Evaluation of vitamin D supply in relation to binding proteins and PTH levels, and in correlation with types of dialysis

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Background
The total 25-hydroxy-vitamin-D (t-25OHD) level reflects the vitamin-D supply, but is also influenced by the levels of vitamin-D-binding-proteins (DBP) and albumin. The type of dialysis influences the levels of serum proteins.

Aims
To examine and monitor the vitamin-D supply on the bases of t-25OHD and bioavailable vitamin-D (Bio-25OHD) levels, parathyroid hormone intact (iPTH), biointact 1-84-PTH (bioPTHi) and ionized calcium (Ca2+) concentrations in patients on peritoneal (PD) and hemodialysis (HD) before and after taking 1000 UI/day cholecalciferol (D3).

Patients
Altogether 50 dialyzed patients (26 males, 24 females) were included in two dialysis groups matched by gender and age (Figure 1). The average time period spent in dialysis was 4.8±3.6 years.

Measurements
The duration of native vitamin D supplementation in the study was 6.0±3.5 months. Twenty-six patients received active forms of vitamin D before (7 HD and 19 PD) and after (8 HD and 18 PD) taking native D3.

Results
Both before and after vitamin D supplementation, lower albumin levels were detected in PD than in HD. The DBP was significantly higher in PD than HD, but only before D3 treatment. After D3 supplementation, the DBP level rose in HD, while decreases significantly after D3 supplementation. The Bio-25OHD values were calculated using a mathematical model (Vermeulen et al, 1999; Bhan et al, 2012).

Conclusions
• There are considerable interactions between t-25OHD and DBP/albumin in PD patients, thus evaluation of the vitamin D supply is more reliable based on the bio-25OHD levels. The t-25OHD values overestimate the vitamin D supply particularly in PD. The Bio-25OHD levels were significantly lower, while bioPTHI and iPTH levels were significantly higher in PD than HD group both before and after taking cholecalciferol. However, cholecalciferol 1000 UI/day supplementation was insufficient to raise levels of 1-25OHD beyond 50 nmol/l and of Bio-25OHD beyond 6.4 nmol/l, particularly in PD (Figure 3).

According to the t-25OHD measurements, 100% of PD patients and 67% of HD patients were vitamin D deficient before cholecalciferol treatment. Deficiency remained in 79% of PD and 34% of HD subjects after D3 supplementation on the bases of 25OHD concentrations (Figure 4, left side).

According to the Bio-25OHD levels, vitamin deficiency remained in 100% of PD and 41% of HD patients after vitamin D3 supplementation. Serious deficiency was more frequent in PD than in HD (87% vs. 19%) on the bases of Bio-25OHD levels. Significant (p<0.05) differences were noted between the twofractions of 25OHD in PD (87% vs. 61%), but not in HD (Figure 4, right side).

Results of the Sperman Rank Order Correlations
The correlations between the total and bio-25OHD levels were excellent (r=0.93) in HD, but weaker in PD (r=0.73). The significant (p<0.001) correlations among the biomarkers, irrespective of vitamin D3 supplementation are summarized in the table.

Correlations among biologically related markers

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<td>Albumin</td>
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<td>Bio-25OHD</td>
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Positive correlations were observed between levels of t-25OHD and DBP and t-25OHD and albumin only in PD. All fractions of 25OHD showed similar negative correlations with the bioPTHI levels in both groups. Significant positive correlations between Ca2+ and Bio-25OHD levels, but not between t-25OHD and Ca2+ were found only in PD.