Reproducibility of Determining Phosphorus Mobilization During Haemodialysis Using a Pseudo-one Compartment Model

Poster No.
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Introduction and Objective

Intradialytic kinetics of phosphorus during haemodialysis (HD) can be described using a pseudo-one compartment model; however, it has been assumed that phosphorus mobilization into the extracellular space is governed by a clearance that is patient-specific. We evaluated the reproducibility of the phosphorus mobilization clearance derived from a pseudo-one compartment model (K_M) when determined in 4 separate HD or haemodiafiltration (HDF) treatments in the same patient.

Methods

Clinical Studies

Two prospective crossover trials (NCT02377570 & NCT02377622) were performed to compare the efficacy of solute clearances and acute safety of novel middle-cut-off (MCO) diaysers (Gambro Dialysatoren GmbH, Hechingen, Germany). Three MCO dialyser prototypes (1.7 m^2) were evaluated, namely Theranova AA, Theranova BB, Theranova CC. These MCO dialyser prototypes contain membranes with different in permeability to middle molecules and albumin. The comparison dialyser was FX CorDiax 80 (1.8 m^2, Fresenius Medical Care, Bad Homburg, Germany). Haemodialfiltration using a FX CorDiax 800 filter (2.0 m^2, Fresenius Medical Care) was also evaluated for comparison in one trial. A brief summary of the test conditions in both trials is tabulated below.

Nominal Condition	NCT02377570	NCT02377622
Blood Flow Rate (mL/min)	300	400
Dialysate Flow Rate (mL/min)	500	600
Treatment Time (hrs)	4	4-5

Postdilutional HDF was performed with ≥23 L of convective ultrafiltration volume. Treatment times varied in trial NCT02377622; results are plotted as if they were 4 hours.

Nineteen patients completed trial NCT02377570 and 20 completed trial NCT02377622. Complete phosphorus kinetic data were available from 128 treatments in 33 patients.

Study Protocol and Data Analysis

Intradialytic measurements of serum and dialysate phosphorus concentrations were used to evaluate the average dialyzer phosphorus clearance (K_d). Serum samples were obtained predialysis, postdialysis and at 30 & 120 minutes after the start of the treatment. A fraction of dialysate was collected via a sampling device. K_d was calculated as the ratio of the mass of phosphorus removed (dialysate concentration of total fraction collected times total dialysate volume per treatment) divided by the area under the serum water concentration curve. Chemical colorimetric assays were used for measurement of phosphorus concentration in serum and dialysate.

The dependence of serum phosphorus concentration on time was analyzed using a pseudo one-compartment model (Agar et al, Clin J Am Soc Nephrol 2011), and phosphorus mobilization clearance (K_M) was calculated using the simplified formula derived by Agar et al (Hemodial Int 2011).

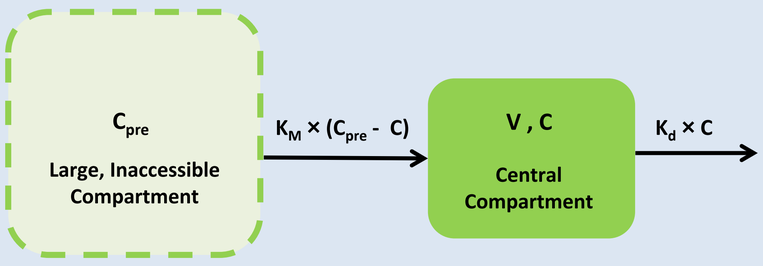
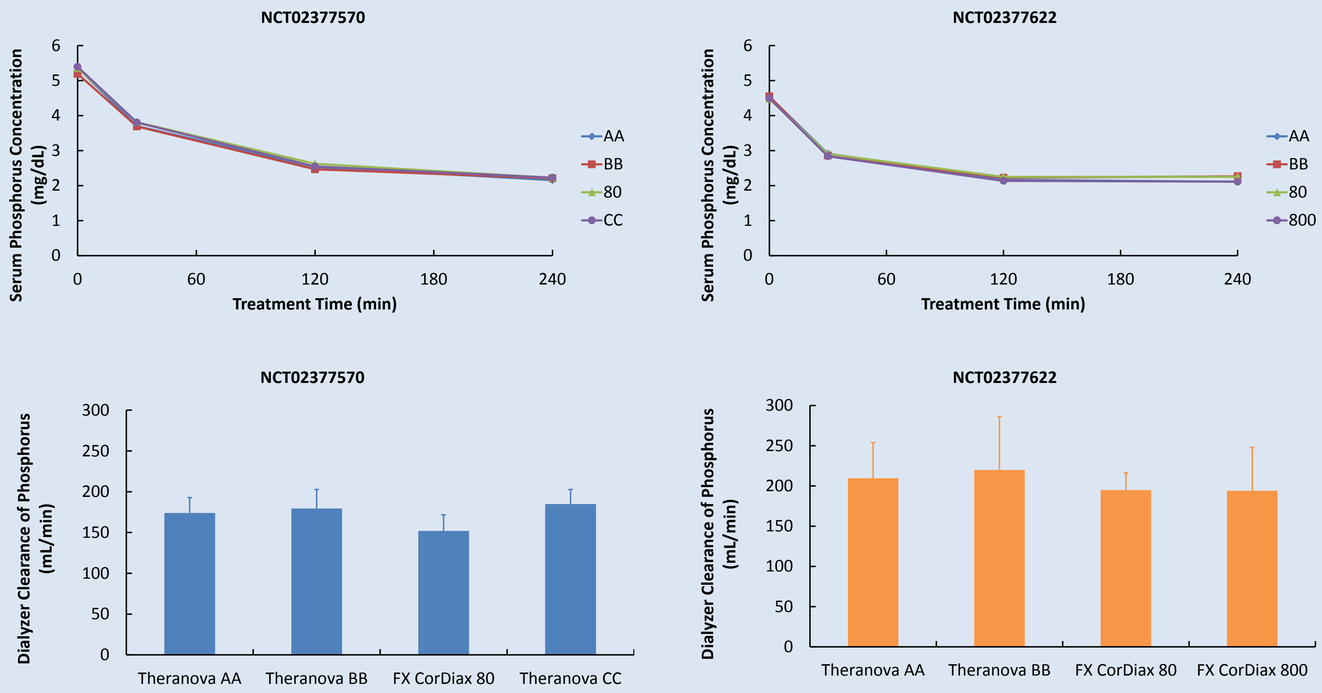


Figure : Pseudo one-compartment model

C_{pre}: Predialysis serum phosphorus concentration
C: Serum phosphorus concentration
K_M: Phosphorus mobilization clearance
V: Volume of central compartment
K_d: Dialyzer phosphorus clearance

Results

Intradialytic Serum Concentrations and Dialyzer Clearances

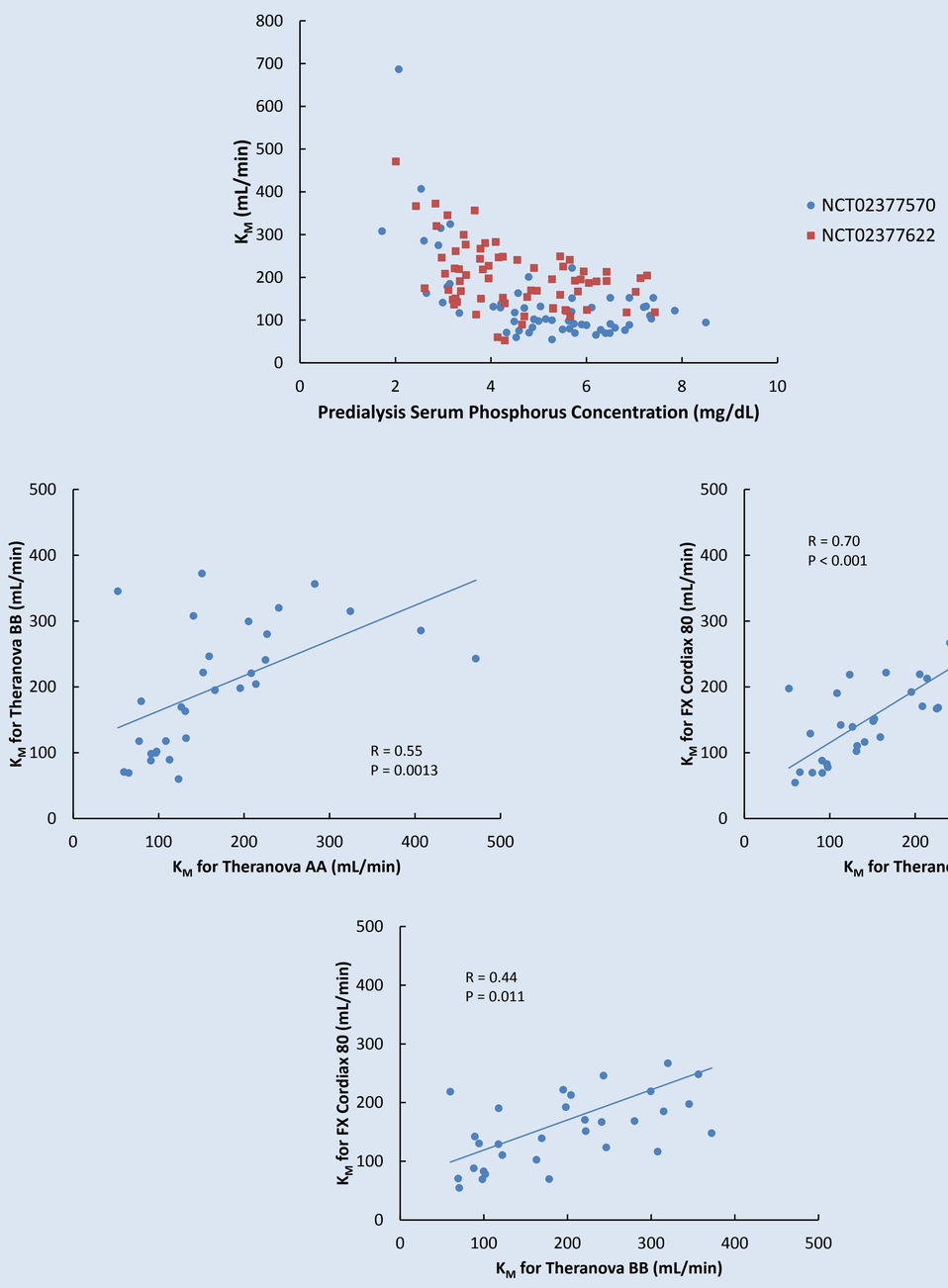


Results

Phosphorus Mobilization Clearance or K_M

Clinical Study	K_M Values (Mean ± SD) for Dialyzer/Filter				CV (%)
	Theranova AA	Theranova BB	FX CorDiax 80	FX CorDiax 800/ Theranova CC	
NCT02377570	139 ± 101	152 ± 85	139 ± 101	142 ± 155	22.8
NCT02377622	192 ± 93	233 ± 91	193 ± 42	184 ± 68	28.0

Mean (median) coefficient of variation (CV) for K_M in both studies was 25.5% (22.5%). K_M varied inversely with predialysis serum phosphorus concentration (P<0.001), as described previously (Leypoldt et al, Kidney Int 2013). Estimates of K_M determined in the 3 treatments common to both trials were significantly correlated.



Conclusions

The reproducibility of phosphorus mobilization clearance determined by a pseudo-one compartment model is considerable, supporting the contention that this parameter is patient-specific. The ability of a pseudo-one compartment model to accurately predict changes in serum phosphorus concentrations after altering the dialysis prescription remains to be demonstrated in a prospective clinical trial.

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