

# CHANGES IN CALCIUM CONCENTRATION AND MASS IN EXTRACELLULAR COMPARTMENT DURING ONE WEEK CYCLE OF HEMODIALYSIS

**Authors:** Jacek Waniewski<sup>1</sup>, Malgorzata Debowska<sup>1</sup>, Alicja Wojcik-Zaluska<sup>2</sup>, Andrzej Ksiazek<sup>3</sup>, Wojciech Zaluska<sup>3</sup>

<sup>1</sup> Department of Mathematical Modeling of Physiological Processes, Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Sciences, Warsaw, Poland

<sup>2</sup> Department of Physical Therapy and Rehabilitation, Medical University of Lublin, Lublin, Poland

<sup>3</sup> Department of Nephrology, Medical University of Lublin, Lublin, Poland

## OBJECTIVES

The distribution and shifts of calcium during and between dialysis sessions depend on many factors, as calcium concentration in dialysis fluid, levels of hormones that control mineral metabolism, and calcium intake. We present a quantitative assessment of calcium kinetics and mass balance in extracellular compartment during the weekly cycle of three hemodialysis sessions with standard calcium concentration.

## METHODS

Twenty five patients on HD were examined during three consecutive hemodialysis sessions of one week dialysis treatment cycle (with the interdialytic breaks of 2-2-3 days) and before the fourth session. Total and ionic calcium concentrations were measured in serum before, at 1, 2 and 3 h, at the end and 45 min after each session and every 30 min in dialysate. The volume of extracellular water was assessed by bioimpedance (BCM) before, at the end, and 45 min after each session. The concentration of calcium in dialysis fluid was 1.25 mmol/L.

## RESULTS

The concentration of calcium in plasma before dialysis was  $2.18 \pm 0.18$  mmol/L with 42% in ionic form, increased during dialysis sessions to  $2.36 \pm 0.17$  mmol/L ( $p < 0.001$ ) with 40% in ionic form, and slightly decreased at 45 min after the end of dialysis to  $2.31 \pm 0.17$  mmol/L ( $p < 0.001$  vs. start of dialysis session) without any further change in percentage of ionic form, Table 1. In contrast, the extracellular calcium mass decreased from  $34.65 \pm 6.41$  mmol at the beginning of dialysis session, to  $32.69 \pm 6.8$  mmol at the end of dialysis session (mostly because of the decrease in extracellular volume by  $2.5 \pm 0.9$  L due to ultrafiltration) and further to  $31.96 \pm 6.7$  mmol after 45 min from the end of dialysis session ( $p < 0.001$  vs. start of dialysis session, Table 1) mostly because of the drop in calcium concentration. The changes in calcium mass during the first dialysis session (after 3 days of interdialytic break) were from  $35.89 \pm 6.55$  to  $33.61 \pm 7.25$  to  $32.73 \pm 7.22$  mmol, respectively, whereas during the second and third dialysis sessions (both after 2 days of interdialytic break) were from  $34.05 \pm 6.33$  to  $32.24 \pm 6.6$  to  $31.58 \pm 6.47$  mg, respectively, Table 1. The changes in ionic calcium followed the patterns for total calcium. The net decrease in total calcium mass in extracellular compartment during dialysis of  $1.96 \pm 2.84$  mmol was similar to and correlated with calcium mass removed in dialyzer ( $1.67 \pm 6.02$  mmol;  $\rho = 0.41$ ,  $p < 0.001$ ); it correlated also with absorption of ionic calcium in dialyzer ( $\rho = 0.58$ ,  $p < 0.001$ ).

**Table 1. Concentration and mass of total calcium in extracellular compartment before, after and 45 min after the end of HD session.**

	Before HD	After HD	45 after HD
Concentration, mmol/L			
All sessions	$2.18 \pm 0.18$ (42%)	$2.36 \pm 0.17$ (40%)*	$2.31 \pm 0.17$ (40%)*
After 3-day break	$2.17 \pm 0.18$ (42%)	$2.39 \pm 0.18$ (40%)*	$2.33 \pm 0.18$ (40%)*
After 2-day break	$2.18 \pm 0.18$ (42%)	$2.35 \pm 0.17$ (40%)*	$2.3 \pm 0.16$ (40%)*
Mass, mmol			
All sessions	$34.65 \pm 6.41$ (42%)	$32.69 \pm 6.8$ (40%)	$31.96 \pm 6.7$ (40%)*
After 3-day break	$35.89 \pm 6.55$ (41%)	$33.61 \pm 7.25$ (40%)	$32.73 \pm 7.22$ (40%)
After 2-day break	$34.05 \pm 6.33$ (42%)	$32.24 \pm 6.6$ (40%)	$31.58 \pm 6.47$ (40%)

\* significant change vs. start of HD session

## CONCLUSIONS

We conclude that in hemodialysis patients on standard (1.25 mmol/L) concentration of calcium in dialysis fluid, the concentrations of total and ionic calcium in the extracellular compartment increase during dialysis sessions and decrease between the sessions, whereas the masses of total and ionic calcium decrease during the sessions and increase between them. The weak correlations between the changes in extracellular calcium mass and the removed calcium mass may be linked to the importance of the opposite transport of ionic and complexed forms of calcium in the dialyzer and the role of the other calcium pools in the maintenance of calcium mass balance in the extracellular compartment.

