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The Serum Calcification Propensity of Hemodialysis Patients is Strongly Modified by Serum Phosphate, Magnesium and Bicarbonate

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Background

Serum calcification propensity as measured by the T50 test (Pasch, JASN 2012, 23:1744) has been validated as a strong predictor of morbidity and mortality in hemodialysis patients. We sought to identify biochemical determinants of the T50 test in a prospective cohort of hemodialysis patients.

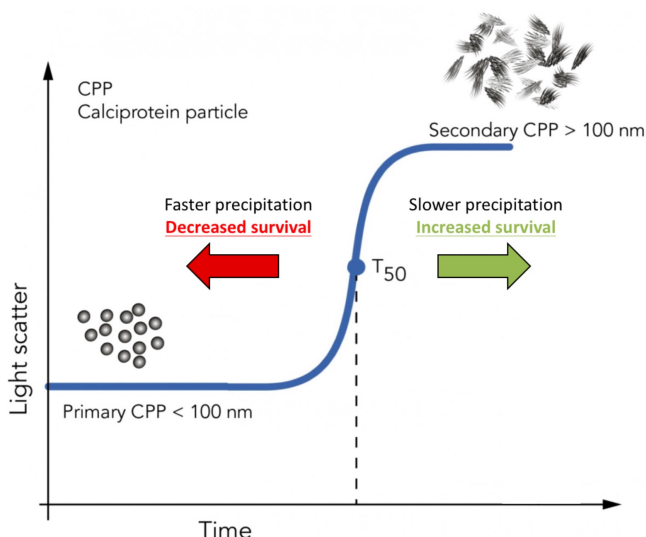


Figure 1: Schematic illustration of the T50 test. T50 denotes the point of time where 50% of the primary calciprotein particles (CPP) are transformed to secondary CPPs.

Methods

15 chronic hemodialysis patients (12 m, 3 f; mean age 73 ± 14 y.) treated with high volume hemodiafiltration (3 x 4 hr/wk) were studied. T50 was determined monthly over a period of 9 months (n = 122) together with midweek pre-dialysis plasma concentrations of Na⁺, K⁺, Calcium, ionized Calcium (iCa⁺⁺), Magnesium, Phosphate, Bicarbonate and Albumin. These biochemical parameters were evaluated as continuous predictors of T50 in a generalized regression model.

Results

The mean T50 value in this cohort was 260 minutes (± 72 [SD]; Range 105 - 460). In the linear model, Magnesium, Bicarbonate, Phosphate and iCa⁺⁺ (not Ca or Ca_{corr}) were highly significant predictors of T50. When the Patient ID was added to the model as a categorical predictor, iCa⁺⁺ became nonsignificant:

Parameter	Mean \pm SD	B	95% CI for B	p
Na	137.6 \pm 3.0	-0.6	[-4.4 3.1]	0.73
K	4.4 \pm 0.5	1.9	[-16.5 20.3]	0.84
Ca	2.09 \pm 0.14 (8.36 \pm 0.56)	216.1	[-383.8 816.0]	0.48
Ca _{corr}	2.30 \pm 0.17	-148.0	[-743.6 447.6]	0.62
iCa	1.10 \pm 0.09	-102.1	[-276.3 72.0]	0.24
Mg	0.94 \pm 0.13 (2.29 \pm 0.32)	164.2	[83.5 244.9]	0.00012
Bicarbonate	25.3 \pm 2.1	7.6	[2.7 12.5]	0.0027
Phosphate	1.49 \pm 0.39 (4.61 \pm 1.21)	-46.2	[-68.3 -24.1]	0.00008
Albumin	31.4 \pm 3.0	5.2	[-9.9 20.3]	0.49

Table 1: General regression model using Na, K, Ca, Ca_{corr}, Ca_{ionized}, Mg, Bicarbonate, Phosphate (all in mmol/l (mg/dl)) and Albumin (in g/l) as continuous predictors and Patient ID as categorical predictor.

While Phosphate shortened the T50 precipitation time (promoting calcification), Magnesium and Bicarbonate prolonged T50, inhibiting calcification. Predicted T50 changes when altering these parameters from the minimum to the maximum measured in the study were: Bicarbonate [19 -> 30 mmol/l]: + 84 min. Magnesium [0.61 -> 1.21 mmol/l]: + 99 min. Phosphate [0.72 -> 2.66]: -90 min.

Conclusions

Several easily measurable and modifiable parameters correlate significantly with T50. Serum Phosphate appeared to promote, serum Magnesium and Bicarbonate to inhibit calcification propensity. Ionized Calcium appeared as a promoter, but intraindividual fluctuations were relatively small in this study.

Although the present data may be influenced by individual patients' comorbidities, they constitute a basis for prospectively studying the determinants of T50.