

# Chronic Kidney Disease- Mineral Bone Disorder Management CKD-MBD

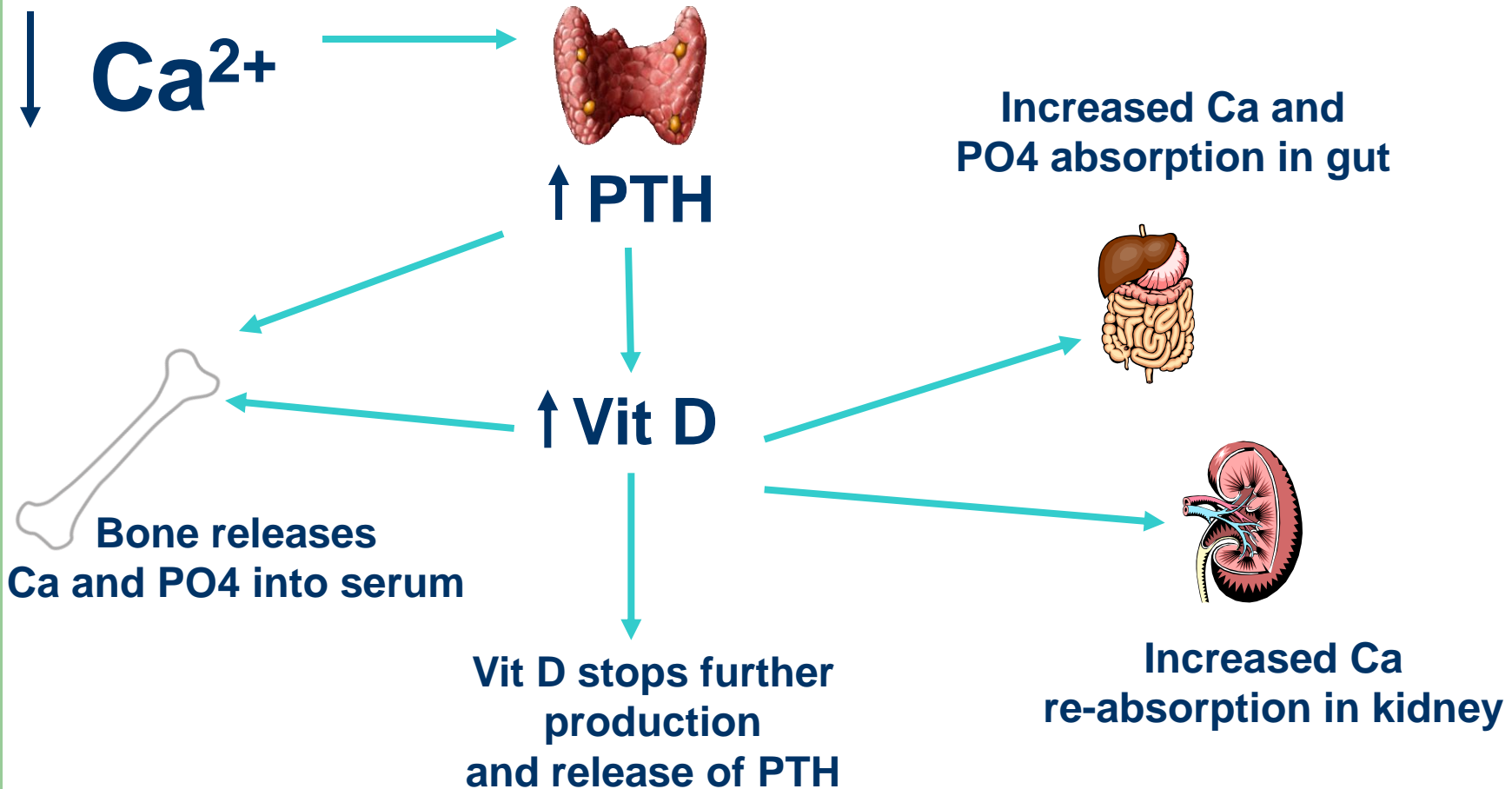
Jen Strong MS RD CSR LMNT  
Clinical Services Specialist

Heartland Kidney Network Webinar Series- May 19, 2011

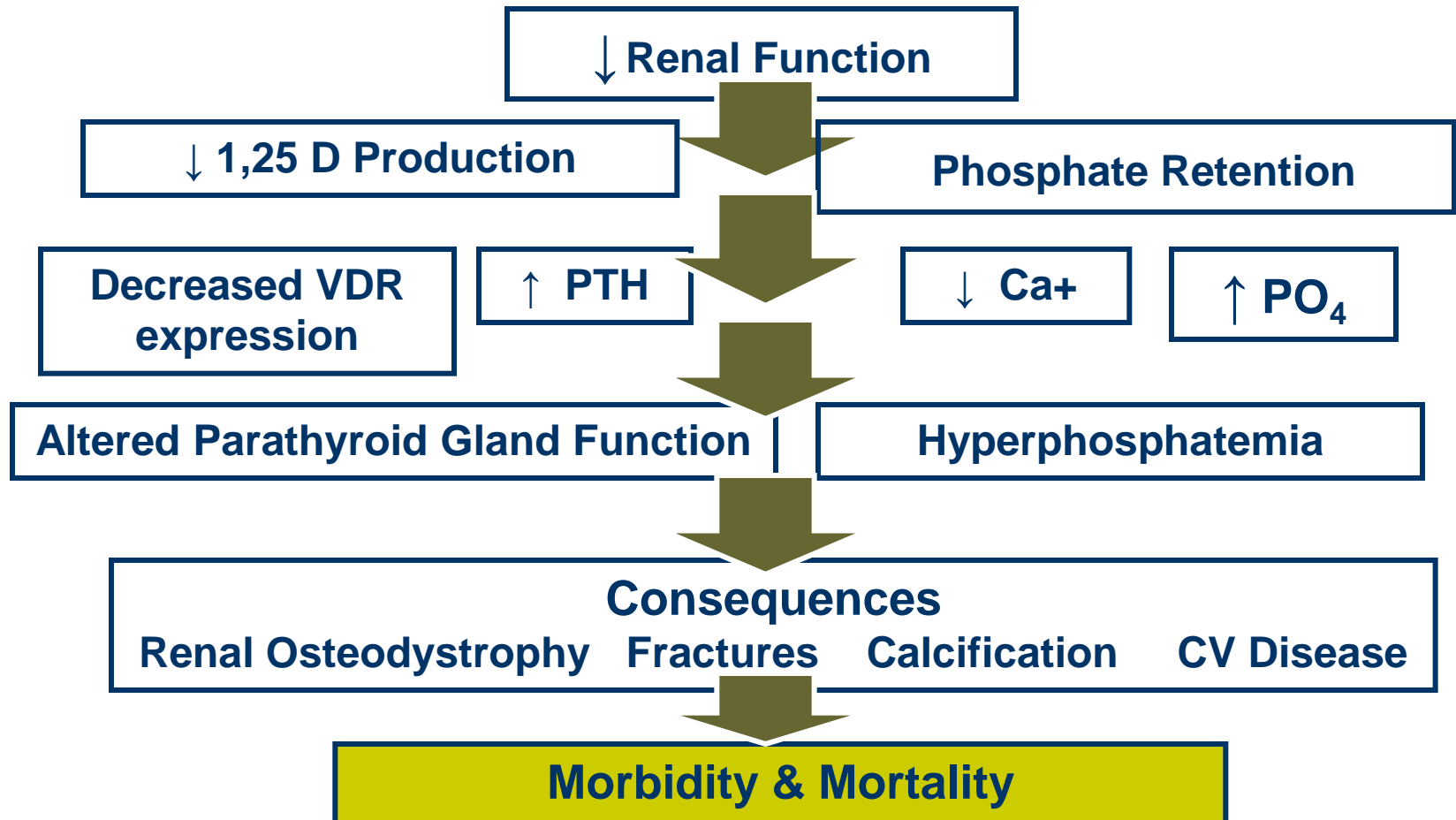
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The Session is Being Recorded  
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(Dial\*6) and Open Thereafter for Q & A**

DaVita  
Discovery Division  
Region 1

# Normal Mineral Homeostasis



# What happens in CKD-MBD?



# CKD-MBD Management

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Maintain Calcium and Phosphorus balance

Control Parathyroid Hormone (PTH) levels

# KDIGO Focus: Normal Target Ranges for Phosphorous and Calcium

Stage	Target PO <sub>4</sub> <sup>1,2</sup>	Target Ca <sup>1,2</sup>
3	KDIGO: Maintain Normal KDOQI: 2.7-4.6 mg/dL	KDIGO: Maintain Normal KDOQI: Normal for Lab
4-5	KDIGO: Maintain Normal KDOQI: 2.7-4.6 mg/dL	KDIGO: Maintain Normal KDOQI: Normal for Lab
5D	KDIGO: Towards Normal KDOQI: 3.5-5.5 mg/dL	KDIGO: Maintain Normal KDOQI: 8.4-9.5 mg/dL

**Emphasis on individual levels of serum calcium and phosphorus rather than Ca x P product**

1. Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group. KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of chronic kidney disease-mineral and bone disorder (CKD-MBD) *Kidney Int.* 2009;76(suppl 113):S1-S130.
2. National Kidney Foundation (NKF). KDOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis.* 2003;42(4 suppl 3):S1-S201.

# KDIGO Focus: Consider Normal Limit for PTH

Stage	Treatment Target Range
3	KDIGO: Upper Limit of Normal* (2C) KDOQI: 35-70 pg/mL
4	KDIGO: Upper Limit of Normal* (2C) KDOQI: 70-110 pg/mL
5	KDIGO: Upper Limit of Normal* (2C) KDOQI: 150-300 pg/mL
5D	KDIGO: 2 to 9 times Upper Limit of Normal (2C) KDOQI: 150-300 pg/mL

1. Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group. KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of chronic kidney disease-mineral and bone disorder (CKD-MBD) *Kidney Int.* 2009;76(suppl 113):S1-S130.
2. Adapted from National Kidney Foundation (NKF). KDOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis.* 2003;42(4 suppl 3):S1-S201.

# Normal Ranges for Measuring Biomarkers

<b>“Normal” Phosphorus</b>	<b>2.5 mg/dL – 4.5 mg/dL</b>
<b>“Normal” Calcium</b>	<b>8.5 mg/dL – 10mg/dL or 10.5 mg/dL</b>
<b>“Normal” iPTH (varies with the assay used)</b>	<b>15 pg/mL - 65 pg/mL</b>

\*“Normal” means within the above ranges.  
These are normal ranges for healthy individuals.

# Patient Case Study

	First Labs
Alb	3.4
Corr Ca	8.5
Phos	5.7
PTH	220

- Pt admitted in April
- New start to HD
- CKD Stage 5 2<sup>o</sup> HTN
- Hx of CAD, GERD
- Meds: Metoprolol 50mg BID  
Atorvastatin 20mg BID  
Famotidine 10mg BID

**How do you assess the patient's MBD status?**

# Patient Case Study

	First Labs
Alb	3.4
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- Pt admitted in April
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Famotidine 10mg BID

# Phosphorus ( $\text{PO}_4$ )

- Second most abundant mineral in body
  - Approximately 80% located in teeth and bones
- Functions
  - Building and maintaining strong bones and teeth
  - Normal nerve and muscle function
  - Energy production (ATP)

# Phosphorus (PO<sub>4</sub>)

- When kidneys fail, phosphorus rises
- Hyperphosphatemia can cause:
  - Bone disease (renal osteodystrophy)
  - Calcium deposits in heart, blood vessels, and other parts of body (calcification)
  - Itching, red eyes, sores

# Phosphorus ( $\text{PO}_4$ )

Dialysis does not remove  $\text{PO}_4$  from the blood very efficiently

- Approximately 800 mg  $\text{PO}_4$  is removed during a traditional in-center hemodialysis treatment
- 300mg per day with peritoneal dialysis

# Potential Causes of Hyperphosphatemia

- Excess phosphorus in diet
- Binder problem
- Inadequate dialysis
- Severe renal bone disease
- Some medications
- Pica

# Phosphorus-rich Foods

- Milk, cheese, ice cream, yogurt
- Nuts
- Beans
- Chocolate, cocoa
- Whole grain breads and cereals
- Quick breads (biscuits, cornbread)
- Cheese-flavored snacks (Cheez-Its, Cheetos), corn chips
- Processed foods with phosphate additives
- Cola and beverages with “phosphoric acid” or other “phos” additives (read labels)
- Beer

# Phosphorus: What's the Limit?

- Most patients need to limit their phosphorus intake to 800 – 1000 mg per day
- 1/2 cup:
  - Whole milk = ~110 mg
  - Skim milk = ~124 mg
  - Heavy cream = ~74 mg

# Which of the following foods is highest in Phosphorus ?

- Half a Snicker's bar (1 oz)
- Brie cheese (1 oz)
- Sardines canned with bones (1 oz)
- Peanut butter (2 Tbsp)



# Which of the following foods is highest in Phosphorus ?

- Half a Snicker's bar (1 oz) ... 54 mg
- Brie cheese (1 oz) ... 53 mg
- Sardines canned with bones (1 oz) ... 139 mg
- Peanut butter (2 Tbsp) ... 118 mg



# Which of the following beverages is highest in Phosphorus ?



# Which of the following beverages is highest in Phosphorus ?



0 mg / 16oz



5 mg / 16oz



43 mg / 16oz



65 mg / 16oz



230 mg / 16oz



496 mg / 16oz

# Phosphorus & Potassium Not on Food Labels

<b>Nutrition Facts</b>			
Serving size: 1/4 Recipe (188g)			
Servings Per Recipe 4			
<b>Amount Per Serving</b>			
<b>Calories</b>	199	Cal. from Fat	45
<b>% Daily Value*</b>			
<b>Total Fat</b>	5g		<b>8%</b>
Saturated Fat	1g		<b>4%</b>
<b>Cholesterol</b>	0mg		<b>0%</b>
<b>Sodium</b>	245mg		<b>10%</b>
<b>Total Carbohydrate</b>	31g		<b>10%</b>
Dietary Fiber	8g		<b>35%</b>
Sugars	0g		
<b>Protein</b>	10g		
Vitamin A	75%	Vitamin C	40%
Calcium	10%	Iron	20%
* Percent Daily Values is based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.			

# Phosphorus Additives on Food Label

- Phosphoric acid
- Polyphosphate
- Pyrophosphate
- Potassium tripolyphosphate
- Aluminum phosphate
- Dicalcium phosphate
- Disodium phosphate
- Monosodium phosphate
- Monocalcium phosphate

# Patient Case Study

	First Labs
Alb	3.4
CorrCa	8.5
Phos	5.7
PTH	220

Initial assessment revealed:

- Lack of knowledge re: renal diet
- Intake of high phosphorus foods and beverages

Patient education provided by RD

Diet Rx changes:

90g protein

1000mg phosphorus

# Patient Case Study

	First Labs	May
Alb	3.4	3.6
CorrCa	8.5	8.7
Phos	5.7	5.6
PTH	220	

**How do you assess the patient's MBD status?**

Assessment during May lab review:

- Patient provides diet recall
- Diet recall reveals decreased intake of phosphorus and increased intake of high protein foods per RD recommendation.
- Patient is able to verbalize understanding of phosphorus restriction and consequences of elevated phosphorus.

# Patient Case Study

	First Labs	May
Alb	3.4	3.6
CorrCa	8.5	8.7
Phos	5.7	5.6
PTH	220	

Assessment during May lab review.

- Patient provides diet recall
- Diet recall reveals decreased intake of phosphorus and **increased intake of high protein foods** per RD recommendation.
- Patient is able to verbalize understanding of phosphorus restriction and consequences of elevated phosphorus.

# Balancing Protein and Phosphorus



3 oz meat = ~200 mg PO<sub>4</sub>

# Protein Needs

## Hemodialysis

- $\geq 1.2$  g/kg IBW
- 70 kg man  
84 grams of protein daily

## PD

- $\geq 1.2$ - $1.3$  g/kg IBW  
(more with peritonitis)
- 70 kg man  
105 grams of protein daily

# Phosphorus (PO<sub>4</sub>)

- High-protein foods are high in phosphorus
- Very challenging for patients to maintain optimal PO<sub>4</sub> levels
- Diet and Dialysis may not be enough to control phosphorus levels
- Phosphate binders are used to reduce absorption of dietary phosphorus

# Phosphate Binders

- Phosphate binders are effective when:
  - Taken with each meal and, if prescribed, with each high phosphorus snack
  - Dosage is adjusted based on amount patient eats
  - Patient follows a low phosphorus diet



# Patient Case Study

	First Labs	May
Alb	3.4	3.6
CorrCa	8.5	8.7
Phos	5.7	5.6
PTH	220	

Intervention based on May lab:

- Patient is initiated on phosphate binder.
- RD instructs patient to take at every meal and to adjust binder dose based on meal size.

Meds: Metoprolol 50mg BID  
Atorvastatin 20mg BID  
Famotidine 10mg BID  
Renvela 800mg with every meal

# Patient Case Study

	First Labs	May	May 2
Alb	3.4	3.6	
CorrCa	8.5	8.7	8.9
Phos	5.7	5.6	5.5
PTH	220		

Phosphorus re-drawn 2 week post intervention is WNL

Patient states he is tolerating binder without GI symptoms

**Patient has achieved MBD goals!!**

# Patient Case Study

	First Labs	May	May 2	June Quarterly lab draw
Alb	3.4	3.6		3.8
CorrCa	8.5	8.7	8.9	9.2
Phos	5.7	5.6	5.5	5.1
PTH	220			475

Quarterly labs are drawn

**How do you assess the patient's MBD status?**

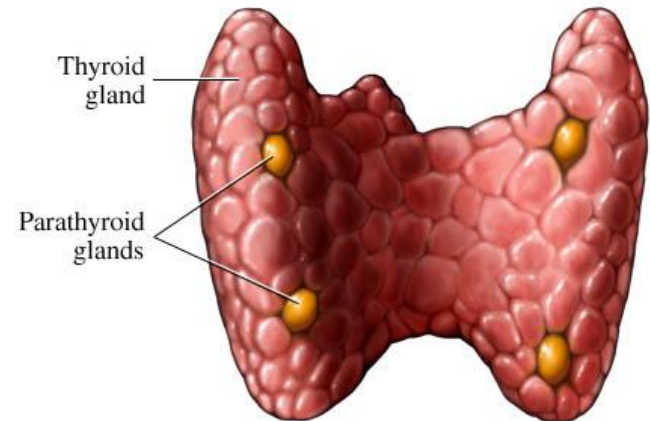
# Patient Case Study

	First Labs	May	May 2	June Quarterly lab draw
Alb	3.4	3.6		3.8
CorrCa	8.5	8.7	8.9	9.2
Phos	5.7	5.6	5.5	5.1
PTH	220			475

**Quarterly lab results indicate PTH is WNL but trending up.**

# Parathyroid Hormone (PTH)

- Secondary Hyperparathyroidism:
  - enlargement of parathyroid gland
  - overproduction of PTH
  - due to loss of kidney function



# Parathyroid Hormone (PTH)

- PTH is secreted in response to:
  - Hyperphosphatemia
  - Hypocalcemia
  - Low levels of active Vitamin D,  
normally produced by healthy kidneys
- PTH stimulates release of calcium and phosphorus from bone

# PTH

- High Intact PTH is treated with Vitamin D
- Can only give Vitamin D if calcium and phosphorus levels are not too high

# Potential Causes of High PTH

- Renal osteodystrophy that has not been treated with Vitamin D
- Inadequate vitamin D dosage
- Uncontrolled (high) phosphorus

# Patient Case Study

	First Labs	May	May 2	June
Alb	3.4	3.6		3.8
CorrCa	8.5	8.7	8.9	9.2
Phos	5.7	5.6	5.5	5.1
PTH	220			475

Intervention based on June lab:

➤ Patient is initiated on vitamin D analog

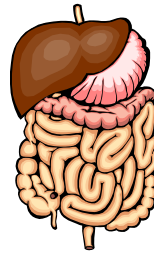
(PTH WNL but trending up)

➤ RD educates patient regarding consequences of elevated PTH

Meds: Metoprolol 50mg BID  
Atorvastatin 20mg BID  
Famotidine 10mg BID  
Renvela 800mg with every meal  
Hectorol 2mcg with every treatment

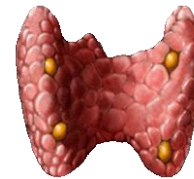
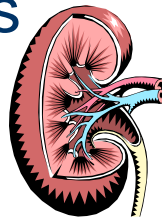
# Principal Biological Effects of Vitamin D

Increases absorption of Ca and P



Maintains bone mineralization and turnover

Indirectly reduces synthesis of calcitriol



Reduces synthesis of PTH

# Patient Case Study

	First Labs	May	May 2	June	June 2
Alb	3.4	3.6		3.8	
CorrCa	8.5	8.7	8.9	9.2	10.0
Phos	5.7	5.6	5.5	5.1	5.3
PTH	220			475	

Calcium and Phosphorus are re-drawn 2 week post intervention  
Results are WNL but both are trending up.

# Calcium (Ca)

- Functions
  - Needed for healthy bones
  - Muscle contraction
- Calcium Allowance: 2000 mg/day (foods and medications)

# Calcium (Ca)

- Hypercalcemia
  - ↑ risk for heart disease
  - ↑ risk for calcification of soft tissue
- Hypocalcemia
  - Painful muscle spasms
  - Osteoporosis
  - Confusion
  - Seizures (when extremely low)

# Potential Causes of High Calcium (Hypercalcemia)

- Absorption of calcium-based phosphate binder
- Consumption of Ca-containing meds (such as Tums)
- Consumption of Ca-fortified foods or high Ca foods
- Increased absorption from intestines from Vitamin D use
- Oversuppression of PTH or adynamic bone
- Severe secondary hyperparathyroidism
- High calcium dialysate
- Malignancy
- Immobilization

# Calcium Fortified Foods



350 mg/8 oz

© Christine Boyd

500 mg/8 oz



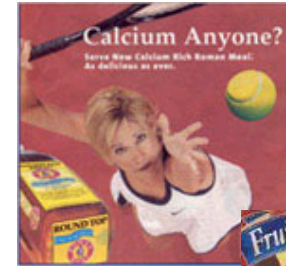
100 mg/3/4 cup



1000 mg/serving



150 mg/slice



100 mg/tbsp



500 mg/pkg



100 mg/4 crackers



100 mg  
8 oz



200 mg/bar



Crystal Light  
with Calcium

200 mg/8 oz



300 mg/aspirin



200 mg/1cup



150 mg/12oz



200 mg/bar



100 mg/2 waffles

# If Calcium Levels are Too High...

## Possible Actions:

- Change to non-calcium phosphate binder
- Evaluate calcium content of dialysate
- Evaluate Vit D dose and consider use of Sensipar if PTH elevated
- Evaluate dietary calcium intake

# Patient Case Study

	First Labs	May	May 2	June	June 2	July
Alb	3.4	3.6		3.8	4.0	4.0
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1
Phos	5.7	5.6	5.5	5.1	5.3	5.1
PTH	220			475		300

**How do you assess the patient's MBD status?**

# Patient Case Study

	First Labs	May	May 2	June	June 2	July
Alb	3.4	3.6		3.8	4.0	4.0
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1
Phos	5.7	5.6	5.5	5.1	5.3	5.1
PTH	220			475		300

**Patient is achieving MBD goals!!  
PTH will be drawn quarterly**

# Patient Case Study

	First Labs	May	May 2	June	June 2	July	September (quarterly draw)
Alb	3.4	3.6		3.8	4.0	4.0	4.1
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1	10.1
Phos	5.7	5.6	5.5	5.1	5.3	5.1	5.2
PTH	220			475		300	625

**How do you assess the patient's MBD status?**

# Patient Case Study

	First Labs	May	May 2	June	June 2	July	September (quarterly draw)
Alb	3.4	3.6		3.8	4.0	4.0	4.1
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1	10.1
Phos	5.7	5.6	5.5	5.1	5.3	5.1	5.2
PTH	220			475		300	625

With calcium on the upper limit of normal, what is the best way to treat the elevated PTH?

# Sensipar



- Lowers calcium and PTH
- Acts directly on the CaSR, increases sensitivity to extracellular Calcium. PTH secretion is blocked and serum PTH decreases
- For proper absorption and better tolerance, should be taken with food (typically at dinner)
- Should not be taken in morning before dialysis since this causes a temporary false low PTH

# Patient Case Study

	First Labs	May	May 2	June	June 2	July	Sept
Alb	3.4	3.6		3.8	4.0	4.0	4.1
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1	10.1
Phos	5.7	5.6	5.5	5.1	5.3	5.1	5.2
PTH	220			475		300	625

Intervention based on September lab:

- Patient is initiated on Sensipar
- RD educates patient regarding timing of dosing Sensipar

Meds: Metoprolol 50mg BID, Atorvastatin 20mg BID, Famotidine 10mg BID  
Renvela 800mg with every meal, Hectorol 2mcg with every treatment  
Sensipar 30mg daily with large meal

# Patient Case Study

	First Labs	May	May 2	June	June 2	July	Sept	Sept 2
Alb	3.4	3.6		3.8	4.0	4.0	4.1	
CorrCa	8.5	8.7	8.9	9.2	10.0	10.1	10.1	9.8
Phos	5.7	5.6	5.5	5.1	5.3	5.1	5.2	5.0
PTH	220			475		300	625	

Calcium and phosphorus re-drawn 1 week post Sensipar initiation WNL  
PTH to be re-drawn next month to evaluate Sensipar

# It Takes a Team!

- Patient understanding is critical
- Understanding the disease and need for the diet and binders helps motivate
- Educate and negotiate changes the patient will be willing to implement
- All staff can reinforce and support adherence to maintaining the diet and taking binders as prescribed

# How you can help

- Remind patients to take binders whenever they eat (especially when you see them eating or drinking)
- Notify dietitian of patient concerns or questions regarding diet or binders
- Reinforce importance of diet
  - Encourage patients to make good choices
- Encourage patients to dialyze their entire treatments

**Questions??**



\*A Certificate of Attendance shall be issued to each participant

## **Questions About the WebEx?**

Contact DeeDee Velasquez-Peralta, Patient & Community Services Specialist at [dvelasquez-peralta@nw12.esrd.net](mailto:dvelasquez-peralta@nw12.esrd.net) or 816.880.1702