# BE AWARE OF CALCIUM GAIN WHEN USING CITRATE-BASED DIALYSATE FOR CHRONIC HAEMODIAFILTRATION

Jan Havlin, Svetlana Vankova | B. Braun Avitum, Dialysis Centre, Prague, CZECH REPUBLIC



## INTRODUCTION AND AIMS

Citrasate® is an acidic dialysate concentrate, where citric acid is used instead of the traditional acetic acid. Citrate prevents clotting of the dialysis circuit by forming complexes with ionized calcium. When using Citrasate® it is recommended to increase the dialysate calcium by 0.25 mmol/L to prevent a decrease of serum calcium. Despite this precaution we observed, after several weeks of using Citrasate®, a higher frequency of hypotensive episodes and cramps in some patients as shown in Figure 1 and 2. We hypothesized, that the reason could be a progressive calcium (Ca) and/or magnesium (Mg) deficit related to the change of diffusion gradients between the serum and the dialysate due to the forming of citrate complexes with these cations. Therefore, we compared the intradialytic changes of serum Ca and Mg and their mass balances using standard acetate- and citrate-based dialysates.

## STUDY SUBJECTS

We enrolled 10 stable patients with end-stage renal disease on chronic post-dilution HDF dialysed three times a week. The characteristics of the patients are shown in Table 1. All of the patients were using calcium carbonate (1.5 – 4 g/day), 1 patient used calcitriol (0.25 mcg three times a week after HDF) and 7 patients received $NaHCO_3$ (500 – 1500 mg/day). None of them used calcimimetics. The mean residual urine volume was 775 ± 301 ml/day.

## DESIGN OF THE STUDY

All of the patients underwent 2 HDF treatments (midweek session) using a different dialysate: Citrasate® with calcium concentration 1.5 mmol/L and a standard acetate-based dialysate with calcium 1.25 mmol/L. The dialysate bicarbonate concentration was 32 mmol/L for both. Blood was sampled before and after HDF for total (tCa), ionized (iCa) serum calcium and magnesium. The calcium (CMB) and magnesium mass balances (MMB), gradients from the dialysate to the patient, without the effect of ultrafiltration, were determined from the cation levels in the dialyzer inlet and from the continuous partial spent dialysate collection (150ml/h) samples. We calculated the differences between post-dialysis and pre-dialysis values (ΔtCa, ΔiCa, ΔMg). Other parameters were set as follows: session duration: 4 hours, the filter: high-permeability polysulfone 1.5-1.8m², the blood flow: 350 ml/min, the dialysate flow: 700 ml/min and the total exchange volume: 19.8 L.

## CALCULATIONS

- CMB = [tCa concentration in the inlet dialysate × QD × t] – [tCa concentration in spent dialysate × (QD × t)], where QD = dialysate flow (ml/min), t = session duration (min).
- ΔtCa, ΔiCa, ΔMg, $\Delta HCO_3$, ΔpH were calculated as the differences between post-dialysis and pre-dialysis values.

## STATISTICS

- The results are expressed as means ±SD
- The significance of the differences were tested by Student´s t-test for paired data
- The correlation between two parameters was evaluated by linear regression analysis

## RESULTS

The results of the measured and calculated parameters are shown in Table 2.

- The mean CMB was positive using Citrasate® and almost neutral using the standard dialysate (Figure 3).
- The mean serum tCa level increased significantly using Citrasate®, while it remained almost stable using standard dialysate (Figure 4).
- The mean serum iCa level slightly decreased using standard dialysate and remained almost stable using Citrasate® (Figure 5).
- The mean MMB was slightly negative for both solutions and the mean serum Mg level decreased significantly using Citrasate®, while it remained almost stable using standard dialysate
- We found no significant differences between Kt/V, ultrafiltration volume or pre-dialysis serum concentrations of tCa, iCa and Mg when comparing both groups.

## CONCLUSIONS

- We observed a significantly higher CMB and intradialytic increase of serum tCa when using Citrasate®, although iCa in the inlet citrate-based dialysate was significantly lower.
- The CMB is mostly dependent on the dialysate content of tCa, but not of iCa. We found no differences between MMB, ΔMg or ΔiCa when comparing citrate- and acetate-based dialysate.
- There was a positive CMB when using Citrasate® with the recommended increased Ca content, which, theoretically, can contribute to extraosseal calcification.
- **The intradialytic loss of calcium and change of serum iCa are not the causes of previously observed higher frequency of hypotension episodes and cramps when using Citrasate® as expected.**

Table 1

| | |
|---|---|
| Age (years) | 71 ± 5 |
| Gender (male/female) | 3/7 |
| Weight (kg) | 66 ± 14 |
| Height (cm) | 160 ± 7 |
| BMI (kg/m²) | 25.7 ± 0.2 |
| Etiology of CKD | |
| Diabetic nephropathy | 4 |
| Vascular nephropathy | 2 |
| Combination of diabetic and vascular nephropathy | 3 |
| Chronic tubulointersticial nephritis | 1 |

Data are reported as means ± SD or as a number of all 10 patients.
BMI = body mass index; CKD = chronic kidney disease.

Table 2

| N = 10 | CITRASATE® | STANDARD | P* |
|---|---|---|---|
| CMB (mg) | 259.7 ± 240.9 | -20.2 ± 195.8 | **0.009** |
| MMB (mg) | -54.6 ± 105.6 | -49.9 ± 77 | NS |
| Plasma tCa pre (mmol/L) | 2.22 ± 0.13 | 2.23 ± 0.1 | NS |
| Plasma tCa post (mmol/L) | 2.41 ± 0.11 | 2.24 ± 0.13 | **0.004** |
| Plasma iCa pre (mmol/L) | 1.152 ± 0.059 | 1.189 ± 0.054 | NS |
| Plasma iCa post (mmol/L) | 1.142 ± 0.036 | 1.15 ± 0.026 | NS |
| Plasma Mg pre (mmol/L) | 0.86 ± 0.16 | 0.9 ± 0.13 | NS |
| Plasma Mg post (mmol/L) | 0.76 ± 0.04 | 0.83 ± 0.04 | **0.002** |
| Blood pH pre | 7.367 ± 0.028 | 7.355 ± 0.035 | NS |
| Blood pH post | 7.447 ± 0.023 | 7.450 ± 0.025 | NS |
| Blood $HCO_3$ pre (mmol/L) | 20.9 ± 1.37 | 20.9 ± 1.37 | NS |
| Blood $HCO_3$ post (mmol/L) | 27 ± 0.6 | 26.7 ± 0.9 | NS |
| ΔtCa (mmol/L) | 0.183 ± 0.107 | 0.006 ± 0.13 | **0.003** |
| ΔiCa (mmol/L) | -0.01 ± 0.044 | -0.039 ± 0.042 | NS |
| ΔMg (mmol/L) | -0.087 ± 0.135 | -0.073 ± 0.097 | NS |
| ΔpH | 0.08 ± 0.023 | 0.095 ± 0.022 | NS |
| $\Delta HCO_3$ (mmol/L) | 6.2 ± 1.1 | 5.8 ± 1.6 | NS |
| Di_Ca | 1.619 ± 0.034 | 1.29 ± 0.027 | **<0.001** |
| Di_iCa | 1.006 ± 0.02 | 1.165 ± 0.012 | **<0.001** |
| Di_Mg | 0.526 ± 0.011 | 0.528 ± 0.011 | NS |
| Di_pH | 7.31 ± 0.02 | 7.26 ± 0.032 | **0.003** |
| Di_$HCO_3$ (mmol/L) | 34.3 ± 0.57 | 34.4 ± 0.98 | NS |

Data are reported as means ± SD. ΔtCa, ΔiCa and ΔMg = differences between postdialysis and predialysis values; Di_Ca, Di_iCa, Di_Mg, Di_pH, Di_$HCO_3$ = inlet dialysate concentrations; *P value for the comparison between Citrasate® and standard bicarbonate dialysate (paired t-test); NS = nonsignificant.

**Figure 1**
Relationship between the percentage of Citrasate® dialysate and frequency of hypotension episodes for each month in a total duration of 22 months.

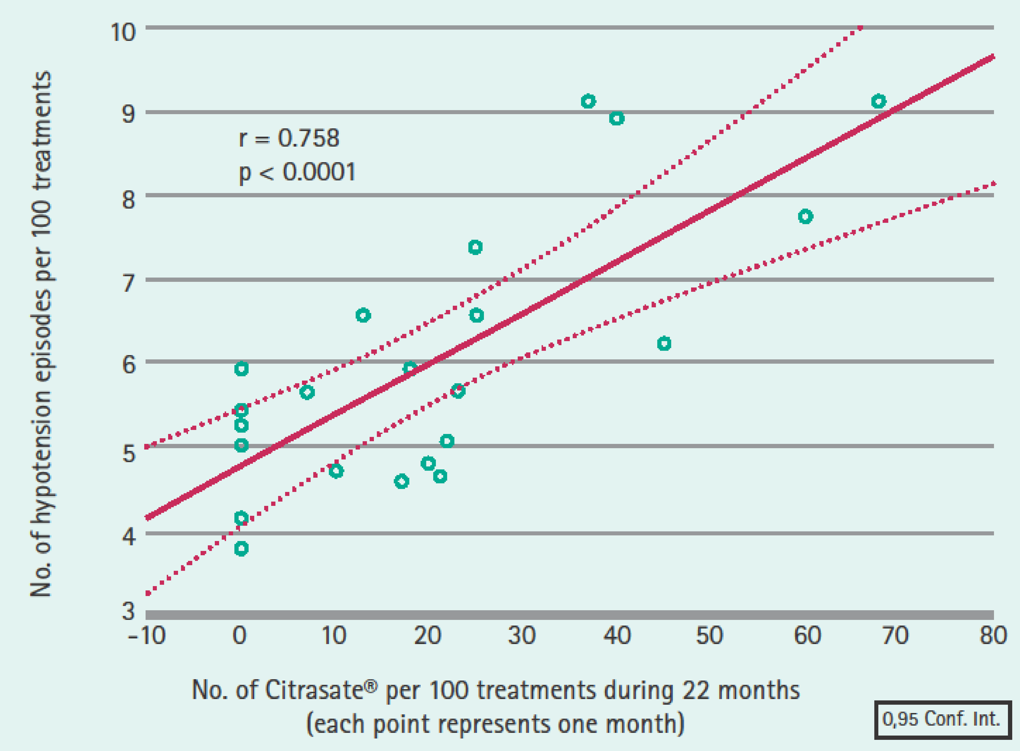



**Figure 2**
Relationship between the percentage of Citrasate® dialysate and frequency of muscle cramps for each month in a total duration of 22 months.

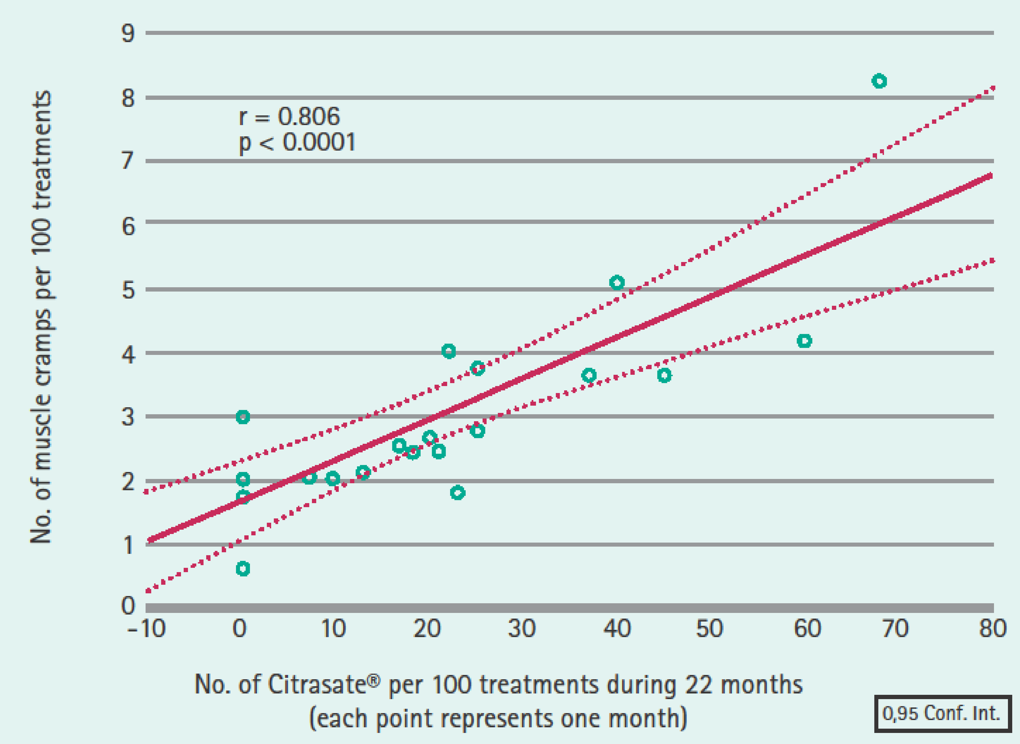



**Figure 3**
Calcium and magnesium mass balances during HDF using standard dialysate with calcium 1.25 and Citrasate® with calcium 1.5 mmol/L

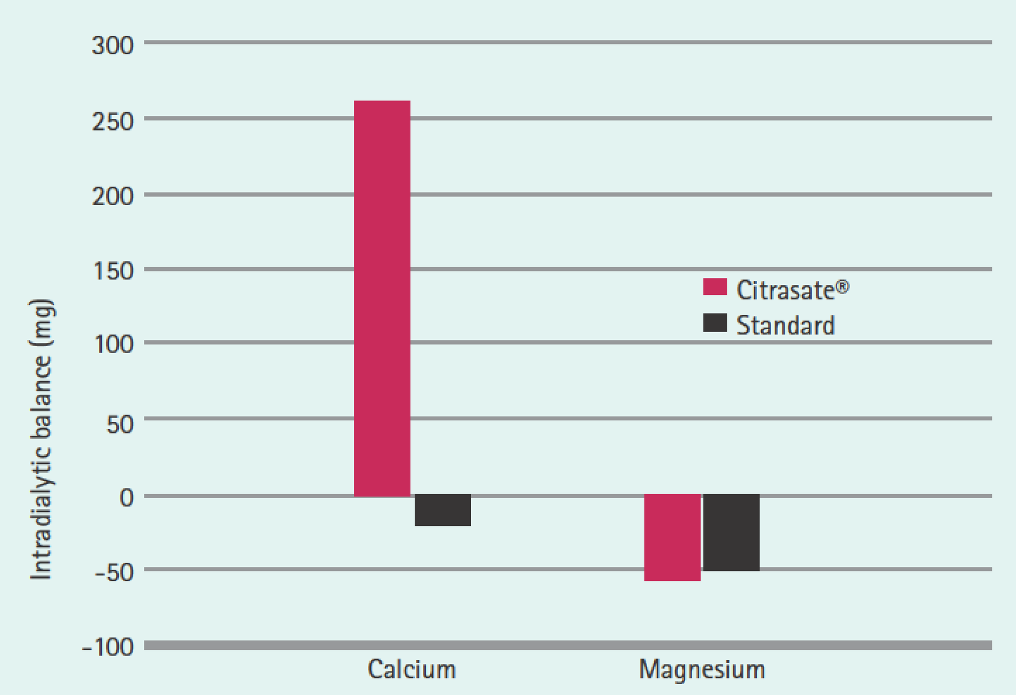



**Figure 4**
Total calcium serum concentration before and after haemodiafiltration

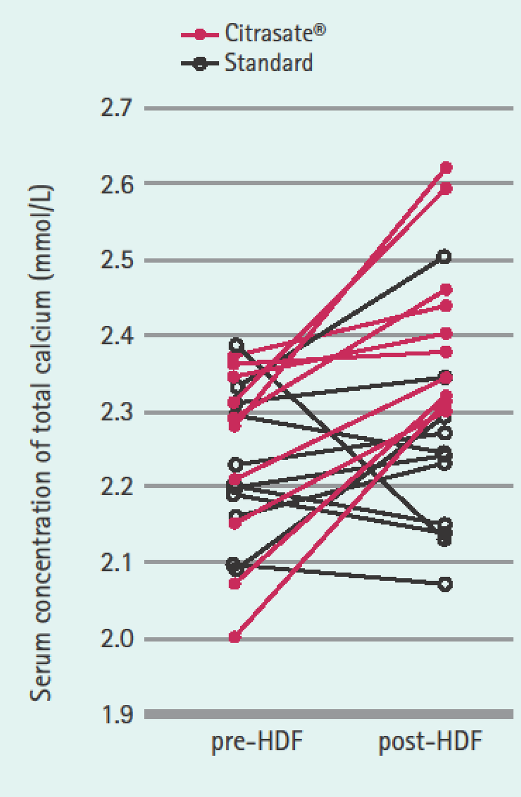
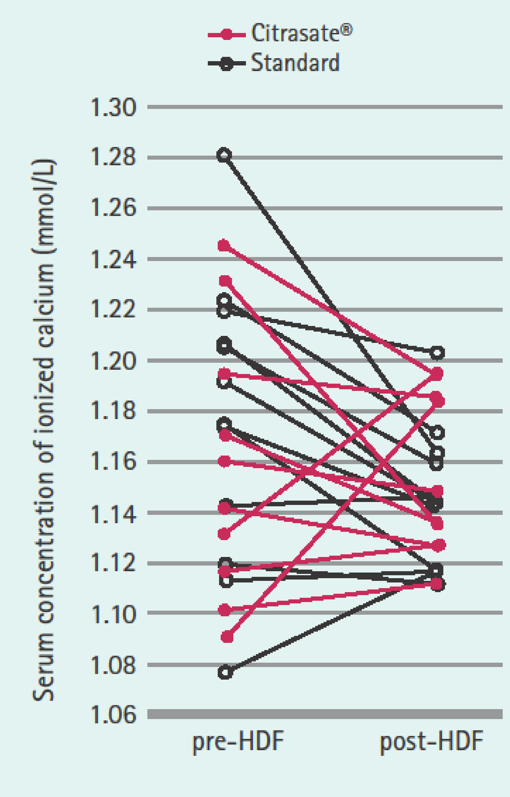



**Figure 5**
Ionized calcium serum concentration before and after haemodiafiltration




52 ERA 480--FP
L1) Dialysis. Extracorporeal dialysis: techniques and adequacy.
Jan Havlin
DOI: 10.3252/pso.eu.52era.2015
ePosters supported by F. Hoffmann- La Roche Ltd.