 ± 12.8 vs 68.6 ± 5.1 years; $P < 0.001$) than the LoWG group and had more anuric individuals (five vs one). None of the HiWG group passed > 500 ml of urine per day. The median baseline urine output for the LoWG group was 388 ml per day (range: 0–1000 ml). The HiWG group had been on dialysis for longer than their LoWG counterparts (median: 54 vs 30 months). Table 1 indicates that baseline pre-dialysis serum osmolality was non-significantly higher for the HiWG and displays serum sodium and urea values as well as weight gain data.

When the thirst data were compared, discrepancies were evident (Figure 1, Table 2). At baseline, the HiWG group generated higher thirst scores on the interdialytic day than the dialysis day, whereas the LoWG group produced similar scores on both days.

LSD vs NSD

The HiWG group had their lowest IDWG and fluid consumption on LSD (Table 1). The LoWG group demonstrated little change in these parameters. The pre-dialysis serum osmolality was non-significantly lower during the low sodium phase for both groups. The HiWG group consistently returned higher interdialytic day scores than the LoWG group throughout the study. Contrary to our expectations, both groups' dialysis day and post-dialysis scores were highest during the LSD phase.

Discussion

The different baseline thirst profiles of the two groups imply that there may be physiological differences

Table 1. The effect of LSD on fluid consumption and serum osmolality

	Baseline	LSD	NSD	ANOVA
HiWG				
IDWG (kg)	3.17 ± 0.55^a	2.23 ± 0.98	2.86 ± 0.38^b	0.002
FC (kg)	3.31 ± 0.33^c	2.30 ± 0.81	2.90 ± 0.36^b	< 0.001
Pre [Na] (mmol/l)	136.1 ± 1.9	135.1 ± 6.3	136.3 ± 2.0	NS
Post [Na] (mmol/l)	134.5 ± 1.7	131.8 ± 2.7	135.0 ± 2.4	NS
Pre [urea] (mmol/l)	28.4 ± 6.5	29.6 ± 5.5	26.7 ± 3.4	NS
Pre osmolality (mOsm/l)	314.5 ± 8.7	310.5 ± 10.9	315.9 ± 11.6	NS
LoWG				
IDWG (kg)	0.97 ± 0.46	1.14 ± 0.60	1.22 ± 0.55	NS
FC (kg)	1.90 ± 0.50	2.04 ± 0.61	1.84 ± 0.49	NS
Pre [Na] (mmol/l)	135.4 ± 3.3	136.9 ± 4.6	137.1 ± 2.4	NS
Post [Na] (mmol/l)	134.3 ± 1.6^b	132.1 ± 1.7	134.6 ± 1.1^a	0.006
Pre [urea] (mmol/l)	22.2 ± 7.5	26.0 ± 7.4	24.7 ± 5.7	NS
Pre osmolality (mOsm/l)	306.7 ± 10.4	305.1 ± 10.6	308.7 ± 9.4	NS

ANOVA, analysis of variance; FC, fluid consumption; NS, not significant.

^a $P < 0.01$, ^b $P < 0.05$ and ^c $P < 0.001$ vs LSD.

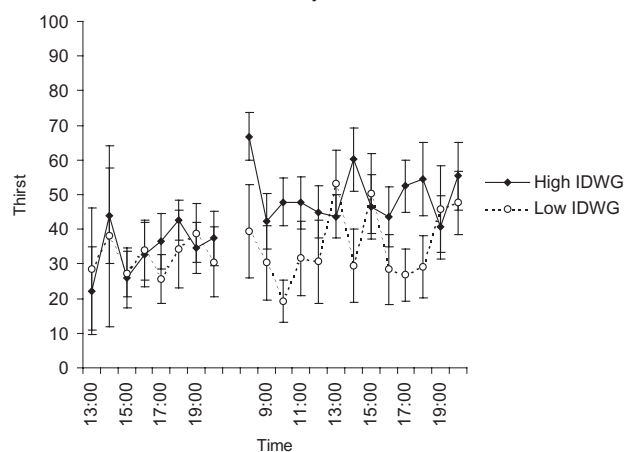


Fig. 1. Baseline thirst profiles for the high and low weight gain groups. Each point represents the mean score at that time point, with the error bars showing SEM. Scores were similar during the dialysis day, but the group with the highest weight gain was consistently more thirsty on the interdialytic day.

Table 2. Derived thirst scores

	Baseline	LSD	NSD
HiWG			
Post-dialysis	29.5 ± 20.9	45.5 ± 12.9	33.7 ± 17.6
DD mean	36.2 ± 16.6	41.9 ± 16.3	34.7 ± 17.1
ID mean	49.9 ± 14.0	48.2 ± 9.9 ^a	51.1 ± 9.0
LoWG			
Post-dialysis	33.0 ± 17.9	48.0 ± 23.6	37.2 ± 17.3
DD mean	32.1 ± 15.4	39.1 ± 15.6	34.8 ± 11.0
ID mean	34.1 ± 14.6	37.6 ± 8.3	40.7 ± 16.2

Post-dialysis is the 2 h period immediately after dialysis. DD, dialysis day; ID, interdialytic day.

^a $P < 0.05$ vs LoWG LSD ID mean.

between them. This may simply reflect the age discrepancy between the groups. Fluid consumption decreases with age [4] and the LoWG group were older than their HiWG counterparts. There were other differences, however. The HiWG group had more anuric individuals and a higher serum osmolality

(although this was not statistically significant). It might be that residual kidney function metabolizes osmotically active molecules or provides clearance of a small but crucial amount of sodium.

There was a reduced fluid intake on LSD with little evidence of reduced interdialytic day thirst scores. Thus, it appears that thirst was maintained at its usual level by consumption of less fluid, but it was not reduced as claimed previously [1]. Indeed, there was a notable increase in post-dialysis scores in both groups, suggesting that a different drive to thirst perception might have been activated. LSD might have reduced the vascular refilling rate, such that intravascular volume depletion was greater than during normal dialysis. This might have stimulated thirst via central baroreceptor mechanisms or by activating the renin-angiotensin system.

In summary, it appears that LSD reduces fluid consumption for patients with high IDWG without causing a noticeable reduction in thirst. Indeed, LSD caused a marked increase in post-dialysis thirst for all participants.

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Conflict of interest statement. None declared.

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