«Υπερφωσφαταίμια σε ασθενείς με χρόνια Νεφρική Νόσο »

Ρήγας Καλαϊτζίδης

Νεφρολόγος

Νεφρολογική Κλινική

Πανεπιστημιακού Νοσοκομείου Ιωαννίνων

Ιωάννινα 24 Ιανουαρίου 2016

Δεν υπάρχει σύγκρουση συμφερόντων

Ιστορικό

- Άνδρας 34 ετών με γνωστή ΧΝΝ εντάχθηκε για μια 3ετία σε αιμοκάθαρση με ΤΝ
- Εστιακή σπειραματοσκλήρυνση χωρίς ανταπόκριση στις τρέχουσες θεραπείες και σταδιακά οδηγήθηκε σε ΧΝΝΤΣ
- Έκανε μεταμόσχευση προ 2ετίας με σταδιακή απόρριψη του μοσχεύματος
- Επανεντάχθηκε στην αιμοκάθαρση τους τελευταίους 6 μήνες
- Είναι καπνιστής 10 τσιγάρων ημερησίως και κοινωνικός πότης

Κλινική εξέταση

Κλινική εξέταση χωρίς αξιολογά ευρήματα

Αιμοκάθαρση από λειτουργική φίστουλα του ΔΕ άνω άκρου

Ιστορικό υπέρτασης από 7ετίας

U/S καρδιάς :Μέτρια υπερτροφία της αριστερής κοιλίας

Εργαστηριακός έλεγχος

Ht 34.6%.

Hb 11.1mg/dL

PLT 333 X 10-3/μl

Σάκχαρο αίματος 82 mg/dl,

Ουρία 182 mg/dl,

Κρεατινίνη 11.8 mg/dl,

Ουρικό οξύ 6.1 mg/dl,

Νάτριο 134 mmol/L,

Κάλιο 5.7 mmol/L

Μαγνήσιο 1.9mg/dl

Ασβέστιο 9.26 mg/dl

Φωσφόρος 8.3 mg/dl

Αλβουμίνη 4.1mg/dl

PTH 192 pg/ml

TCHOL 210 mg/dl, TRG 190 mg/dl

HDL 38 mg/dl, LDL 134 mg/dl

Συνθήκες αιμοκάθαρσης

Συνεδρία αιμοκάθαρσης :3.5h X 3 φορές την εβδομάδα

Φίλτρο: κουπροφάνη με επιφάνεια 1.6

Διάλυμα διττανθρακικών CACA

ΔΔ βάρους μεταξύ των συνεδριών 3.5Kg

Kt/v 1.3

Υπολειμματική διούρηση : 600mg/24h

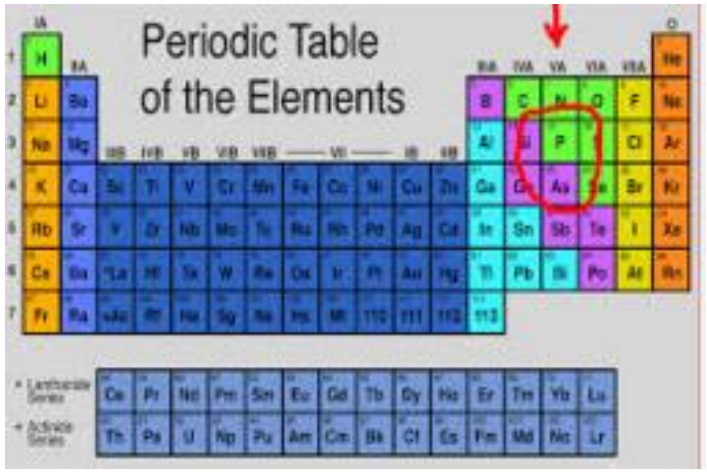
Φαρμακευτική Αγωγή

- Σεβελαμέρη 1-1-1
- Cinecalcet 30mg
- Αμλοδιπίνη 10mg
- Λισινοπρίλη 10mg
- Καρβεδιλόλη mg 6.25Χ2
- Ερυθροποιητίνη 40/15d

Προβλήματα/παράγοντες κινδύνου

- Χρονιά νεφρική νόσο τελικού σταδίου
- Υπερφωσφαταιμία
- Καπνιστής
- Υπέρταση
- Υπερτροφία αριστερής κοιλίας
- Δυσλιπιδαιμία

Η υπερφωσφαταιμία



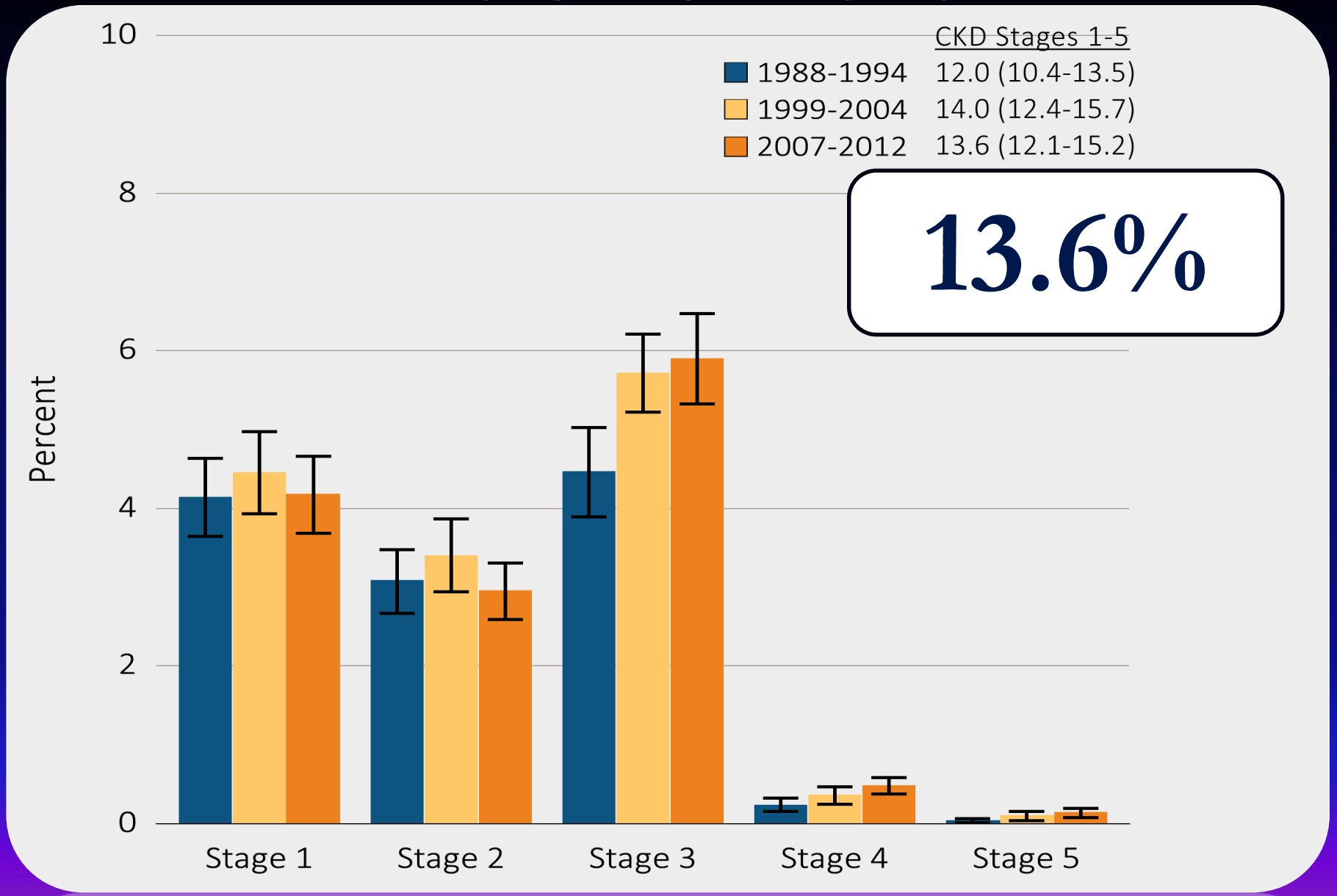
The definition, classification and prognosis of chronic kidney disease: a KDIGO Controversies Conference report

Andrew S. Levey[1], Paul E. de Jong[2], Josef Coresh[3], Meguid El Nahas[4], Brad C. Astor[3], Kunihiro Matsushita[3], Ron T. Gansevoort[2], Bertram L. Kasiske[5] and Kai-Uwe Eckardt[6]

Composite ranking for relative risks by GFR and albuminuria (KDIGO 2009)

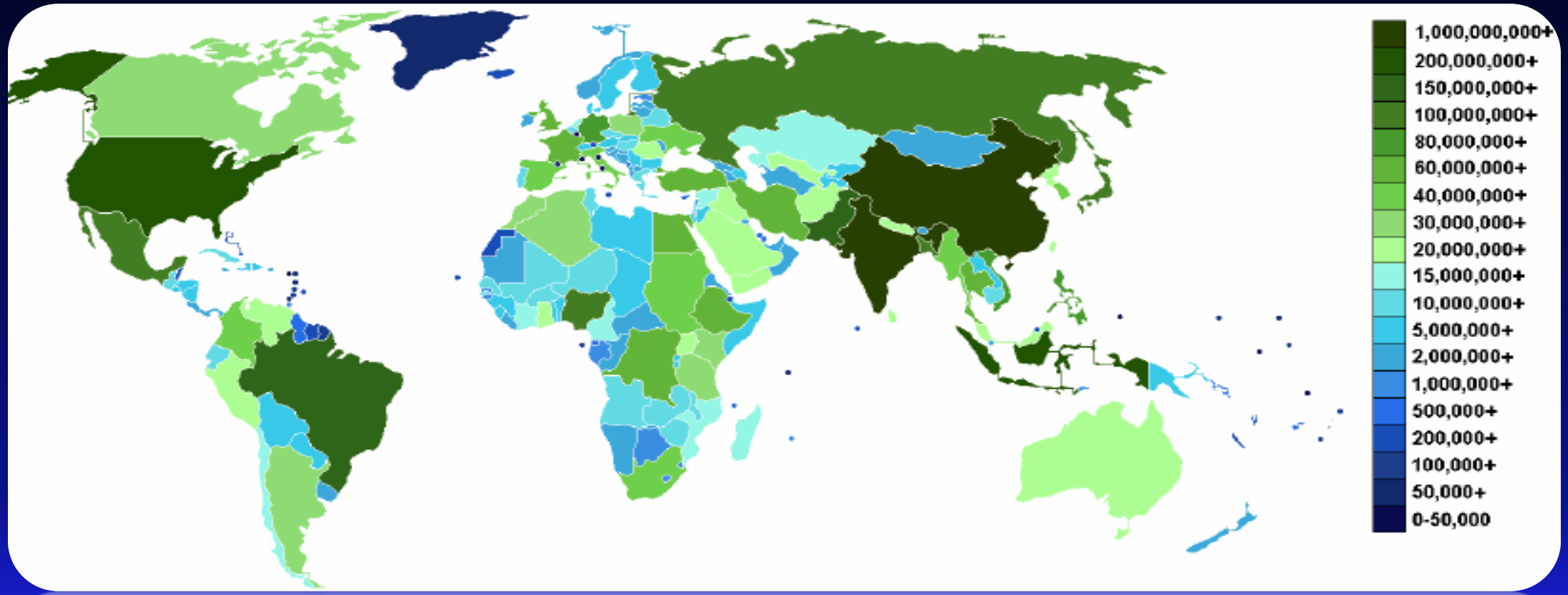
GFR stages, description and range (ml/min per 1.73 m^2)				Albuminuria stages, description and range (mg/g)				
				A1		A2	A3	
				Optimal and high-normal		High	Very high and nephrotic	
				<10	10–29	30–299	300–1999	⩾2000
	G1	High and optimal	>105					
			90–104					
	G2	Mild	75–89					
			60–74					
	G3a	Mild-moderate	45–59					
	G3b	Moderate-severe	30–44					
	G4	Severe	15–29					
	G5	Kidney failure	<15					

Prevalence of CKD by stage among NHANES participants, 1988-2012



disease.

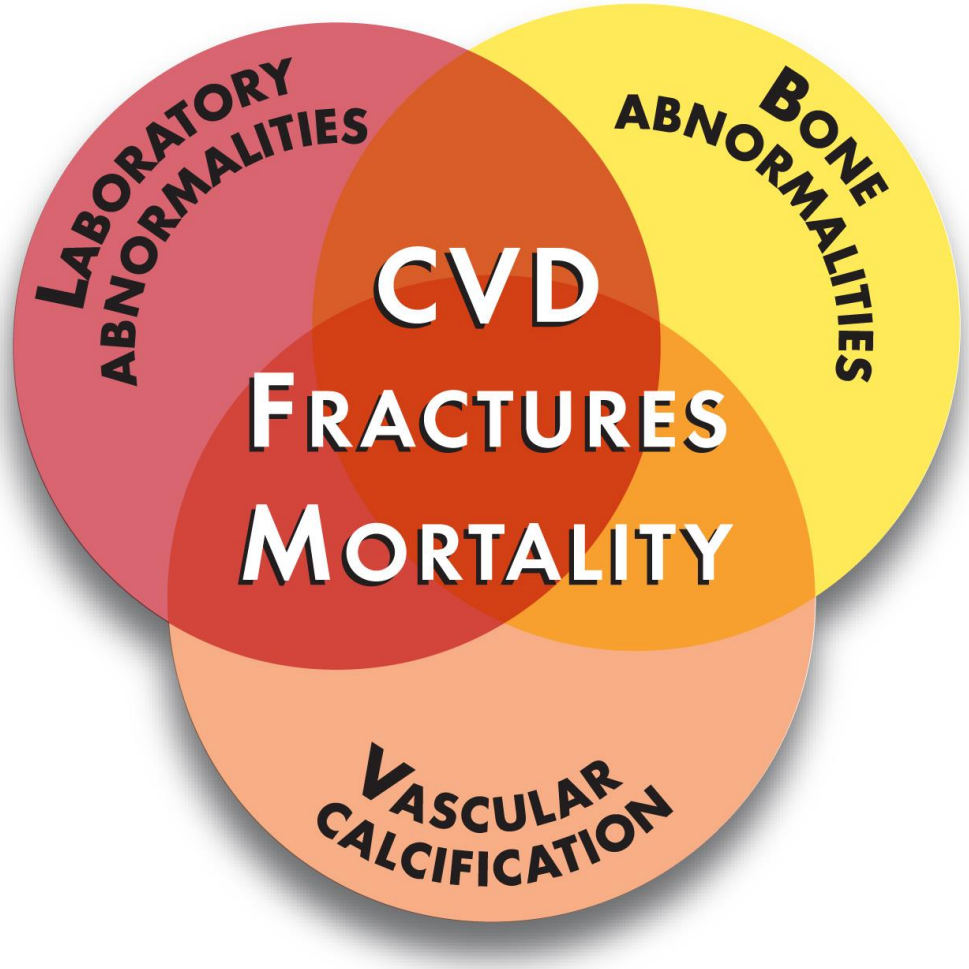
Estimated worldwide prevalence of CKD 3-5 is 200-350 million patients[1]



50-75% of end-stage CKD patients suffer from CKD-MBD2

1. Eknoyan G. "KDIGO: past present and future"; (2006) *Sourced from www.kdigo.org, download date 02.02.2012*
2. USRDS 2009 Annual Data Report

Chronic Kidney Disease–Mineral and Bone Disorder



CKD-MBD

www.kdigo.org

Οι κυριότερες θεωρίες για την γήρανση

Box 1. Examples of Main Theories of Aging

- Evolutionary theory: based on Darwin's theory of natural selection
- Neuroendocrine theory: aging is due to changes in endocrine and neural function
- Neuroendocrine-immuno theory: a combination of the immune and neuroendocrine theories
- Phosphate retention theory: a novel theory based on the finding that dietary restriction of phosphate attenuates the aging characteristics in klotho null mice[13]

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- Neuroendocrine-immuno theory: a combination of the immune and neuroendocrine theories
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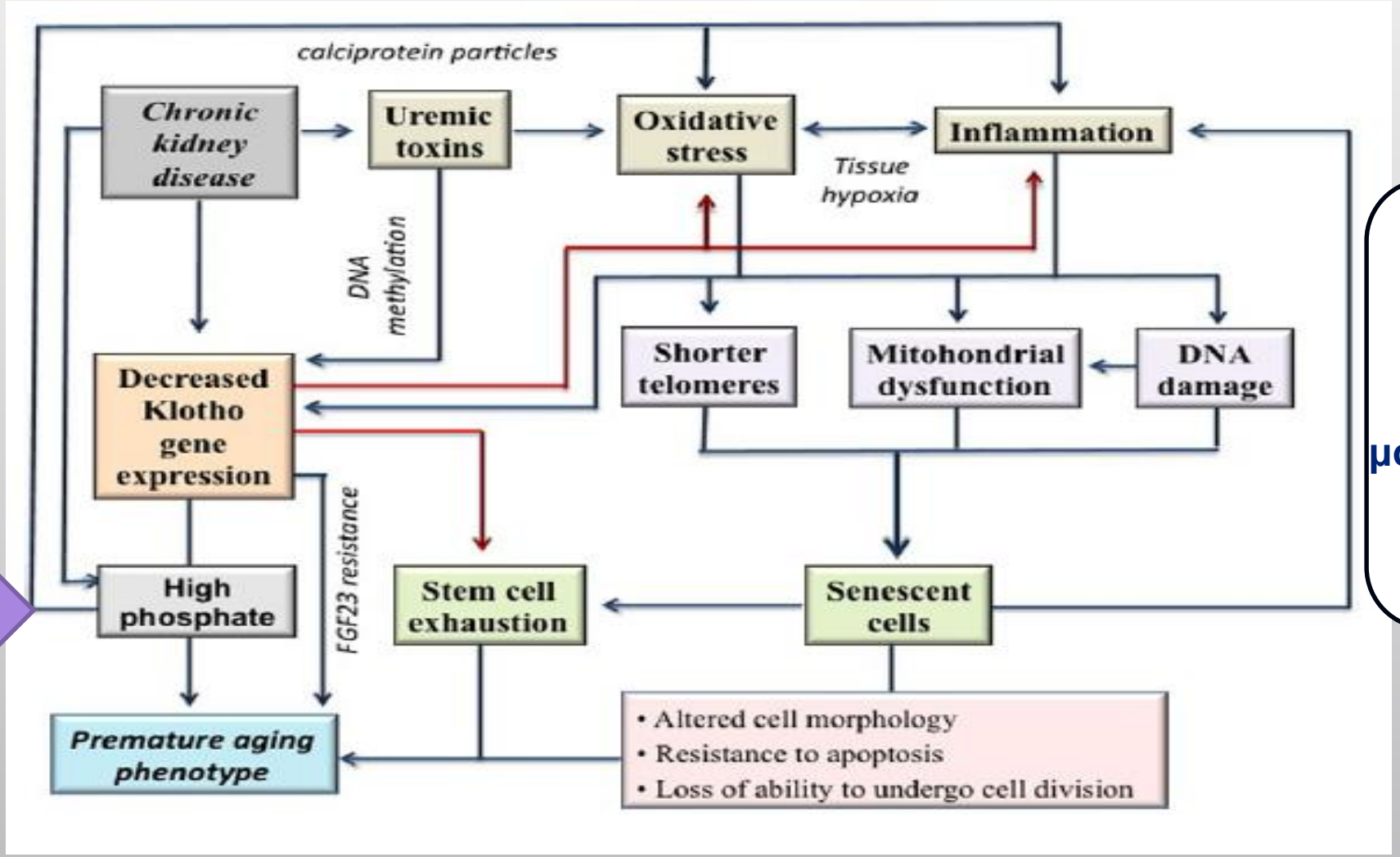
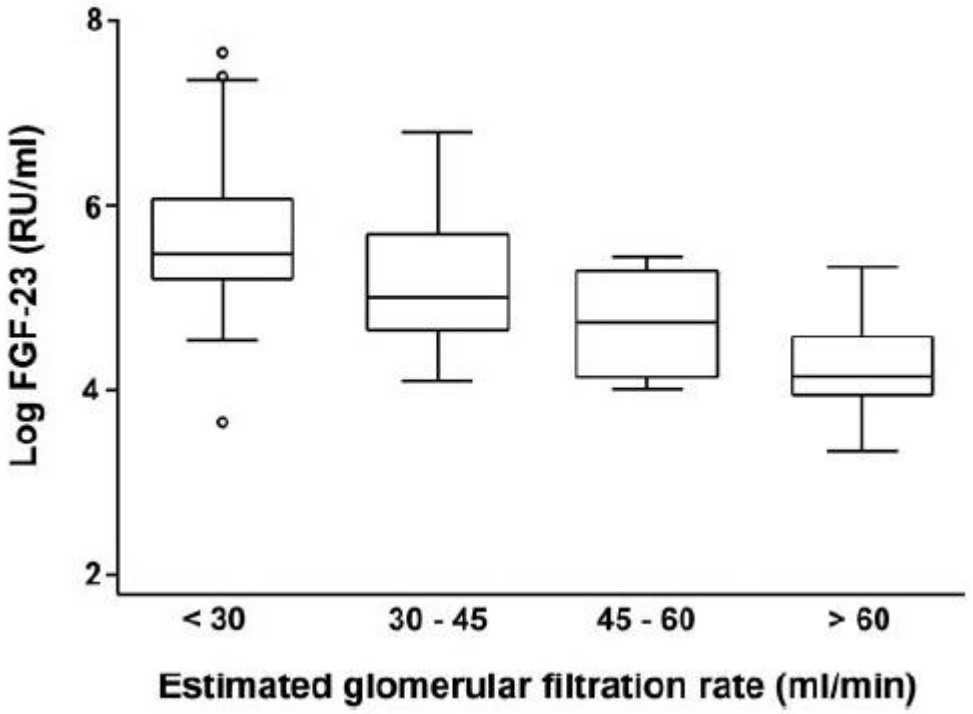
Chronic Kidney Disease: A Clinical Model of Premature Aging

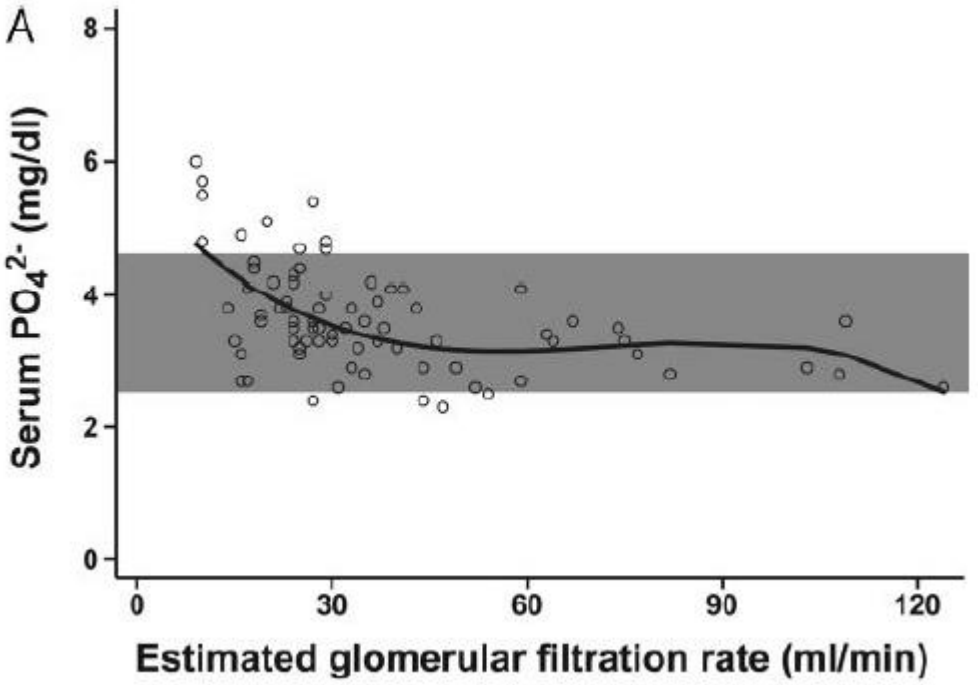
Peter Stenvinkel, MD, PhD, and Tobias E. Larsson, MD, PhD



Η ΧΝΝ είναι ένα κλασικό μοντέλο γήρανσης

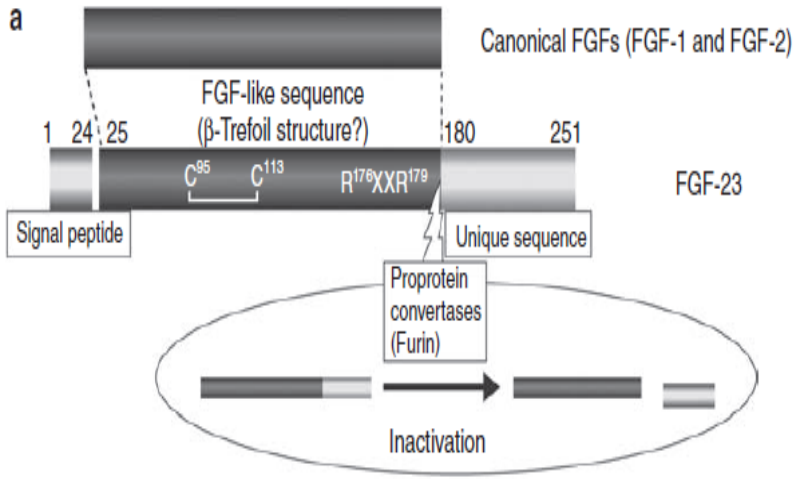
Αύξηση των επιπέδων του φωσφόρου & του FGF 23 με την μείωση της νεφρικής λειτουργίας

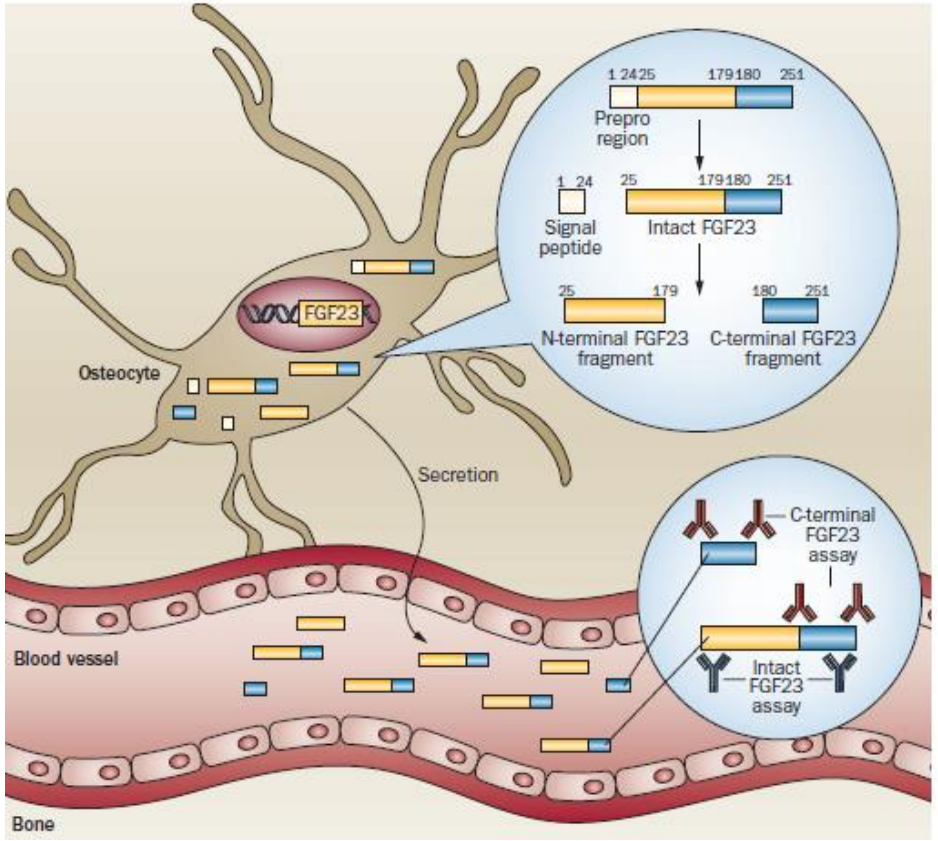




J Am Soc Nephrol 16: 2205–2215, 2005

Schematic structure of fibroblast growth factor (FGF)-23

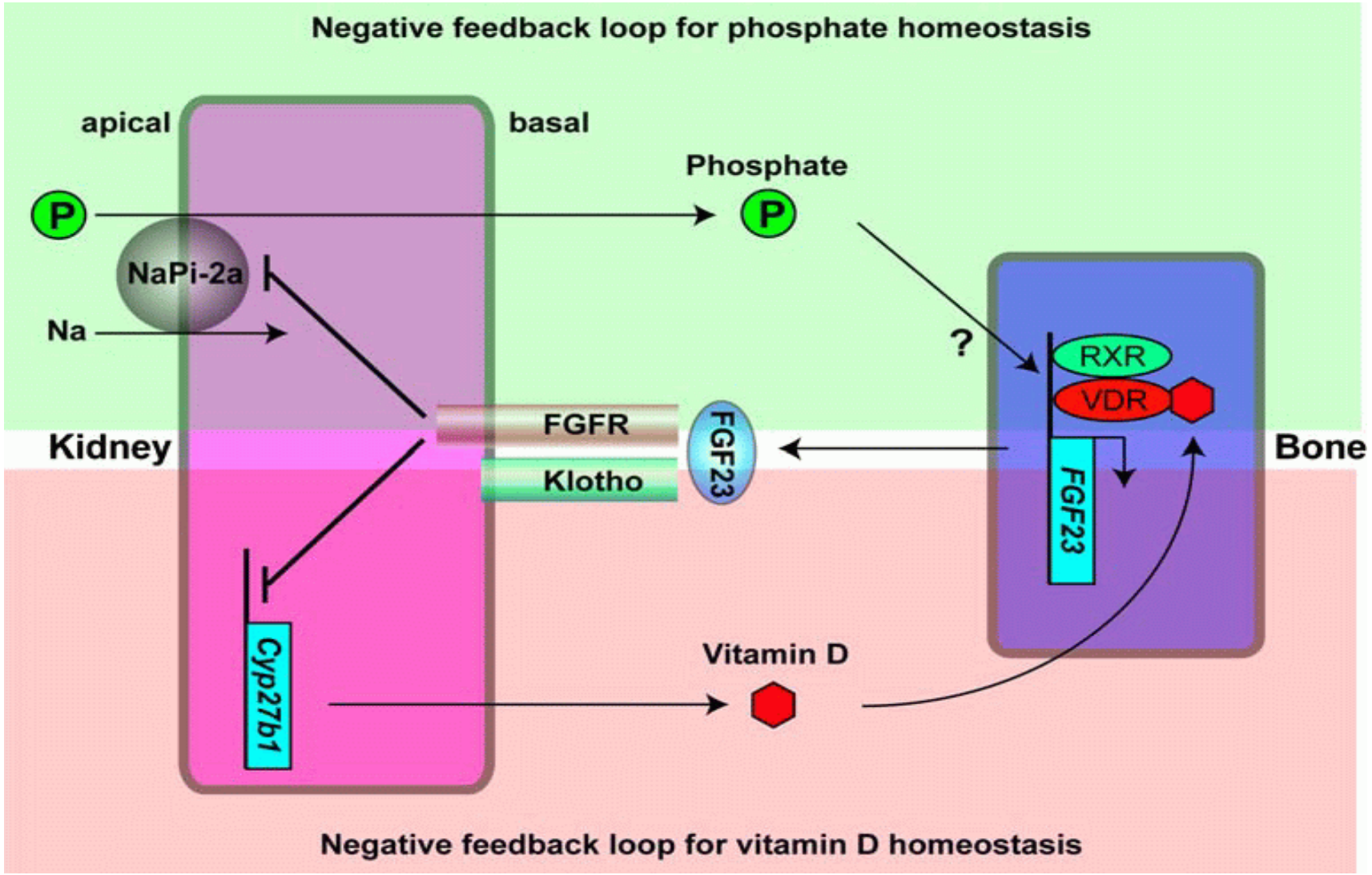




120 Aminoacids
7 subfamilies of FGFs
FGF19 –CYP7A1
FGF21-glucose uptake

Kidney International (2009) 76 (Suppl 114), S34–S42;

Makoto Kuro-o



Pflugers Arch - Eur J Physiol (2010) 459:333–343

Klotho and aging

Makoto Kuro-o *

Department of Pathology, The University of Texas Southwestern Medical Center at Dallas, 6000 Harry Hines Blvd., Dallas, TX 75390-9072, USA

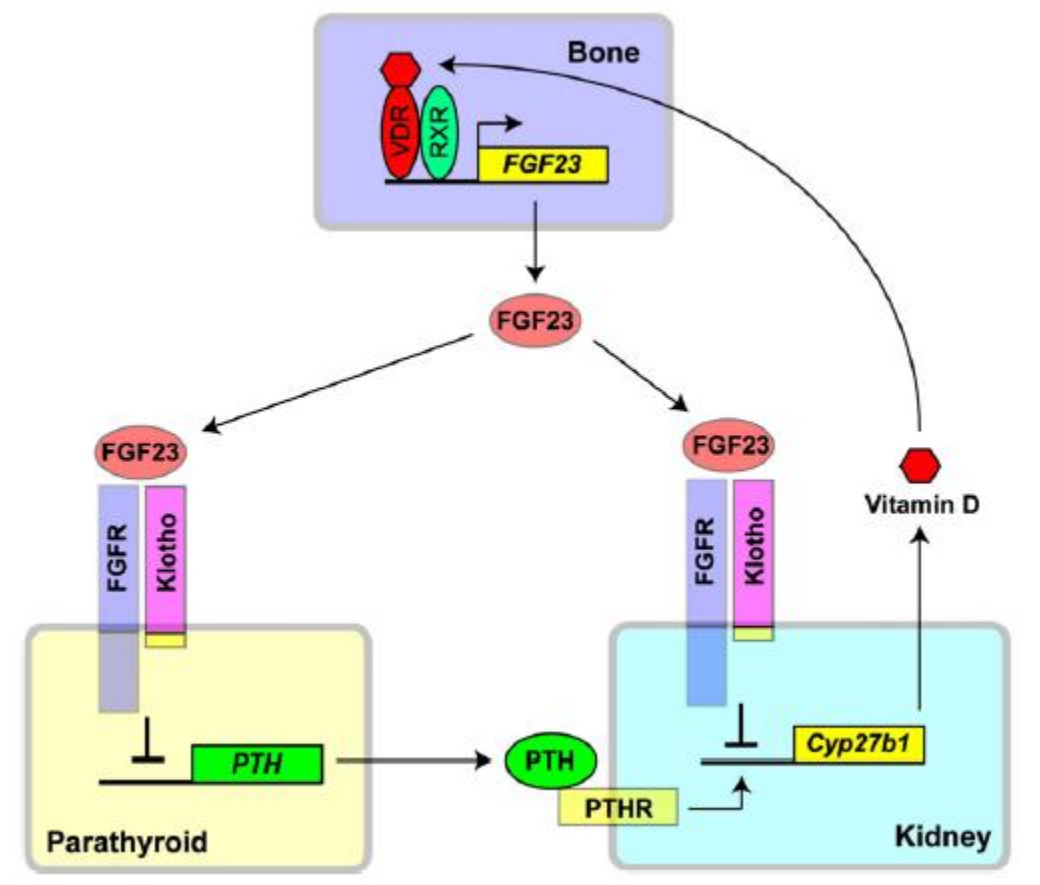
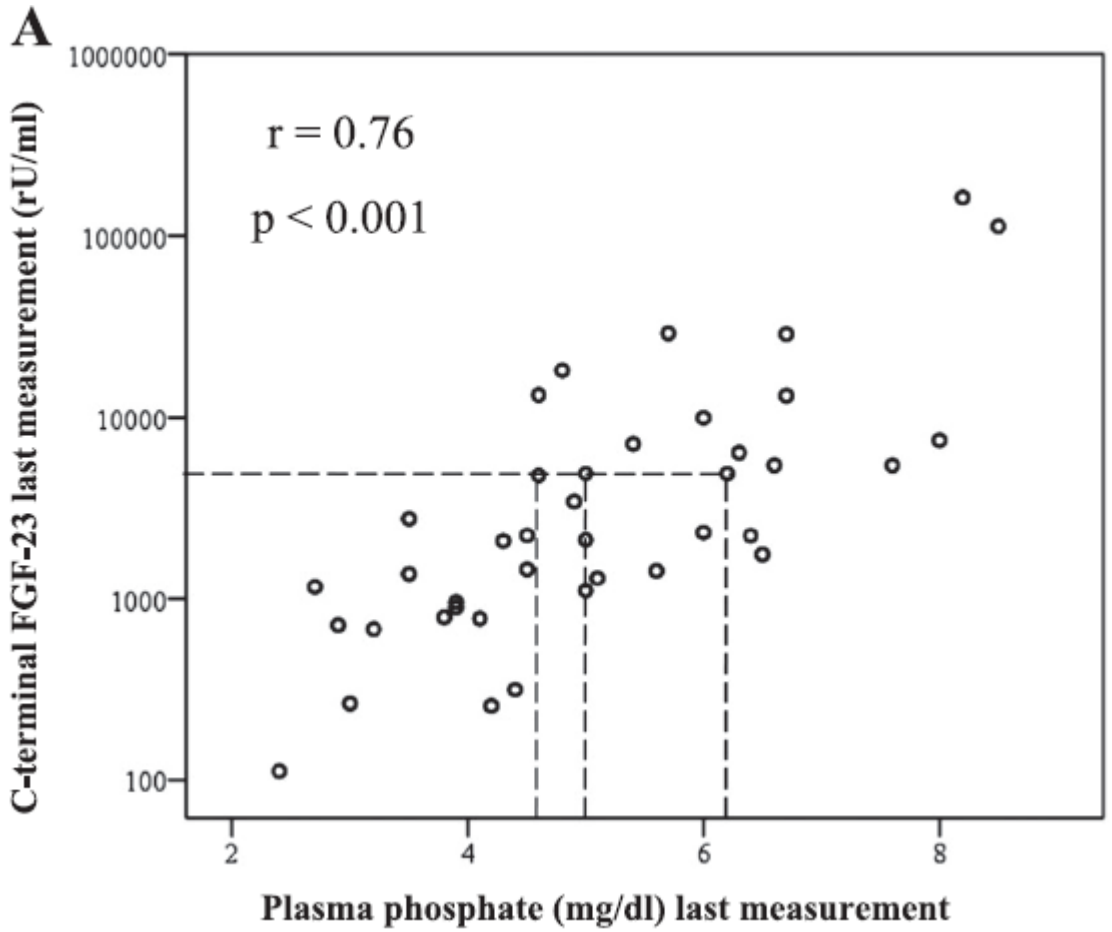


Fig. 2. Endocrine axes that regulate vitamin D metabolism mediated by FGF23 and Klotho. Active vitamin D (1,25-dihydroxyvitamin D_3) binds to vitamin D receptor (VDR) in osteocytes, which in turn forms a heterodimer with a nuclear receptor RXR and directly binds to a promoter region of the FGF23 gene to transactivate its expression. FGF23 secreted from the bone acts on the Klotho-FGFR complex in the kidney (the bone–kidney axis) and parathyroid gland (the bone–parathyroid axis). In the kidney, FGF23 suppresses expression of *Cyp27b1* gene that encodes 1α-hydroxylase and closes a negative feedback loop for vitamin D homeostasis. In the parathyroid gland, FGF23 suppresses expression of PTH. Since PTH is a potent inducer of *Cyp27b1* gene expression, suppression of PTH by FGF23 reduces expression of *Cyp27b1* gene as well as serum levels of 1,25-dihydroxyvitamin D_3, which closes another negative feedback loop for vitamin D homeostasis. Klotho and FGF23 are indispensable for the regulation of vitamin D metabolism, because defects in either Klotho or FGF23 cause hypervitaminosis D.

Expected Concentration Range of FGF23 in Healthy Individuals and Across the Spectrum of CKD Based on Large-Scale FGF23 Measurements in Epidemiologic Cohorts

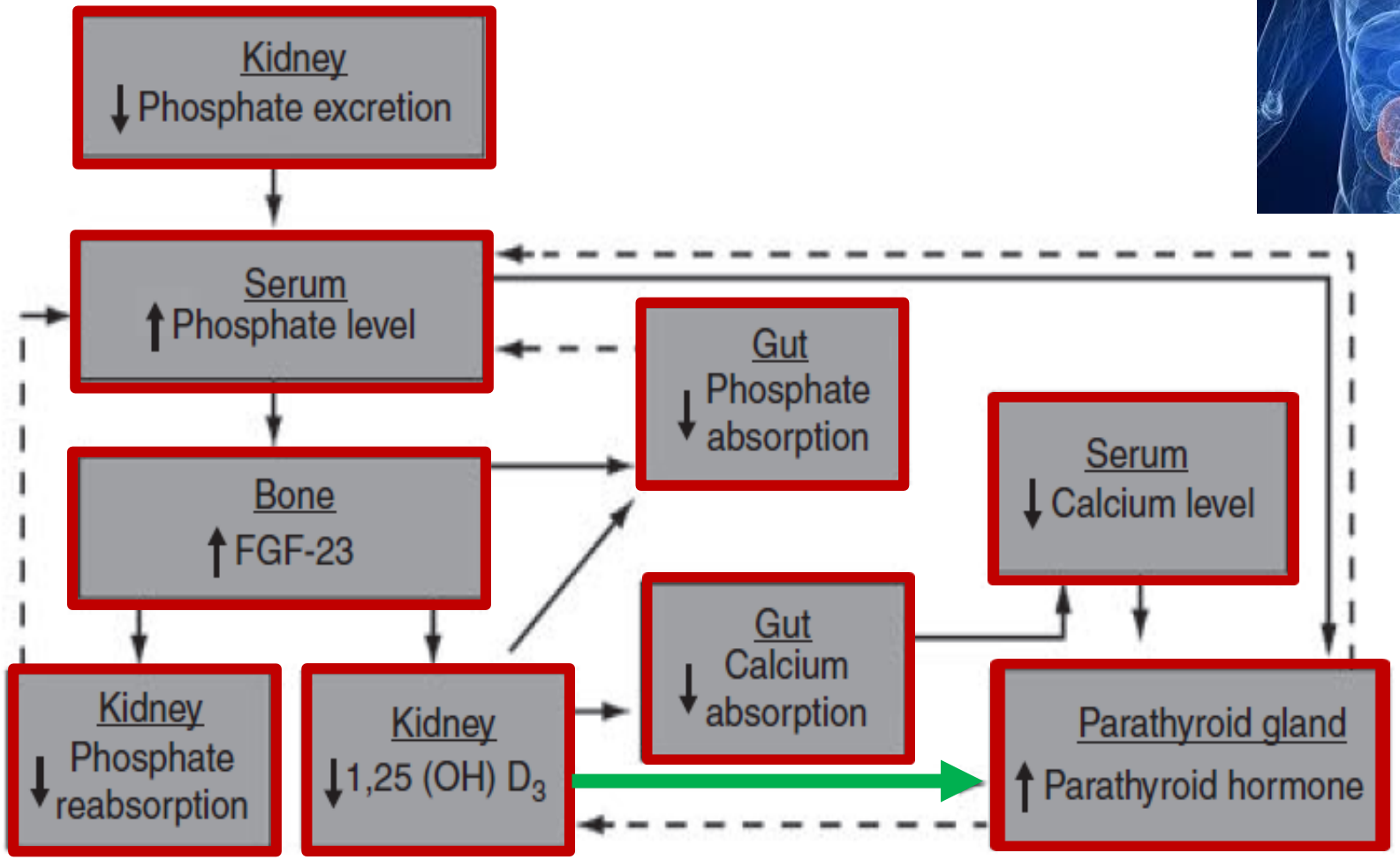
Population	Intact FGF23 (pg/mL)	C-Terminal FGF23 (RU/mL)
Normal renal function	20-60	25-70
CKD 2	25-80	30-150
CKD 3	40-120	50-300
CKD 4	80-500	100-1,000
CKD 5	250-1,250	400-2,000
End-stage renal disease	500-50,000	1,000-100,000

Single FGF-23 Measurement and Time-Averaged Plasma Phosphate Levels in Hemodialysis Patients



Clin J Am Soc Nephrol 8: 1764–1772, 2013

Με την μείωση της νεφρικής λειτουργίας

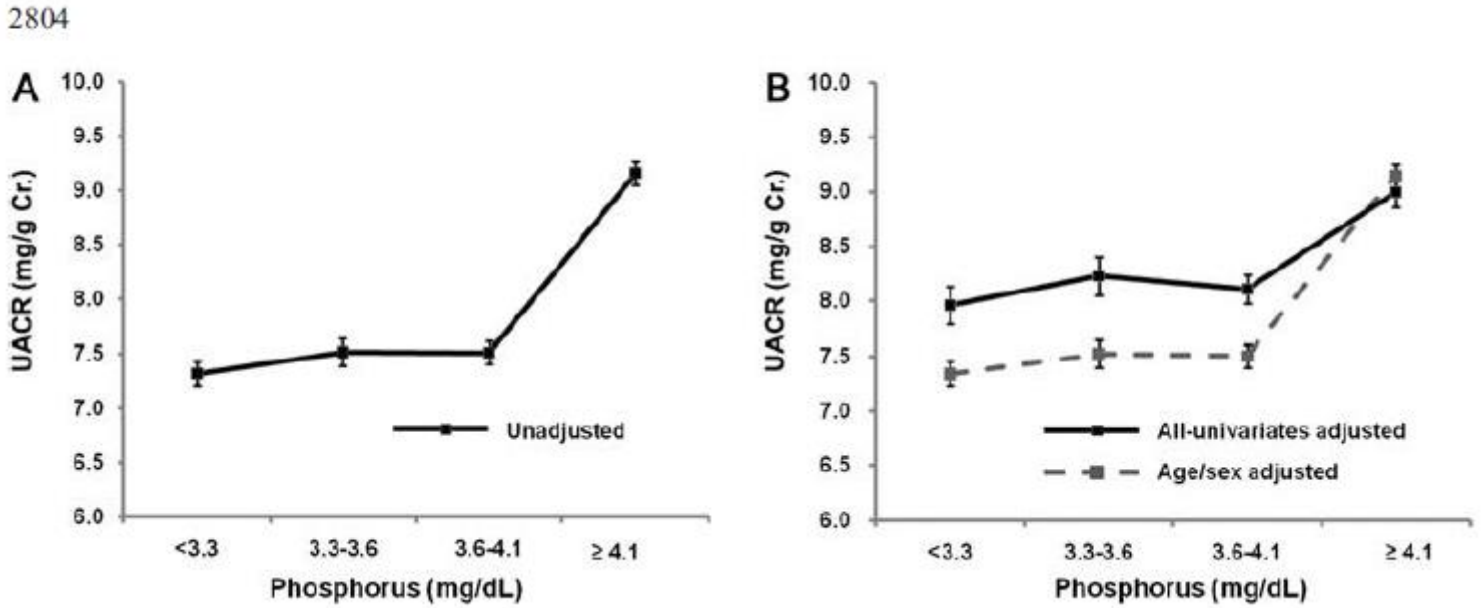


Kidney International (2009) 76 (Suppl 114), S34–S42;

agenda

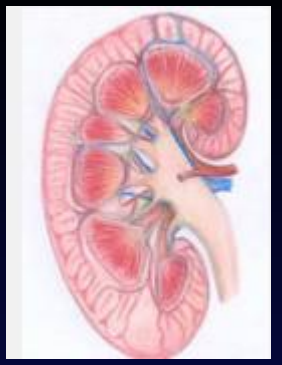
- Pathophysiology
- **Hyperphoshatemia and CVD risk**
- Phoshate diet in CKD
- Phoshate binters in CKD
- Activate Vitamin Analogs
- Calcimimetic drugs
- Questions
- Conclusion

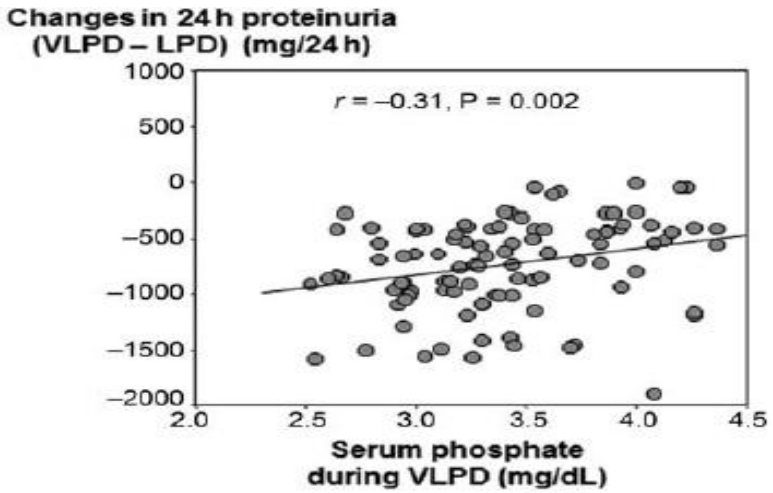
Serum phosphorus as a predictor of low-grade albuminuria in a general population without evidence of chronic kidney disease

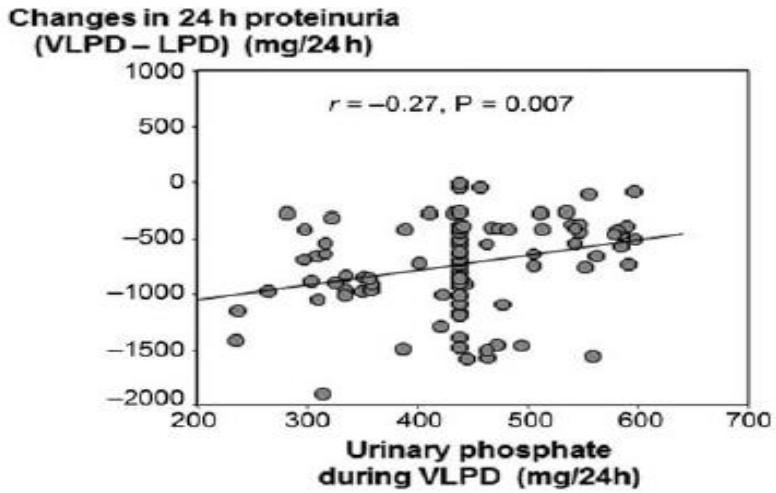


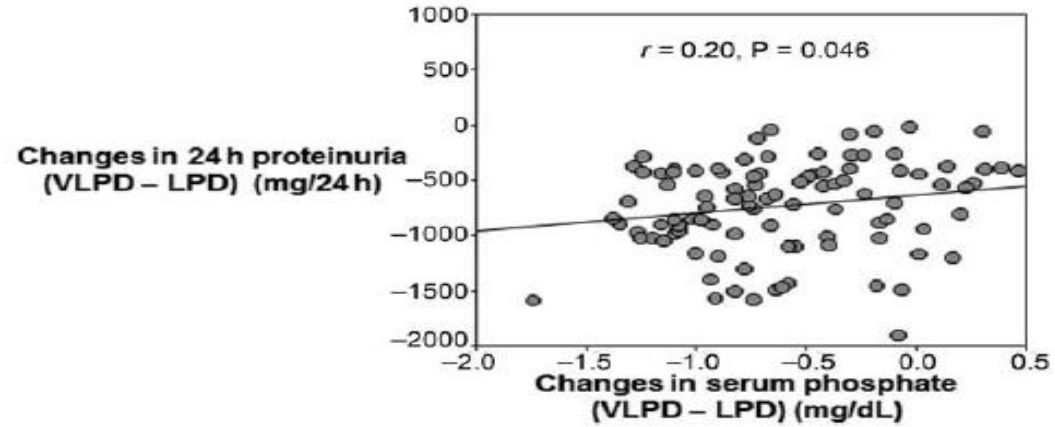
Nephrol Dial Transplant (2012) 27: 2799–2806

Η υπερφωσφαταιμία σχετίζεται με την αύξηση του λευκώματος στην ηπία νεφροπάθεια



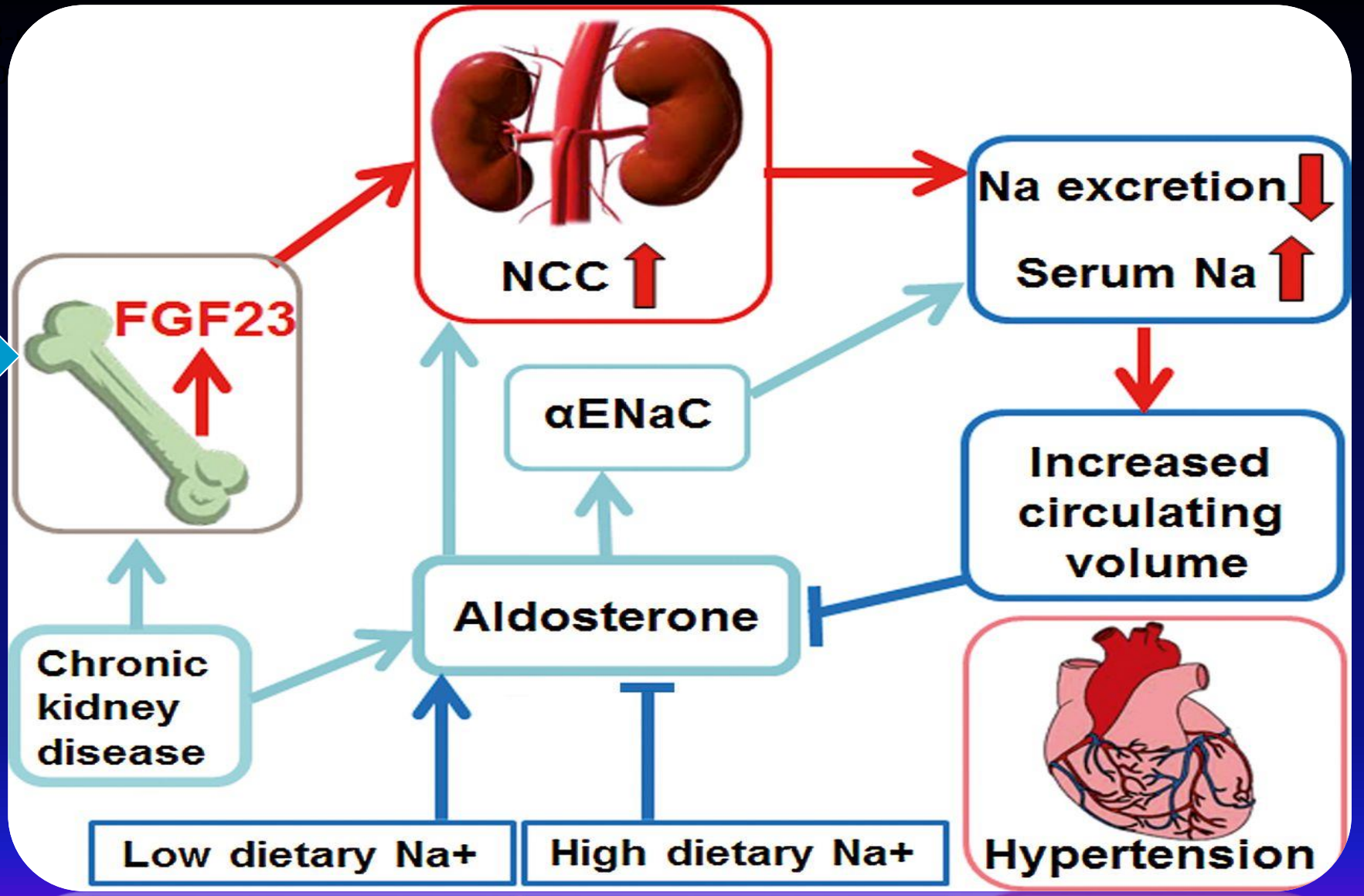






Proposed model of FGF23-
renal tubular NCC exp

Hyperphosphatemia



Andrukhova O et al. EMBO Mol Med. 2014;6:744-759

EMBO Molecular Medicine

Adverse effects of hyperphosphatemia on myocardial hypertrophy, renal function, and bone in rats with renal failure

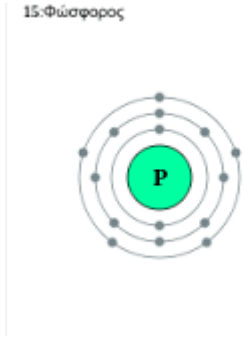


Table 5. Multivariate analysis of predictors of myocardial hypertrophy, renal function, and trabecular bone volume

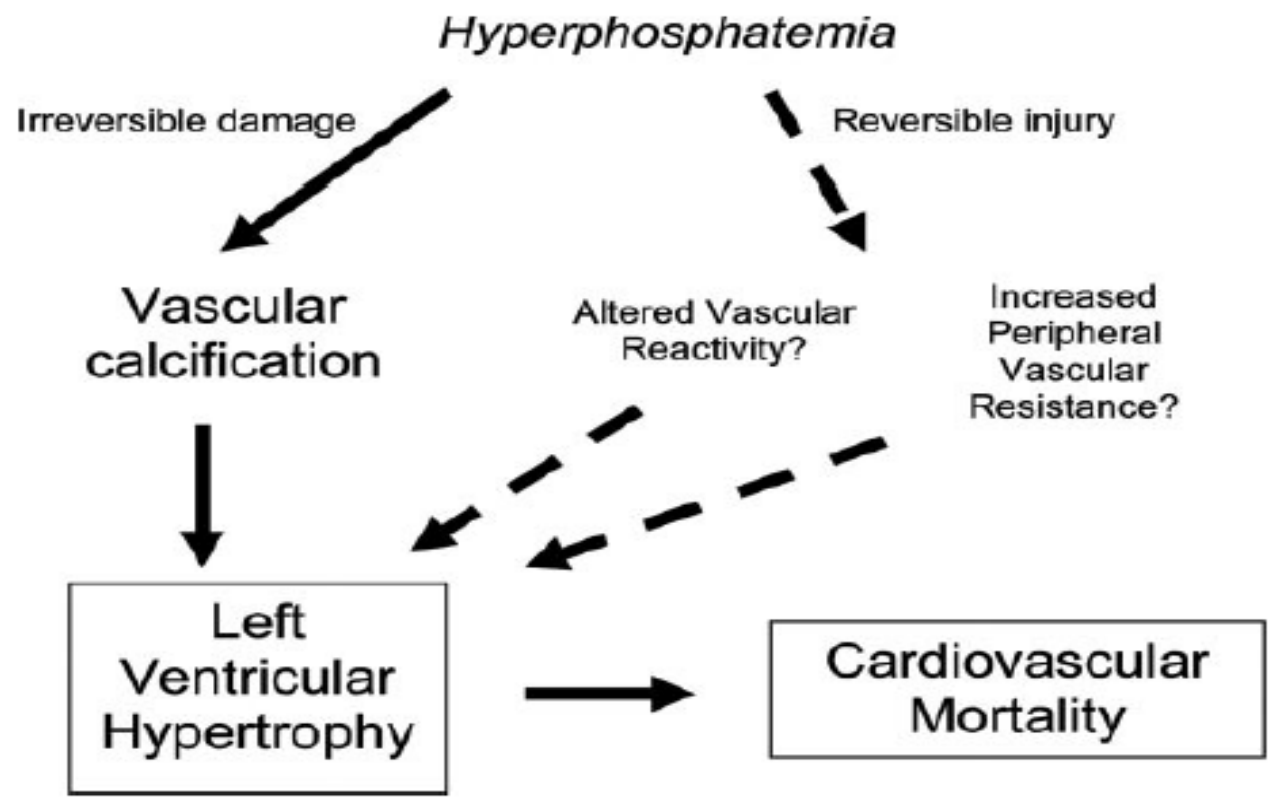
	B	Confidence index	*P* value
Heart weight/100 g body weight			
Hematocrit	0.004	0, 0.008	0.059
Tail-cuff plethysmyography	0.001	0.0008, 0.0012	0.03
Phosphorus	0.005	0.003, 0.007	0.00001
Creatine			
Tail-cuff plethysmyography	0.003	−0.001, 0.005	0.052
Phosphorus	0.037	0.017, 0.057	0.002
BV/TV			
Calcium	6.9	2.87, 10.93	0.002
Phosphorus	0.93	0.1, 1.72	0.03

BV/TV, trabecular bone volume to bone volume; B, standardized regression coefficient (β).

Myocardial hypertrophy, were associated with hyperphosphatemia

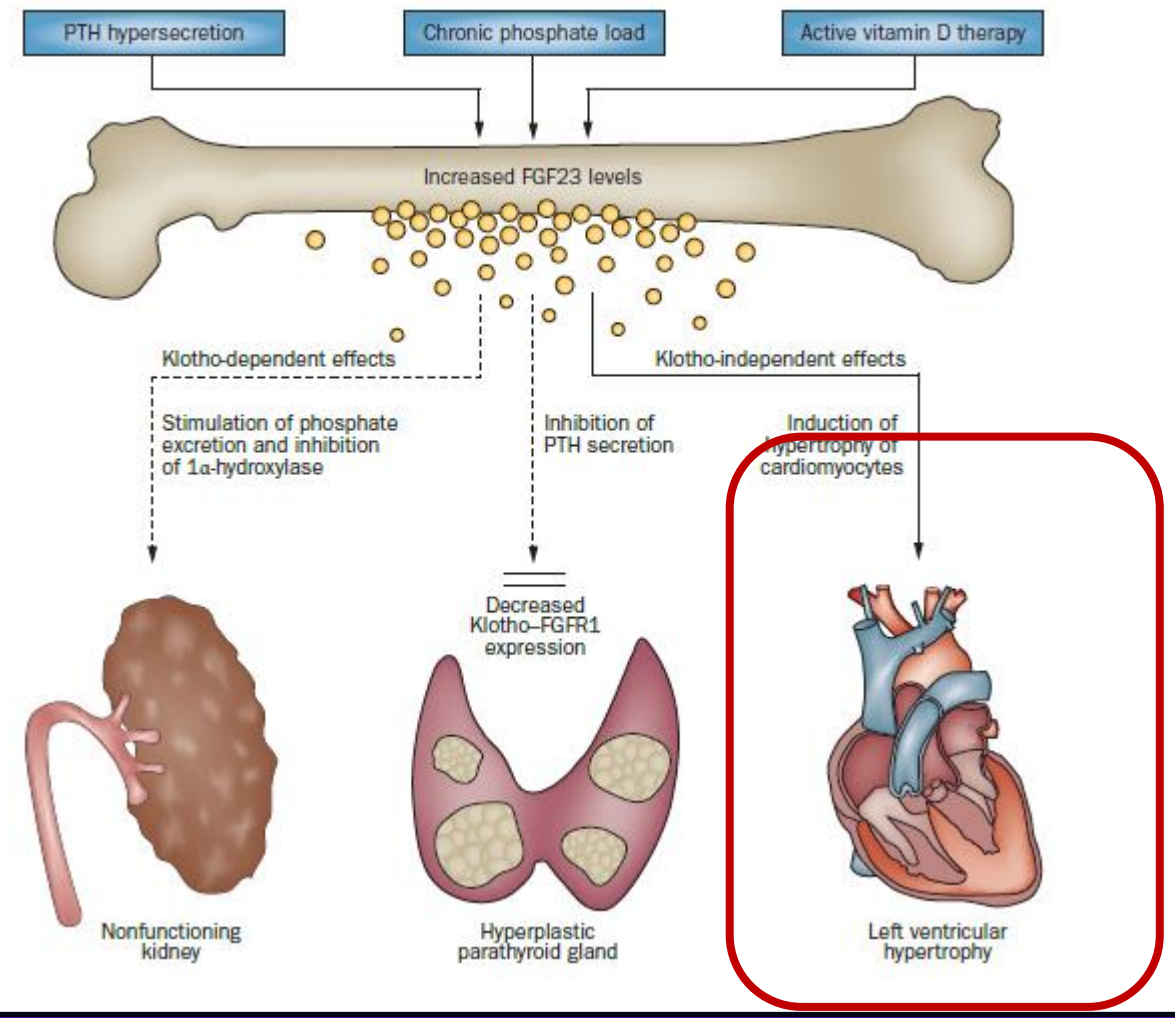
Kidney International, Vol. 66 (2004), pp. 2237–2244

Proposed model for the deleterious effects of hyperphosphatemia on cardiovascular mortality.



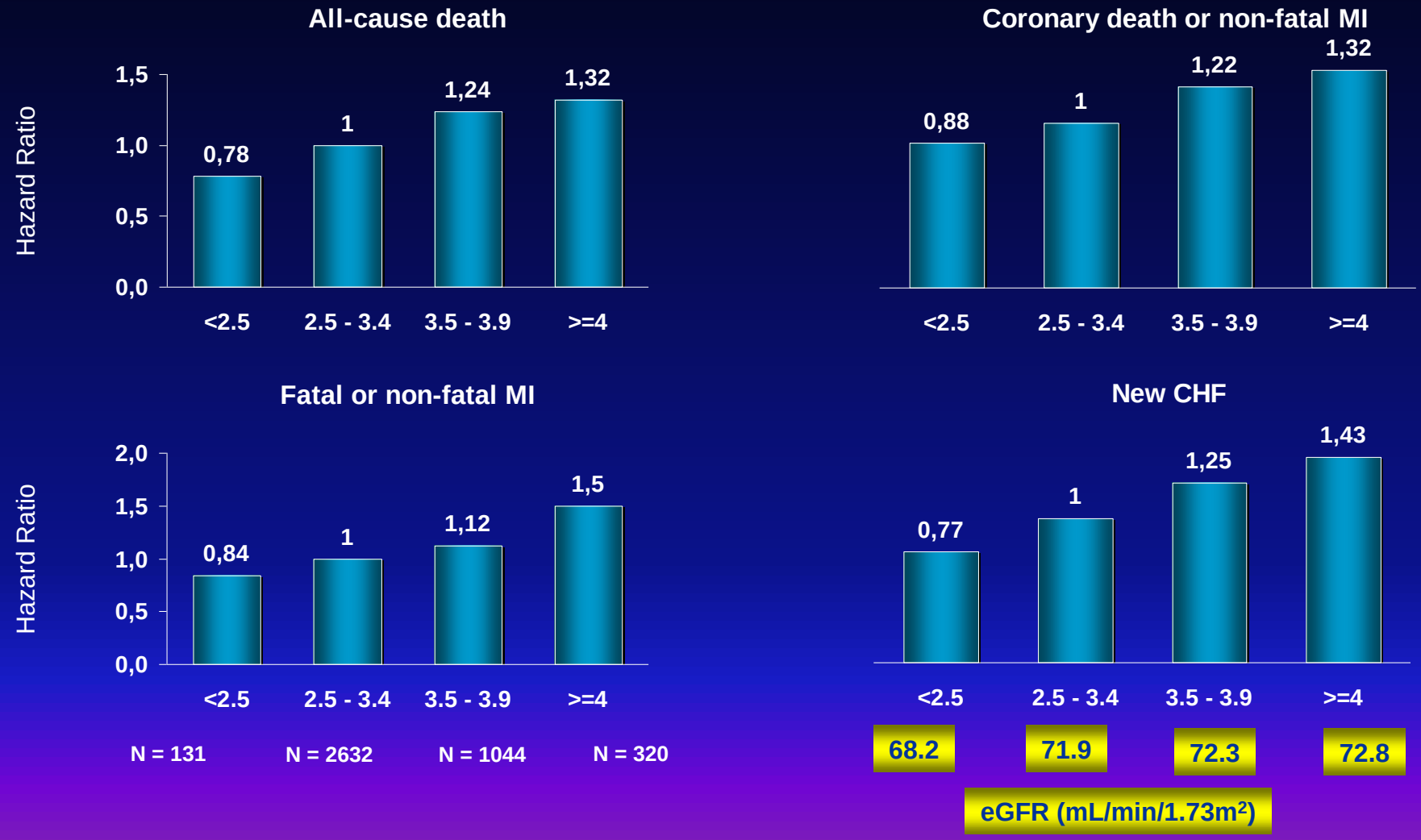
J Am Soc Nephrol 17: S255–S261, 2006

| Klotho-dependent and Klotho-independent effects of FGF23 in ESRD.



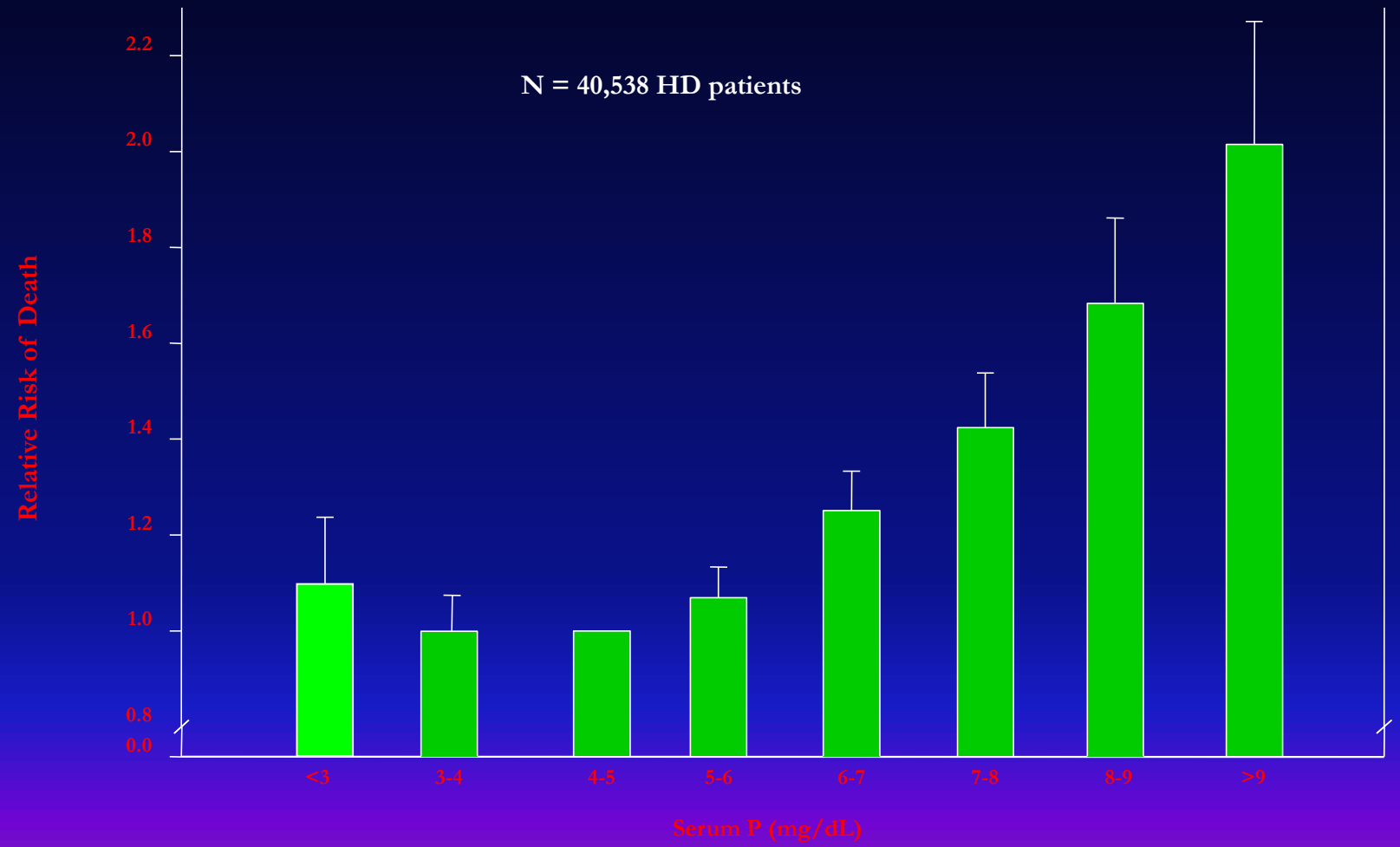
Komaba, H. & Fukagawa, M. Nat. Rev. Nephrol. 8, 484–490 (2012);

Higher levels of serum phosphate, even within the normal range, are associated with adverse outcomes in patients with prior myocardial infarction



Tonelli M. Circulation. 2005;112:2627-2633

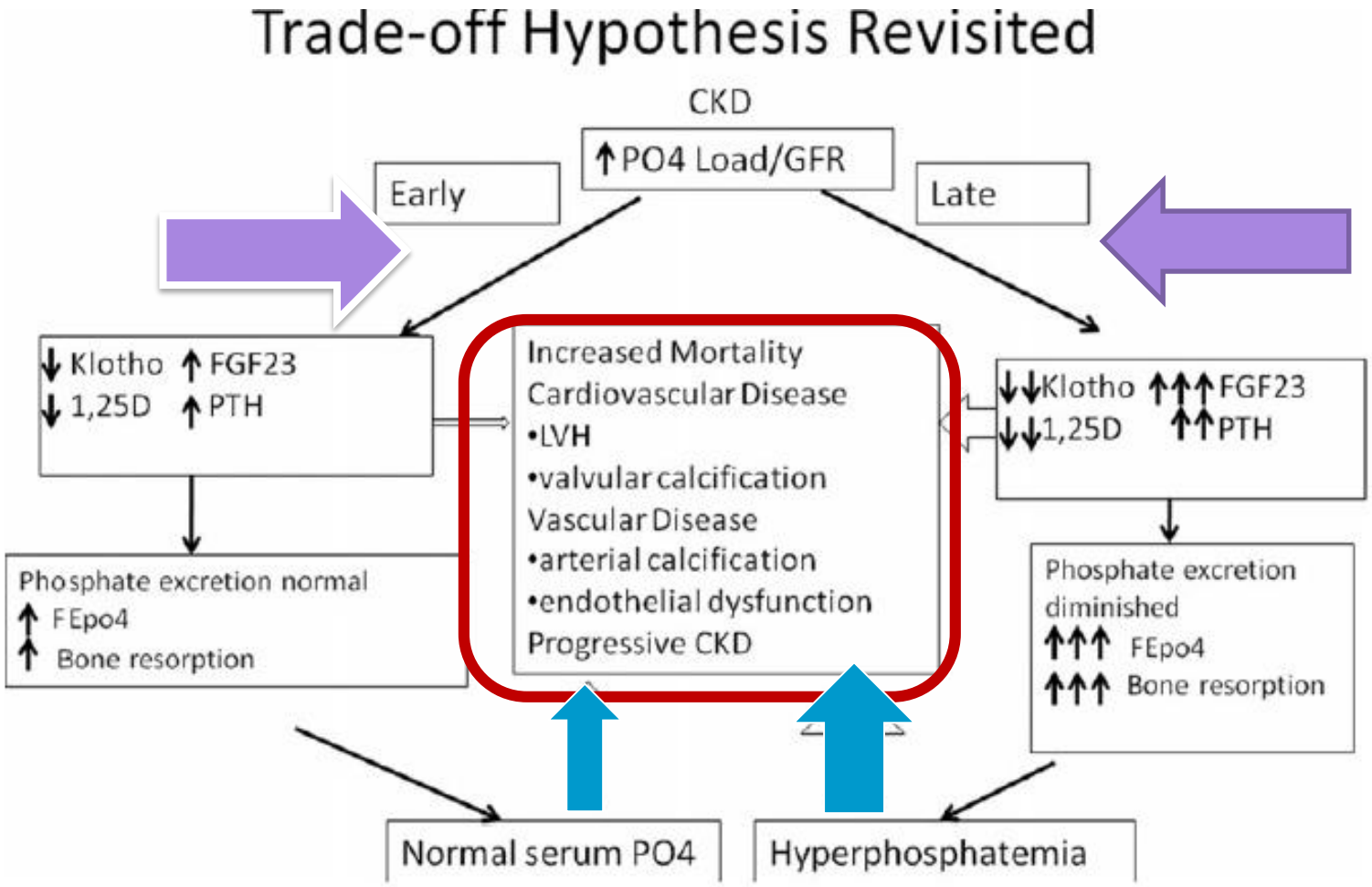
Mortality Risk by Serum P Levels



Block et al. *J Am Soc Nephrol.* 2004;15:2208-2218.

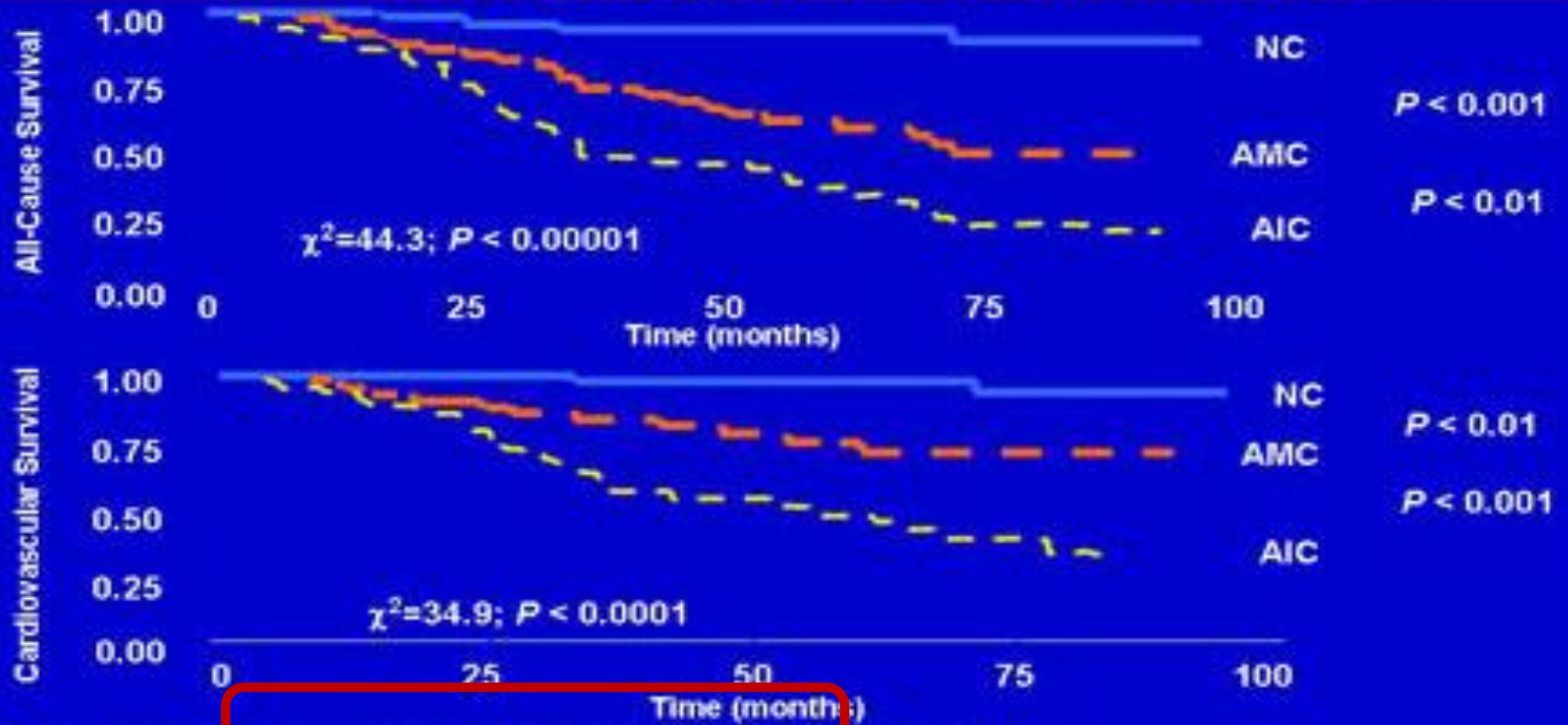
Seminars in Dialysis

PTH, PHOSPHATE AND VITAMIN D: CURRENT ISSUES AND CONCERNS



Arnold J. Felsenfeld,* Barton S. Levine,* and Mariano Rodriguez†

Impact of arterial calcification in stable hemodialysis patients with ESRD

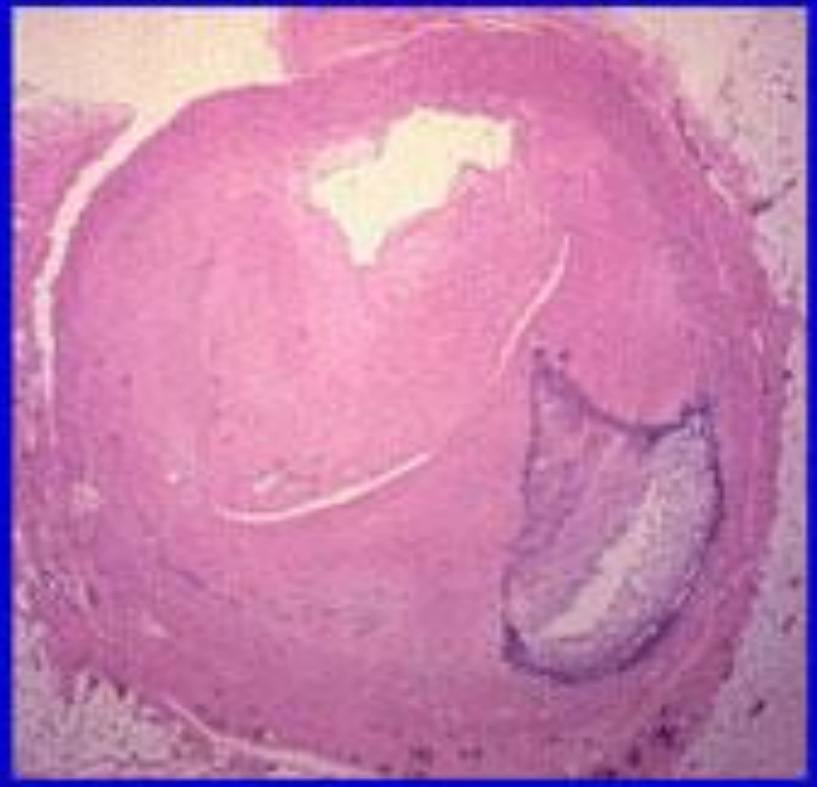


Risk of calcification increased with hyperphosphatemia and dose of $CaCO_3$

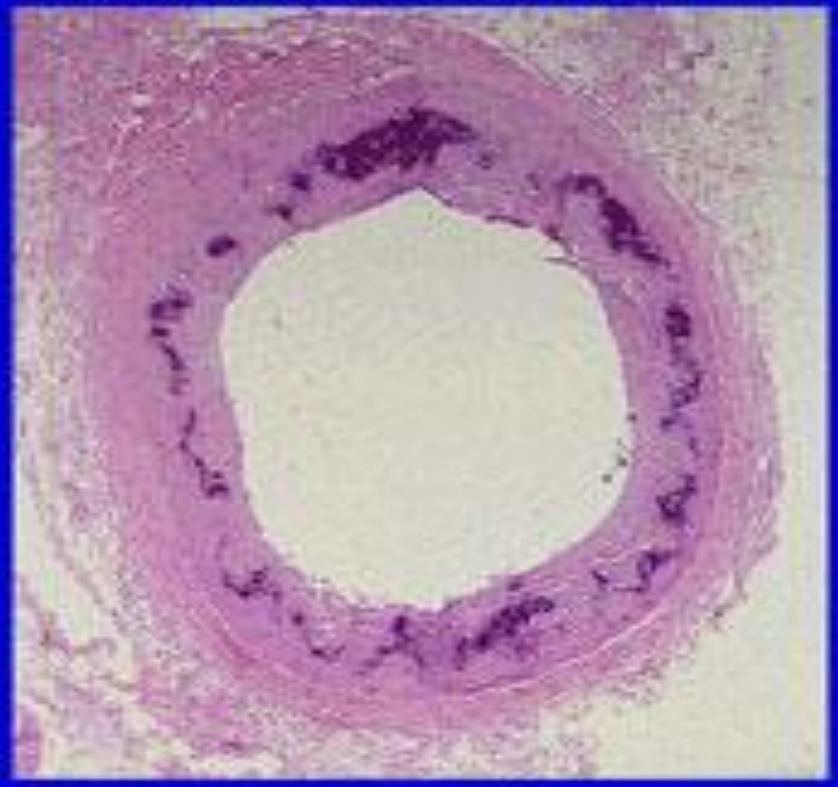
London G, et al. *Nephrol Dial Transplant.* 2000;15:1731-1740.

Vascular calcification (VC) in CKD

Atherosclerotic
Arterial Intimal Calcification



Mönkeberg
Arterial Medial Calcification

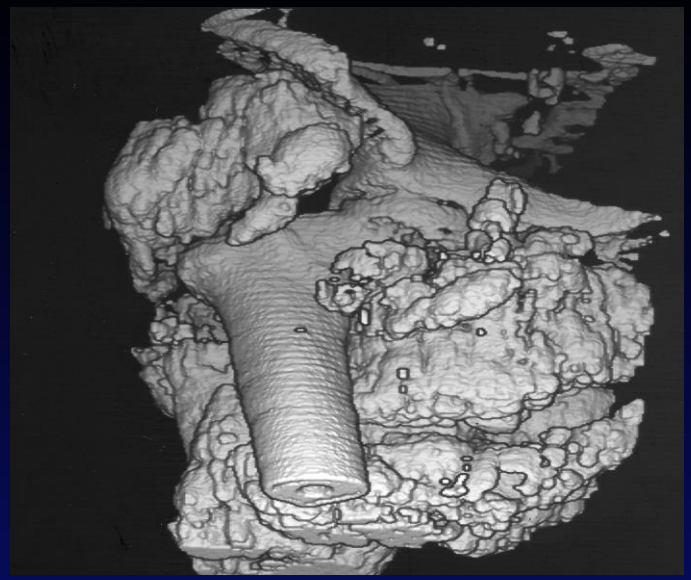


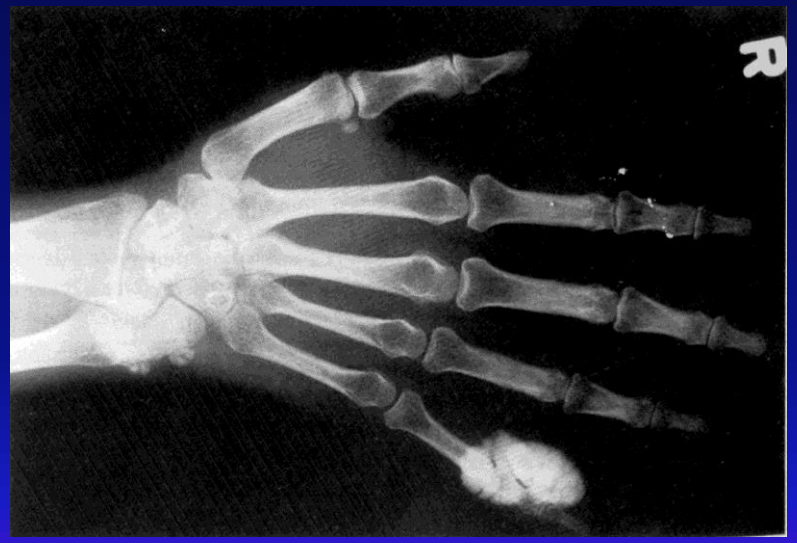
In CKD, both forms of VC are observed in the large arteries, calciphylaxis is mainly Mönkeberg, coronary artery calcification and cardiac valve calcification is atherosclerotic.

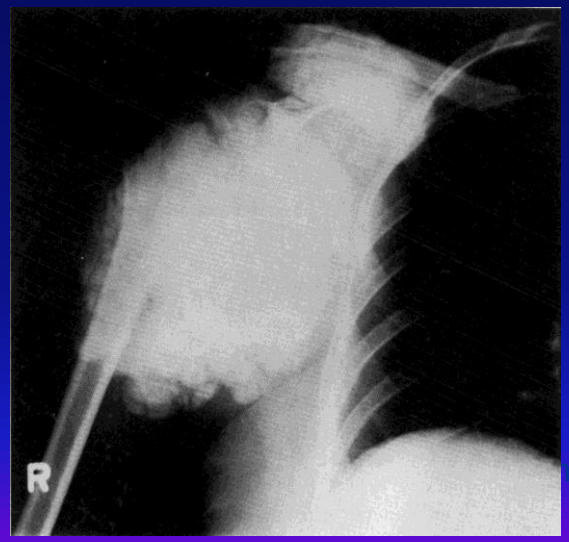
Vascular calcification

Passive process?

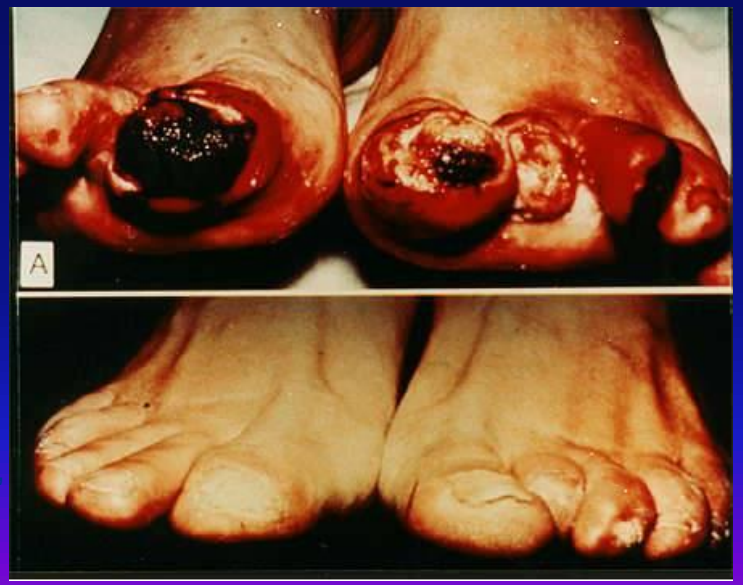
- Medial wall calcification and phosphorous







Source: [illegible] Riley-Brown,



agenda

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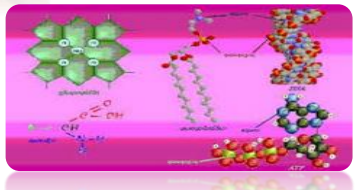
- **Phoshate diet in CKD**
- Phoshate binters in CKD
- Activate Vitamin Analogs
- Calcimimetic drugs
- Questions
- Conclusion

Ρύθμιση φωσφόρου

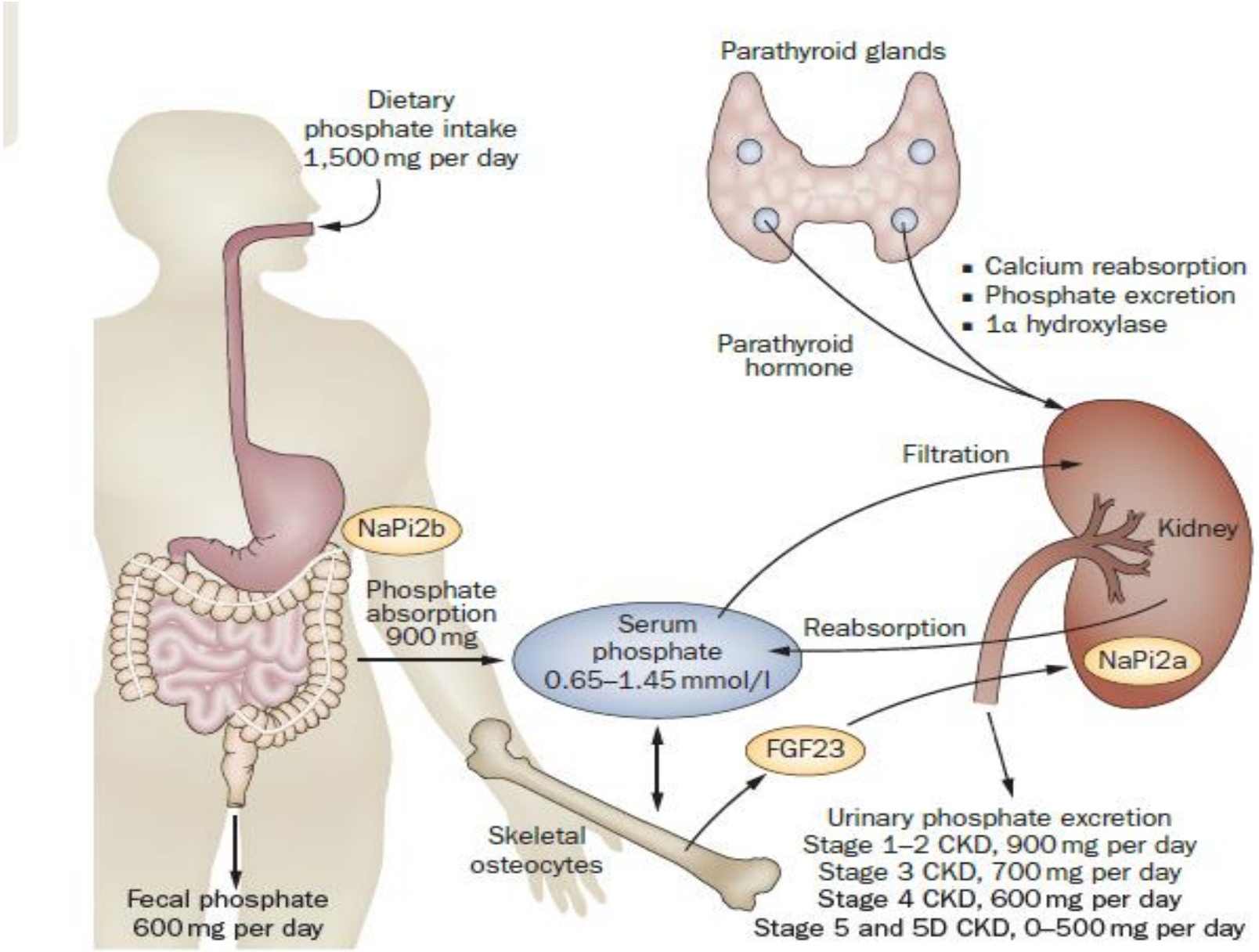
- **Δίαιτα**

- **Δεσμευτικά φωσφόρου**



- **Εξωνεφρική κάθαρση**

Ισοζύγιο του μεταβολισμού του φωσφόρου



Ρύθμιση φωσφόρου

Υπερφωσφαταιμία

50-70% απορρόφηση

του προσλαμβανόμενου φωσφόρου

π.χ.

πρόσληψη	:	1000 mg/ημέρα	ή	7000 mg/εβδομάδα
απορρόφηση	:	≈ 600 mg/ημέρα	ή	4200 mg/εβδομάδα

HD  800-1000 mg/συνεδρία

ΠΚ 300 mg/ημέρα

HD: ≈ 250 mg/ημέρα

ΠΚ: ≈ 280 mg/ημέρα

nPCR (g/Kg/day) = 1g → 800-1200 mg φωσφόρου

Στάδια 3,4 & 5 ΧΝΝ

(*χωρίς εξωνεφρική κάθαρση*)

Η υπερφωσφαταιμία εμφανίζεται όταν eGFR<20mL/min/1.73m2

Μείωση της πρόσληψης του φωσφόρου <900mg/day

Αν η μείωση της πρόσληψης του φωσφόρου για διάστημα 2 μηνών αποτύχει

Χορήγηση δεσμευτικών του φωσφόρου

Σε αιμοκαθαιρόμενους ασθενείς
Θεραπεία υπερφωσφαταιμίας

- Μείωση της πρόσληψης του φωσφόρου <900mg/day

- Increase dialytic phosphate removal

Χορήγηση δεσμευτικών του φωσφόρου

Dietary modification

Οι τροφές με μεγάλη περιεκτικότητα σε φωσφόρο πρέπει να αποφεύγονται

- A nutritional good diet contains too much phosphate

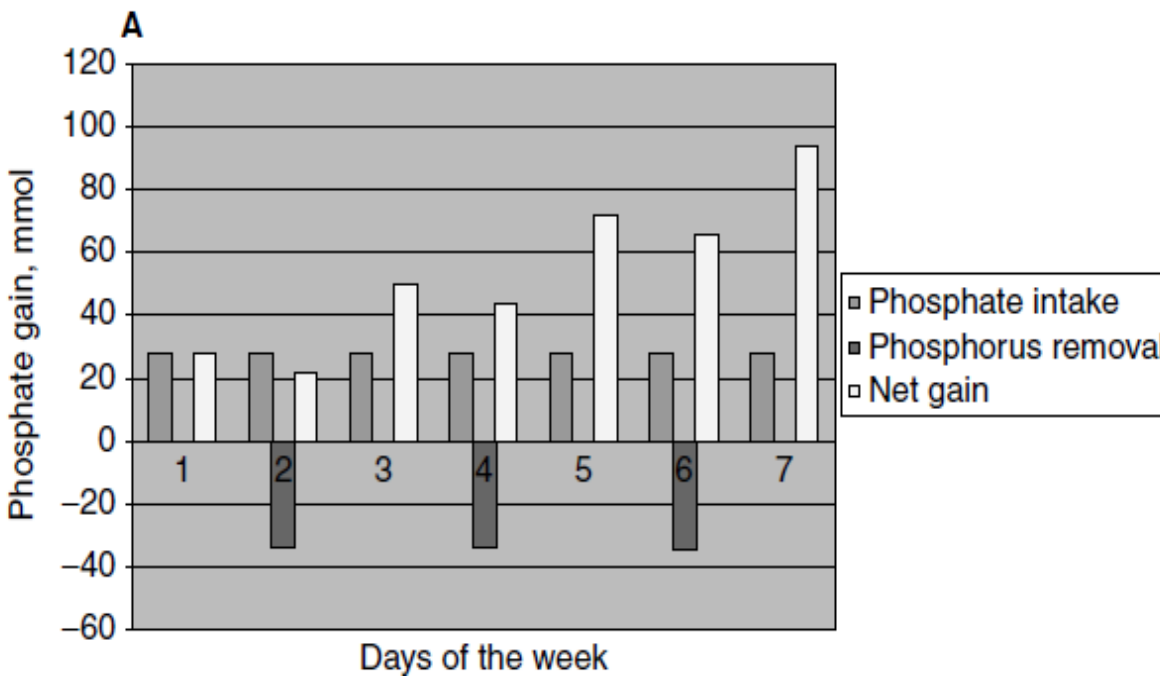
Phosphorus content in frequent food consumption

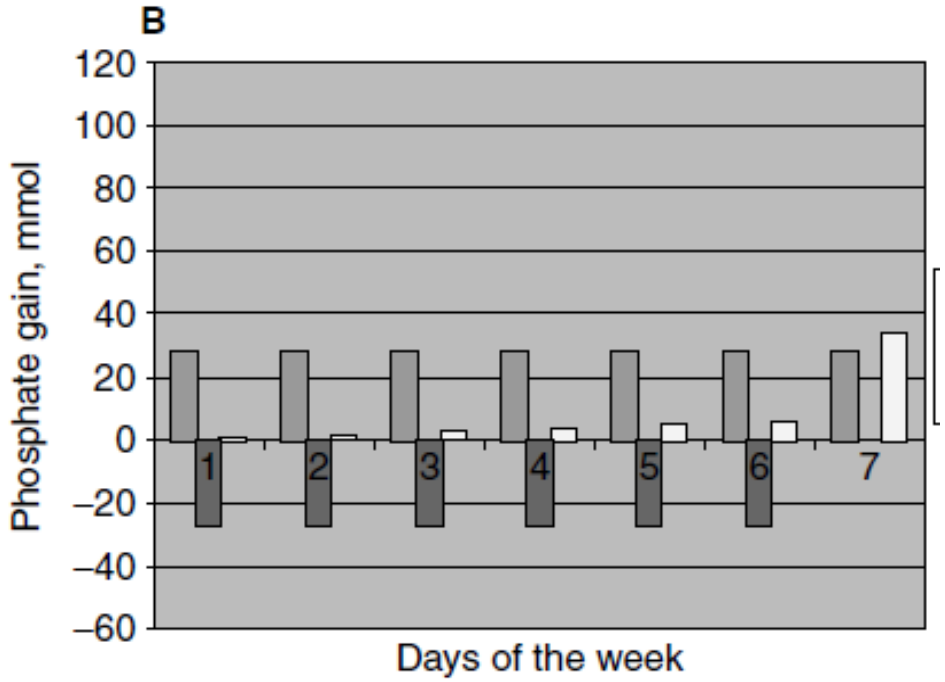
Είδος Τροφής / 100 γρ.	Φωσφόρος (mg)
Γάλα Αγελάδος	93
Μητρικό γάλα	14
Γάλα κατσίκας	106
Γάλα συμπ/νο σακχ/χο.	206
Γάλα εβαπορέ άγλυκο	205
Γάλα σκόνη - πλήρες	708
Γάλα αποβουτυρωμένο	1016
Γάλα σοκ/χο πλήρες	94
Γιαούρτι μερικά αποβουτ.	94
Γιαούρτι (πλήρες γάλα)	87
Μυζήθρα χωρίς κρέμα	175
Μυζήθρα με κρέμα	152
Τυρί Βίτσεριος	564
Τυρί, γραβιέρα	821
Τυρί παρμεζάνα	782
Τυρί ροκφόρ	535
Τυρί ολλανδικό	415

Είδος Τροφής / 100 γρ.	Φωσφόρος (mg)
Τυρί φέτα (μαλακή)	184
Ψωμί άσπρο	87
Ψωμί πιτυρούχο	228
Αυγό βραστό ή ωμό	205
Αυγό τηγανιτό	222
Αστακός κονσέρβα ή μαγειρεμένος	192
Γαρίδες ωμές	136
Γαρίδες τηγανιτές	191
Γλώσσα	135
Καβούρια μαγειρεμένα	175
Καλαμαράκια ωμά	119
Καλαμαράκια τηγανιτά	-
Καραβίδες	-
Μαρίδες	122
Μπακαλιάρος ωμός	194
Μπακαλιάρος μαγειρεμένος	274
Μπακαλιάρος αλατισμένος	891

Είδος Τροφής / 100 γρ.	Φωσφόρος (mg)
Μπαρμπούνια ωμά	220
Μύδια (μόνο σάρκα)	236
Ξιφίας ωμός	-
Ρέγγα	256
Σαρδέλες ωμές	33
Σαρδέλες κονσέρβα με λάδι	434
Σκουμπρί	-
Σολομός άψητος	186
Σολομός σε κονσέρβα	-
Στρείδια, άψητα	143
Στρείδια μαγειρεμένα	241
Τόνος ωμός	-
Τόνος σε κονσέρβα με λάδι	294
Τσιπούρα ωμή	250
Τσίχλα	-
Χαβιάρι	-
Χταπόδι ωμό	173

The role of daily dialysis in the control of hyperphosphatemia





Kidney International, Vol. 67, Supplement 95 (2005), pp. S28–S32

The role of daily dialysis in the control of hyperphosphatemia

Dialysis phosphorus removal: 3 times per week

Diet	1000 mg/day 7 x 1000 (per week) =	7000 mg
Absorption	60% 7000 x 60% =	4200 mg
Dialysis	800 mg 3 x 800 (per week) =	2400 mg
Balance	4200 – 2400 =	1800 mg

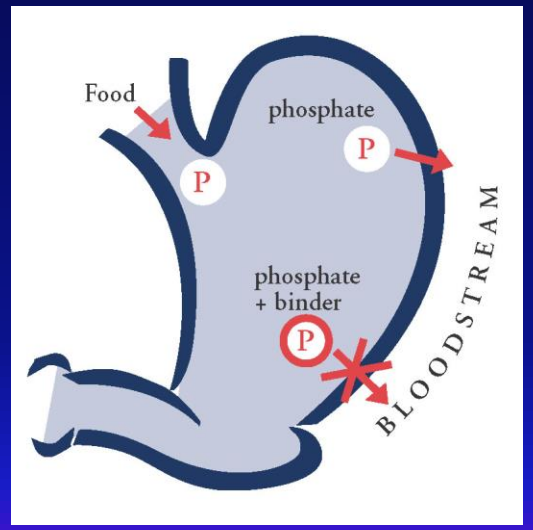
Dialysis phosphorus removal: 6 times per week

Diet	1000 mg/day 7 x 1000 (per week) =	7000 mg
Absorption	60% 7000 x 60% =	4200 mg
Dialysis	800 mg 6 x 800 (per week)	4800 mg
Balance	4200 – 4800	- 600 mg

Oral phosphate binders

Oral phosphate binders work by forming insoluble complexes in the gut and then excrete the complexes in the faeces.

- **Take it together with a meal!**



Pharmacology, efficacy and safety of oral phosphate binders

Table 2 | Phosphate binders currently available for clinical use

Binder type	Binding method	Advantages	Disadvantages
Aluminum salts	Coordination compounds and ionic	Highly effective, inexpensive	Proven toxicity, requires monitoring
Calcium carbonate and acetate	Ionic	Moderately effective, fairly inexpensive	Hypercalcemia common, possible vascular calcification
Magnesium salts	Ionic	Moderately effective, free of calcium and aluminum, fairly inexpensive	Gastrointestinal effects, requires monitoring
Lanthanum carbonate	Ionic	Highly effective, low pill burden	Expensive, gastrointestinal effects
Sevelamer hydrochloride and sevelamer carbonate	Ion exchange	Moderately effective, lipid effects	Expensive, high pill burden, gastrointestinal effects

Hutchison, A. J. *et al. Nat. Rev. Nephrol.* 7, 578–589 (2011);

Νεότερα δεσμευτικά φωσφόρου

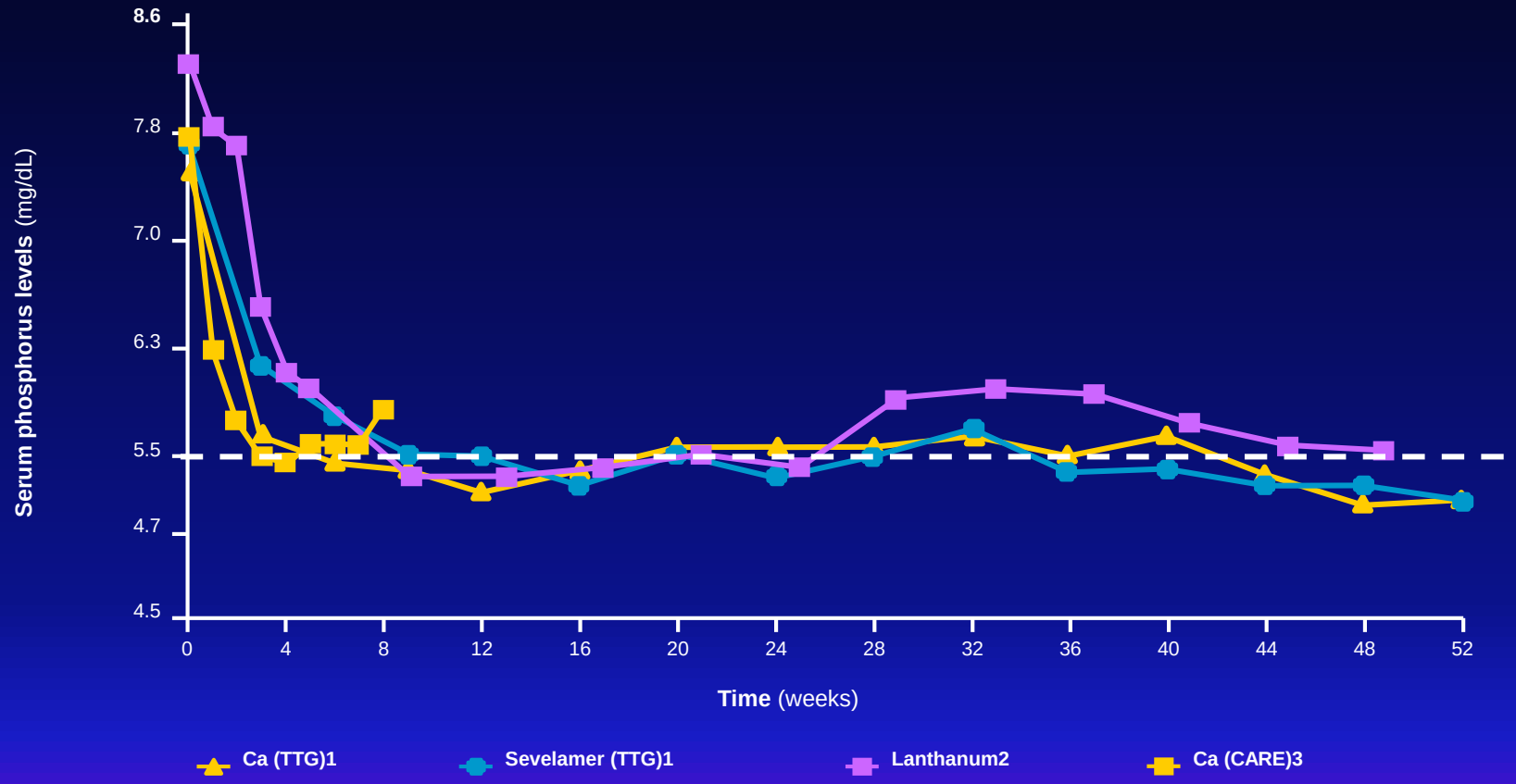
Table 1. (Continued)

Binder	Advantages	Disadvantages	Forms	Dosage (mg)
Sucroferric Oxyhydroxide	• free • pill burden than sevelamer • Potential to raise transferrin, iron and hemoglobin levels	• Expensive • GI side effects • Cannot be prescribed with oral levothyroxine or pariodoxil • Long-term side effects unknown • Unknown if iron accumulation long term	• Tablets, chewable	• 500 mg (1 tablet) three times per day • Maximum dose is 3000 mg/day
Ferric Citrate	• free • Less pill burden than sevelamer • Potential to raise transferrin, iron and hemoglobin levels • Potential to decrease iron and ESA usage	• Expensive • GI side effects • Long-term side effects unknown • Unknown if iron accumulation long term	• Tablets	• Each tablet contains 210 mg ferric iron • Starting dose: 2 tablets three times per day • Maximum dose is 12 tablets per day

GI, gastrointestinal; ESA, erythropoietin stimulation agents.

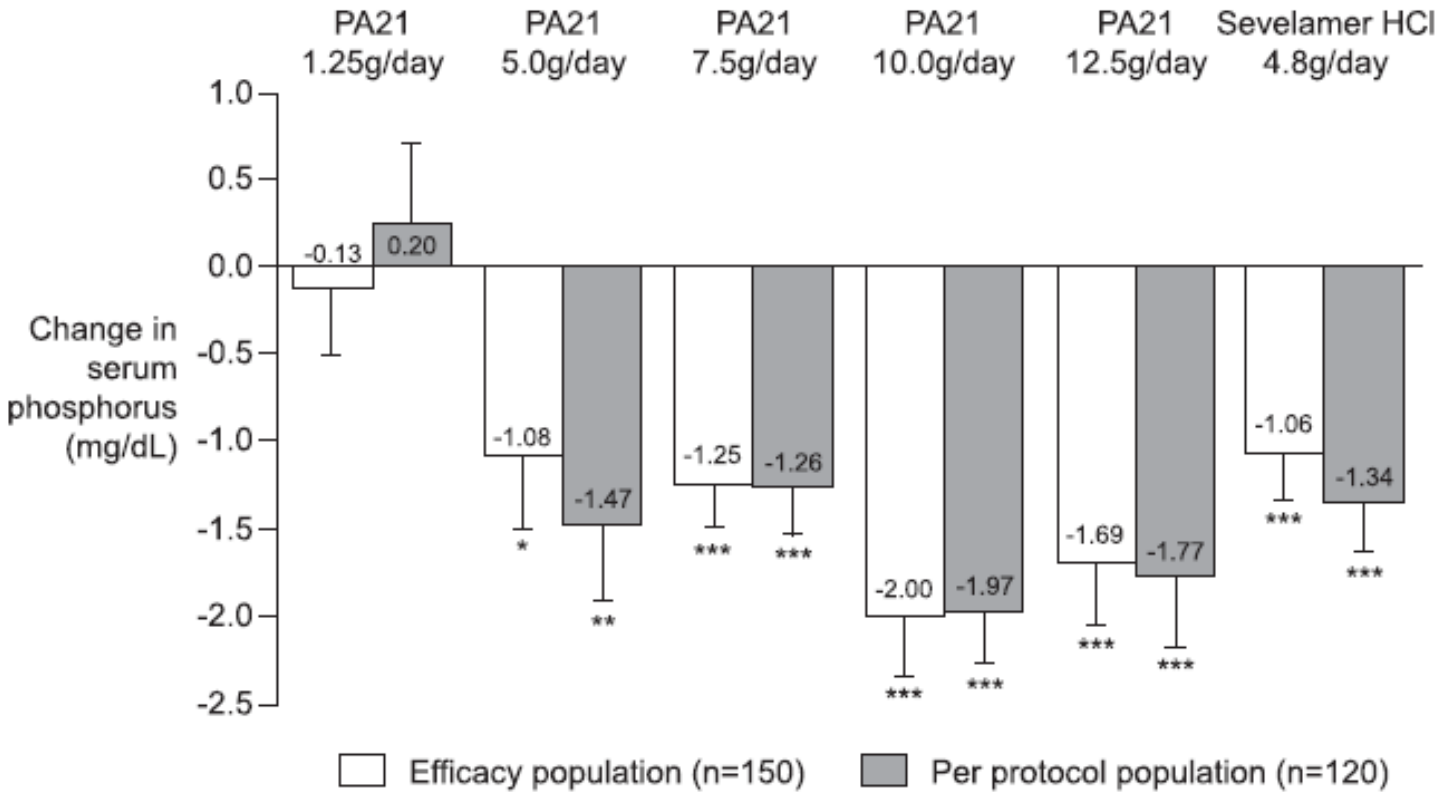
Seminars in Dialysis—Vol 28, No 6 (November–December) 2015 pp. 610–619

Phosphate binders have similar efficacy in reducing serum phosphate levels



Adapted from:
1. Chertow GM et al. *Kidney Int* 2002;62:245–252
2. Hutchison A. 2003 World Congress of Nephrology; Berlin, Germany
3. Qunibi W et al. *Kidney Int* 2004;65:1914–1926

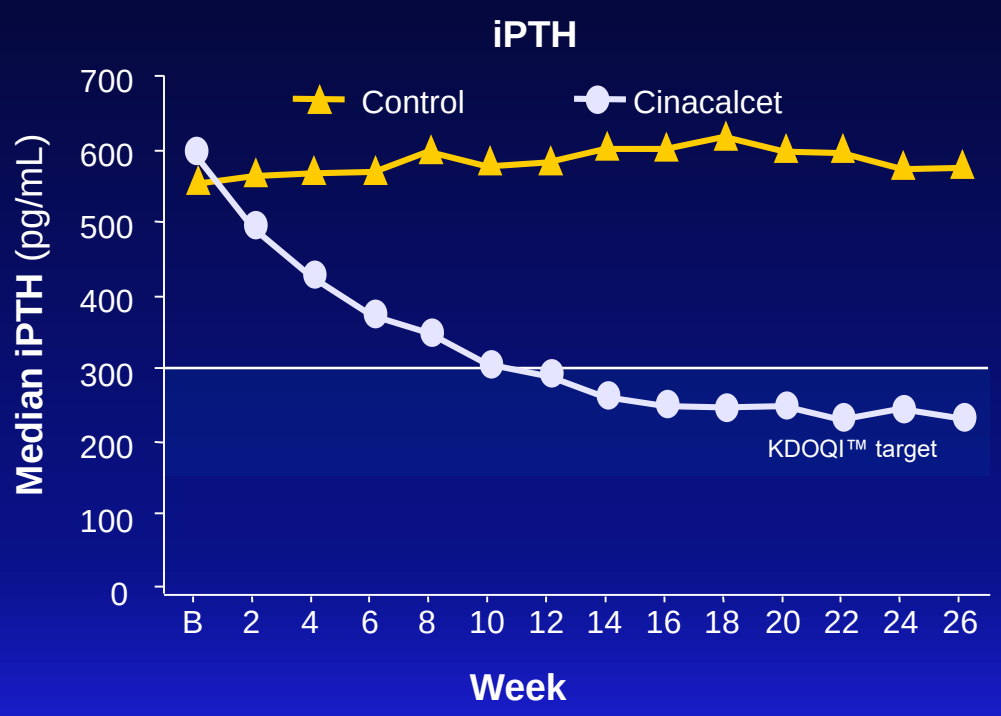
Randomized Clinical Trial of the Iron-Based Phosphate Binder PA21polynuclear iron(III)-oxyhydroxide phosphate binder in Hemodialysis Patients

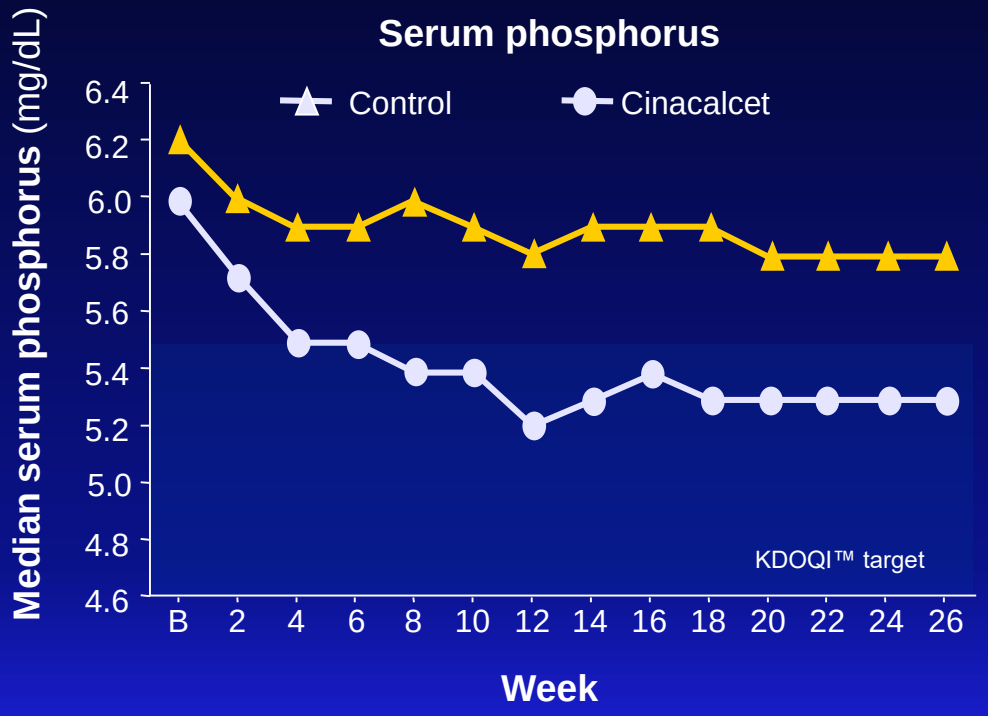


PA21 5–12.5 g/d significantly reduces serum phosphorus in hemodialysis patients.

Clin J Am Soc Nephrol 8: 280–289, 2013.

Cinacalcet improves PTH and P control simultaneously





Moe SM et al. *Kidney Int* 2005;67:760–771

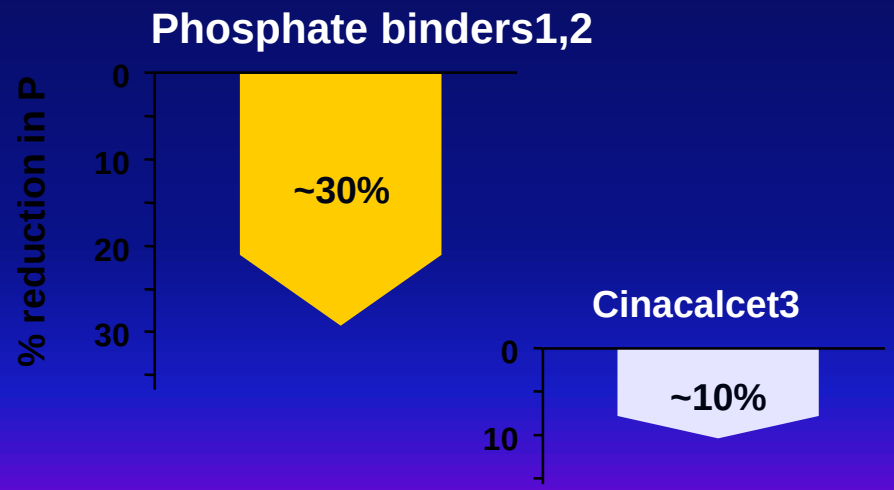
Guidance on managing P levels in dialysis patients

KDIGO® suggests avoiding hyperphosphataemia (>5.5 mg/dL) as this has been associated with poor outcomes and mortality in CKD 5D

Reduction of phosphate in the diet, phosphate binders and increased dialysis duration and frequency are measures to lower serum P levels

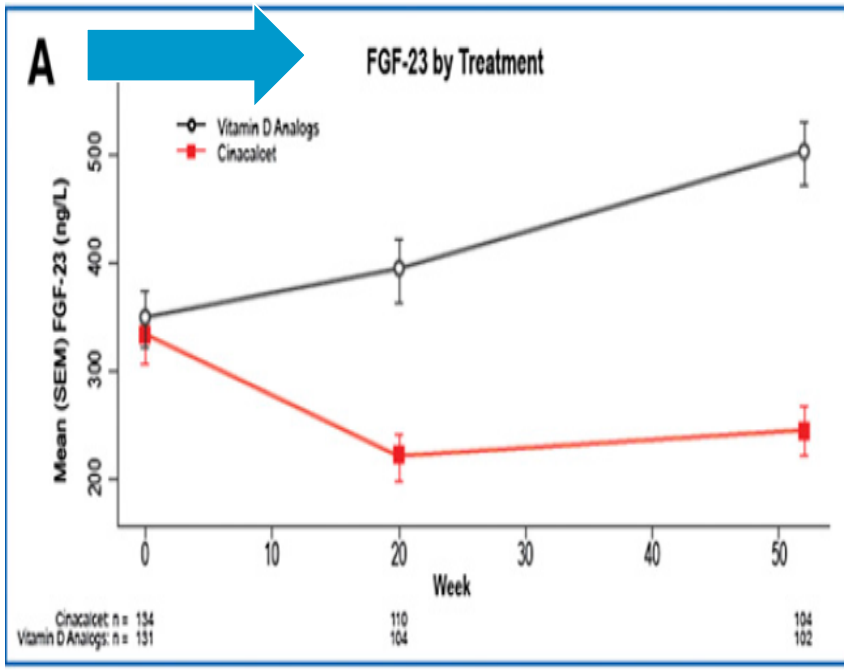
Cinacalcet can further improve P control by:

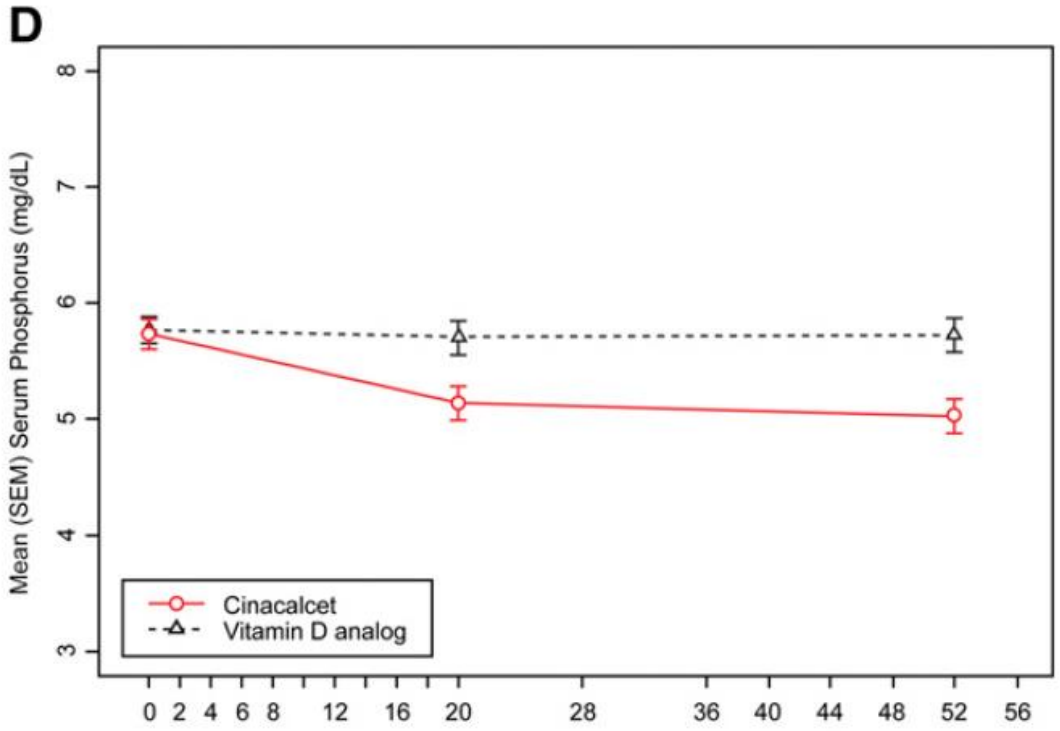
- **controlling PTH levels as key factor to improve P target achievement**
- **thus reducing P release from bone**



1. Chertow GM et al. *Kidney Int* 2002;62:245–252
2. Qunibi W et al. *Kidney Int* 2004;65:1914–1926
3. Block GA et al. *New Engl J Med* 2004;350:1516–1525

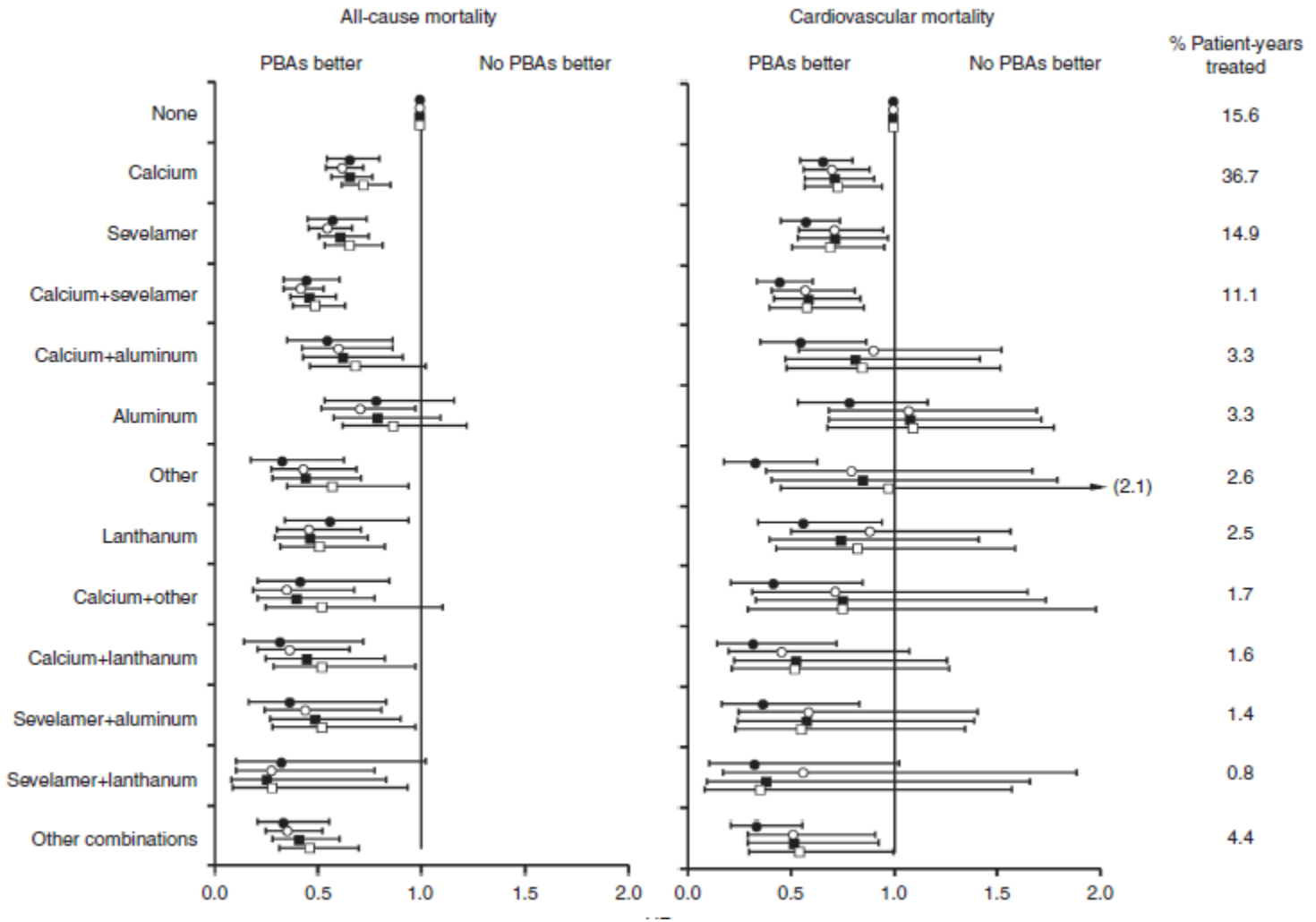
Effect of Cinacalcet and Vitamin D Analogs on Fibroblast Growth Factor-23 during the Treatment of Secondary Hyperparathyroidism





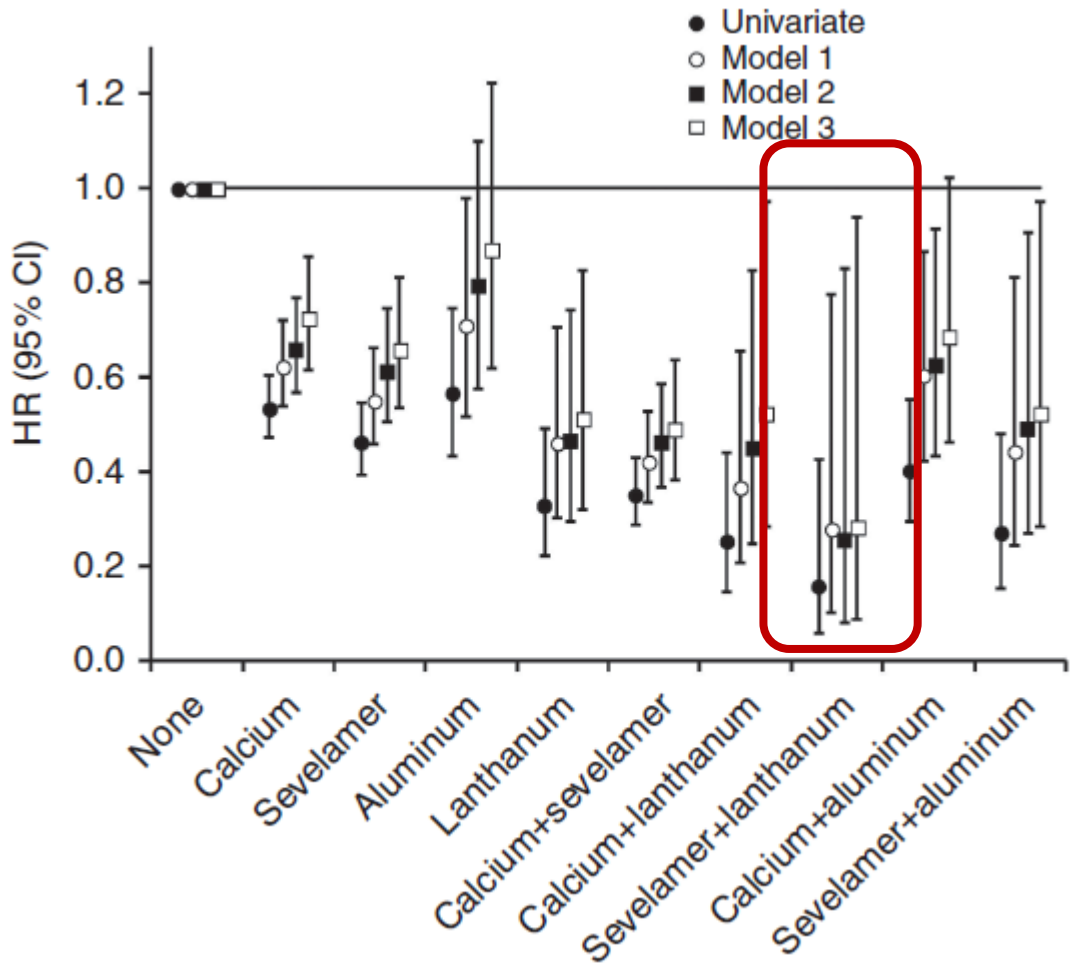
Clin J Am Soc Nephrol 10: 1021–1030, 2015

Use of phosphate-binding agents is associated with a lower risk of mortality



Kidney International (2013) 84, 998–1008

Use of phosphate-binding agents is associated with a lower risk of mortality



Kidney International (2013) 84, 998–1008

Στον ασθενή μας ..

θεραπεία κατά βήματα

Συστήσαμε μείωση της πρόσληψης του φωσφόρου <900mg/day

Increase dialytic phosphate removal

Αυξήσαμε το δεσμευτικό του φώσφορου

Διατηρήσαμε το calcimimetic

Βελτίωση των συνθηκών αιμοκάθαρσης

Συνεδρία αιμοκάθαρσης :4h χ 3 φορές την εβδομάδα

Φίλτρο: high flux με επιφάνεια 1.8

Διάλυμα διττανθρακικών CACA

ΔΔ βάρους μεταξύ των συνεδριών 3.5Kg

Kt/v 1.43

Φαρμακευτική Αγωγή

- Σεβελαμέρη 3-3-3
- Cinecalcet 30mg
- Αμλοδιπίνη 10mg
- Λισινοπρίλη 10mg
- Καρβεδιλόλη mg
- Ερυθροποιητίνη

Εργαστηριακός έλεγχος

Ht 33.2%.

Hb 11.2mg/dL

PLT 256. X 10-3/μl

Σάκχαρο αίματος 90 mg/dl,

Ουρία 178 mg/dl,

Κρεατινίνη 9.3 mg/dl,

Μαγνήσιο 1.8mg/dl

Ασβέστιο 8.6 mg/dl

Φωσφόρος 7,2 mg/dl

Αλβουμίνη 4.0mg/dl

PTH 176pg/ml

Που βρίσκεται το πρόβλημα;

Reasons for failure of phosphate control

Pseudohyperphosphataemia (incorrect sample handling; analytical error).
2. High dietary phosphate intake.
3. High doses of active vitamin D metabolites.
4. Phosphate-containing drugs (enema, infusion).
5. Inadequacy of haemodialysis.
6. Advanced osteitis fibrosa (efflux of P from bone independent of intestinal P uptake).
7. Metabolic acidosis (phosphate shift from intracellular into extracellular space).
8. Patient non-compliance with phosphate binders.
9. Incorrect intake of phosphate binders (timing and dosing).
10. Inefficiency of calcium carbonate because of achlorhydria (spontaneous or after medication).

Γιατί η διατήρηση των επιπέδων του φωσφόρου στον ορό είναι πολύ δύσκολη υπόθεση;

- Αποκλίσεις από την δίαιτα
- το σχήμα των δεσμευτικών
- μη αναγνώριση του κρυμμένου φωσφόρου που
- υπάρχει στις τροφές

The Triple Threat

- low dialytic removal
- high enteral absorption
- and low binder efficacy

Enteral Phosphate Absorption

A notable variability in enteral phosphate absorption is also fr uently overlooked

The widely cited 60% rate of dietary phosphate absorptic

the variability in the 5 individual phosphate absorption rates (26%, 40% 69%, 84%, and 85%)

Other Contributors to Hyperphosphatemia

- Patients with **hyperparathyroidism**
- and high-turnover bone disease

PTH<300

- often have a **significant endogenous source of phosphate**,

Η χορήγηση ανάλογων της βιταμίνης D αυξάνει την απορρόφηση του φωσφόρου

2 mg/d of calcitriol for 2 weeks resulted in more than a 2-fold increase in phosphate absorption in 2 patients

but a mean increase of only 21% in the other 3 patients

2X

Ρύθμιση φωσφόρου
Φώσφορο-δεσμευτικά

26 X 9= 225mg

The absorption of 200 mg must be blocked using binders

.

(sevelamer)	At phosphate-binding rates of 26 mg
calcium acetate	to 33 mg

HD : ≈ 250 mg/ημέρα

ΠΚ : ≈ 280 mg/ημέρα

nPCR (g/Kg/day) = 1g → 800-1200 mg φωσφόρου

μη αναγνώριση του κρυμμένου φωσφόρου που υπάρχει στις τροφές

Phosphorus in dietary protein

Dietary protein intake	Dietary phosphorus
1.2 g/kg	1353 ± 253 mg
1.0-1.2	1052 ± 219
0.8-1.0	936 ± 217
0.6-0.8	831 ± 142
<0.6	599 ± 105

Rufino et al. *Nephrol Dial Transplant*.;13:65-67, 1998.

Dietary Phosphorus Restriction in Dialysis Patients: Potential Impact of Processed Meat, Poultry, and Fish Products as Protein Sources

Table 2. Phosphorus-Binding Requirement in a 70-kg Dialysis Patient Consuming 1.2 g of Protein/kg for 2 Different Levels of Phosphorus Intake

Phosphorus Intake (mg/g protein)	Phosphorus Content (mg/d)	Phosphorus Absorption (mg/d)	Other Phosphorus Absorption (mg/d)	Dialysis Removal (mg/d)	Binding Requirement (mg/d)	Phosphate Binder Pill Requirement (calcium acetate/sevelamer carbonate/ lanthanum carbonate)
12	1,008	605	100	−400	305	9.2/11.7/2.7
9	756	454	100	−400	154	4.7/5.9/1.3

Am J Kidney Dis 54:18-23. © 2009

Dietary Phosphorus Restriction in Dialysis Patients: Potential Impact of Processed Meat, Poultry, and Fish Products as Protein Sources

	Phosphorus-Protein Ratio (mg/g)	Phosphorus Labeled
Cooked food items		
Applegate Farms Roasted Turkey Breast, Boneless	10.93	No
Armour Sizzle and Serve Beef Sausage Links	9.17	No
Ball Park Beef Franks	14.25	Yes
Butterball White Turkey, Oven Roasted	21.47	Yes
Carando Deli Quick Genoa Salami	8.4	No
Dak Premium Ham with Natural Juices	15.68	Yes
Dietz & Watson, Black Forest Collection, Braunschweiger Liverwurst	21	Yes
Gorton's Grilled Salmon, Classic Grilled	19.58	Yes
Hillshire Farm Deli Select Roast Beef, Ultrathin	13.69	Yes
Hormel Bone In Ham with Natural Juices, Spiral Sliced	11.55	Yes
Hormel Meatloaf & Tomato Sauce, Homestyle	7.64	No
Hormel Sliced, Roasted Turkey Breast and Gravy	12.27	Yes
Hormel Slow Simmered Pork Roast, Au Jus	9.5	No
Hormel Slow Simmered Salisbury Steak and Gravy	10.27	Yes
Jones All-Natural, Golden Brown, Beef Sausage Links	7.49	No
Louis Kemp Crab Delights, Flake Style (crab flavored seafood from surimi)	6.07	Yes
Oscar Mayer Bologna (made with chicken and pork)	17.73	Yes
Oscar Mayer Premium Beef Franks	12.6	Yes
Perdue Baked Chicken Breasts Cutlets, Homestyle	12.6	Yes
Perdue Mealtime Starter Chicken Breast Roast with Ribmeat, Homestyle Gravy	17.88	Yes
Perdue Short Cuts Carved Chicken Breasts, Skinless with Rib Meat, Original Roasted	8.43	No
Perdue Short Cuts Carved Turkey Breasts, Oven Roasted	7.1	
Sabrett Skinless Beef Frankfurters	8.14	
Shady Brook Farms Turkey Meatballs, Italian Style	8.5	No
Tyson Boneless Skinless Grilled Chicken Breast Strips with Rib Meat	11.49	Yes
Tyson Breaded Chicken Breast Patties with Rib Meat	13.33	No
Tyson Maple and Brown Sugar Glazed Ham, Smoke-Flavored	14	Yes

Στις έτοιμες τροφές υπάρχει Το μεγάλο πρόβλημα

Am J Kidney Dis 54:18-23. © 2009

Better reporting of phosphorus content of foods by manufacturers could result in improved dietary phosphorus control without risk of protein malnutrition.

Measured Phosphorus Content and Reference Values of Popular Beverages

Beverage	Mean ± SD Measured P (mg/8 fl oz)	NDSR 2014 Reference Value for P (mg/8 fl oz)	Absolute Difference (mg/8 fl oz)	% Difference
Carbonated drinks				
Coke	37.5 ± 0.2	25	+12.5	+50%
Cherry Coke	33.8 ± 0	25	+8.8	+35%
Dr. Pepper	25.9 ± 0.2	25	+0.9	+4%
Diet Dr. Pepper	27.1 ± 0.5	21	+6.1	+29%
Pepsi	31.2 ± 0.7	25	+6.2	+25%
Diet Pepsi	24.1 ± 0.3	21	+3.1	+15%
AMP Energy	30.9 ± 0.8	40	−9.1	−23%
Fruit-Flavored Drinks				
Crystal Light, Classic Orange[a]	100.5 ± 16.0	10	+90.5	+905%
Crystal Light, Raspberry Ice[a]	2.4 ± 0.1	10	−7.6	−76%
Crystal Light, Fruit Punch[a]	10.9 ± 0.5	10	+0.9	+9%
Tang, Orange[a]	91.1 ± 5.0	39	+52.1	+134%
Kool-Aid, Tropical Punch[a]	2.7 ± 0.3	0	+2.7	NA
Vitamin Water, Revive Fruit Punch	261.4 ± 1.7	0	+261.4	NA
Vitamin Water, Focus Kiwi Strawberry	0.9 ± 0	0	+0.9	NA
Vitamin Water, Essential Orange-Orange	63.4 ± 0.7	0	+63.4	NA
Vitamin Water, Defense Raspberry Apple[b]	1.5 ± 0.1	0	+1.5	NA
Vitamin Water Zero, Squeezed Lemonade[b]	86.2 ± 1.2	0	+86.2	NA
Vitamin Water Zero, Rise Orange[b]	97.7 ± 1.7	0	+97.7	NA
Mio Fit, Arctic Grape[a,b]	12.4 ± 2.1	82	−69.6	−85%
Mio Fit, Berry Blast[a,b]	14.4 ± 1.6	82	−67.6	−82%
SoBe Lifewater, Blood Orange Mango[b]	43.9 ± 0.5	0	+43.9	NA
Aquafina Flavor Splash, Mixed Berry[b]	56.3 ± 0.7	62	−5.7	−9%
Propel Zero, Berry	54.9 ± 0.3	59	−4.1	−7%
Sports Drinks				
Gatorade, Frost Glacier Freeze (powder)[a]	20.9 ± 3.2	0	+20.9	NA
Gatorade, Orange (powder)[a]	21.0 ± 4.4	0	+21	NA

Am J Kidney Dis. 2015;65(6):967-971

A dearth of data: the problem of phosphorus in prescription medications

Richard A. Sherman[1], Supriya Ravella[1] and Toros Kapoian[1]

We examined the labels of the branded forms of 200 of the most widely prescribed medications in Dialysis Clinic centers in the United States and found that 23 (11.5%) contained phosphorus.

Notable were the phosphorus content of a generic **10 mg lisinopril (32.6 mg)** and a generic **10 mg amlodipine (40.1 mg).**
The significant potential for iatrogenic injury accruing from the use of these drugs warrants efforts at remediation. Specific information on the phosphorus content of medications used by dialysis population needs to be made available to the dialysis community

Kidney International (2015) 87, 1097–1099;

Συστήσαμε την διακοπή

- τροφίμων με συντηρητικά
- αναψυκτικών
- χυμών
- σοκολάτας
- καφέδων

Εργαστηριακός έλεγχος

Ουρία 161 mg/dl,

Κρεατινίνη 8.8 mg/dl,

Μαγνήσιο 1.7mg/dl

Ασβέστιο 8.6 mg/dl

Φωσφόρος 5.3 mg/dl

PTH 168pg/ml


Tabula terræ Nouæ Zemblæ,
in qua fretum sinusq WAIGATS
item ora littoralis TARTARIÆ atq
RUSSIÆ, ad urbem usq KILDEINAR
præscribitur adhuc cursus quem inde
nautæ in reditu tenent secus septentrionale
littus et TRAIECTUS
prope fretum WAIGATS ad Russiæ
oram et ad promontorium CANDENOS
atq fauces usq MARIS ALBI.
AUTHORE GERHARDO DE VEER.
NOVA ZEMBLA
Admiraliteyt Ins.
Schwartz eck
Langenes
Loms Bay
Gros Baij
TARTARIÆ PARS

Ευχαριστώ

Statin Dosing Modifications in CKD

	Adjust for Reduced GFR (mL/min per 1.73M²)			
	60-90 (Stage 2)	15-59 (Stage 3-4)	< 15 (Stage 5)	Notes
Atorvastatin	None	None	None	
Fluvastatin	None	Max dose 40 mg/day if GFR < 30	Max recommended dose 40 mg/day	
Lovastatin	None	↓ to 50%	↓ to 50%	
Pitavastatin	None	1 mg/day starting dose, not to exceed 2 mg/day	1 mg/day starting dose, max dose 2 mg/day	
Pravastatin	None	None	None	
Rosuvastatin	None	5 mg once daily to start, not to exceed 10 mg once daily	5 mg once daily to start, not to exceed 10 mg once daily	
Simvastatin	None	↓ to 50%	↓ to 50%	FDA restriction on 80 mg dose

www.kdoqi.org[21]
http://www.fda.gov/Drugs/DrugSafety/ucm256581.htm[22]
http://www.accessdata.fda.gov[23]