How I treat CKD

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Aim of this lesson

- How I diagnosis a CKD patient?
- How I follow a CKD patient?
- How I treat the complications of CKD?

Diagnosis of CKD

- CKD is defined as abnormalities of kidney structure or function, present for ≥3 months, with implications for health

Table 1. Criteria for CKD (either of the following present for ≥3 months)

Markers of Kidney Damage	Albuminuria > 30 mg/day
	Urine sediment abnormalities (e.g., hematuria, red cell casts etc)
	Electrolyte and other abnormalities due to tubular disorders
	Abnormalities detected by histology
	Structural abnormalities detected by imaging
	History of kidney transplantation
Decreased GFR	GFR <60 mL/min/1.73 m^2

Albuminuria

- Increased glomerular permeability, urine albumin excretion rate (AER) >30 mg/day, approximately equivalent to urine albumin-to-creatinine ratio (ACR) >3 mg/mmol or >30 mg/g.
- The normal urine ACR in young adults is <10 mg/g.
- Urine ACR 30-299 mg/g : “microalbuminuria”.
- Urine ACR >300 mg /g :“macroalbuminuria” or “clinical nephropathy”.

Albuminuria

- Threshold value corresponds approximately to urine reagent strip values of trace or +, depending on urine concentration.
- High urine ACR can be confirmed by urine albumin excretion in a timed urine collection expressed as AER.

Urinary sediment abnormalities

Finding	Disease
Isolated microscopic hematuria	GBM disorders
RBC casts WBC casts	proliferative glomerulonephritis pyelonephritis or interstitial nephritis
Oval fat bodies or fatty casts Granular casts and renal tubular epithelial cells	diseases with proteinuria parenchymal diseases (non-specific

Renal tubular disorders

- Renal tubular acidosis
- Nephrogenic diabetes insipidus
- Renal potassium wasting
- Renal magnesium wasting
- Fanconi syndrome
- Cystinuria

Pathologic abnormalities

- Glomerular diseases (diabetes, autoimmune diseases, systemic infections, drugs, neoplasia)
- Vascular diseases (atherosclerosis, HTN, ischemia, vasculitis, thrombotic microangiopathy)
- Tubulointerstitial diseases (UTI, stones, obstruction, drug toxicity)
- Cystic and congenital diseases (polycystic kidney disease)

Structural abnormalities

Detected by imaging: ultrasound, CT scan and MRI with or without contrast, isotope scans, angiography	
Polycystic kidneys	Cortical scarring due to infarcts, pyelonephritis or associated with vesicoureteral reflux
Dysplastic kidneys	Renal masses or enlarged kidneys due to infiltrative diseases
Hydronephrosis due to obstruction	Small and hyperechoic kidneys (common in later stages of CKD due to many parenchymal diseases
Renal artery stenosis	

History of kidney transplantation

- Kidney biopsies in most kidney transplant recipients have histopathologic abnormalities even if GFR is >60 mL/min/1.73 m2 and ACR is <30 mg/g.
- Kidney transplant recipients routinely receive subspecialty care.

CKD staging

GFR categories in CKD

Category	GFR (mL/min/1.73 m²)	Terms
G1	>90	Normal or high
G2	60-89	Mildly decreased*
G3a	45-59	Mildly to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure (add D if treated by dialysis)

* Relative to young adult level

Neither GFR category G1 nor G2 without markers of kidney damage fulfill the criteria for CKD.

CKD staging

Albuminuria categories in CKD

Category	AER	Approximately Equivalent ACR		Terms
	(mg/d)	(mg/mmol)	(mg/g)	
A1	<30	<3	<30	Normal to mildly increased
A2	30-299	3-29	30-299	Moderately increased*
A3	≥300	>30	≥300	Severely increased**

*Relative to young adult level

**Including nephrotic syndrome (albumin excretion usually >2200 mg/d)

Guide to Frequency of Monitoring (in months) by GFR and Albuminuria Category

GFR Categories (mL/min/ 1.73m²)				Albuminuria Categories (mg/g or mg/mmol)		
				A1	A2	A3
				Normal to increased	Moderately increased	Severely increased
				10-29 mg/g (<3 mg/mmol)	30-299 mg/g (3-29 mg/mmol)	>300 mg/g (>30 mg/mmol)
	G1	high and optimal	≥90	12 if CKD	12	6
	G2	Mild	60-89	12 if CKD	12	6
	G3a	mild-moderate	45-59	12	6	4
	G3b	moderate-severe	30-44	6	4	4
	G4	Severe	15-29	4	4	≤3
	G5	kidney failure	<15	≤3	≤3	≤3

What is the recommended nutrition in CKD patients?

- Gastrointestinal blood loss (100 mL blood = 14–17 g protein)
- Intradialytic nitrogen losses HD, 6–8 g amino acid per procedure and in PD, 8–10 g protein per day.

Protein Intake

- Lowering protein intake to 0.8 g/kg/day in the adults with GFR <30 mL/min/ 1.73 m2, with appropriate education to avoid the risk of malnutrition.
- Avoiding high protein intake (>1.3g/kg/day) in people with CKD

Daily Dietary Recommendations For Dialysis Patients

Nutrient or Substance	Hemodialysis	Peritoneal Dialysis
Protein (g/kg)	>1.2	>1.2; >1.5 with peritonitis
Calories (sedentary, kcal/kg)	30–35[b]	30–35[b, c]
Protein (%)	15–25	
Carbohydrate (%)	50–60[d]	50–60[c, d]
Fat (%)	25–35	
Cholesterol	<200 mg (0.52 mmol)	
Saturated fat (%)	<7	
Crude fiber (g)	20–30	
Sodium	80–100 mmol[e]	
Potassium	< 1 mmol/kg if elevated	Usually not an issue
Calcium	2.0 g (50 mmol)[f]	
Phosphorus	0.8–1.0 g (26–32 mmol)[g]	
Magnesium	0.2–0.3 g (8–12 mmol)	
Iron	See Chapter 34	
Vitamin A	None	
β-carotene	None	
Retinol	None	
Thiamine (mg)	1.5	
Riboflavin (mg)	1.7	
Vitamin B6 (mg)	10	
Vitamin B12 (mg)	0.006	
Niacin (mg)	20	
Folic acid (mg)	>1.0	
Pantothenic acid (mg)	10	
Biotin (mg)	0.3	
Vitamin C (mg)	60–100	
Vitamin E	None	
Vitamin D	See Chapter 36	
Vitamin K	See text	

CKD 5D

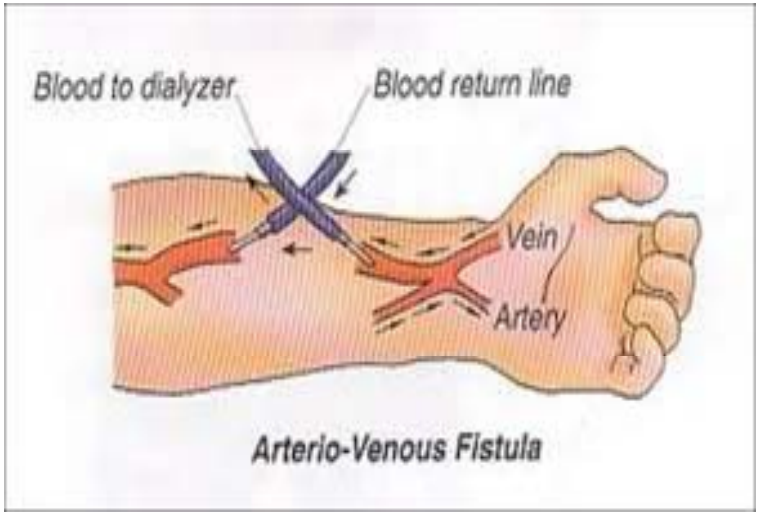
- Both hemodialysis and peritoneal dialysis patients should ingest 1.2 g of protein/kg/day!
- All dialysis patients younger than 61 years ingest 35 kcal/kg/day.
- For patients older than 60 years, the recommended intake is 30–35 kcal/kg/day, with the lower value used for sedentary patients.

When I must refer a CKD patient for…

- … Once a patient has reached CKD stage 4, he or she should be under a nephrologist's care.
- … preemptive transplantation:
  - has a higher success rate in general than when transplantation is initiated after hemodialysis
  - Usually done when eGFR/1.73 m^2 is>10cc/min

Decision for dialysis line

- …..choosing hemodialysis, an AV fistula should be placed at least 6 months prior to the planned initiation of dialysis.

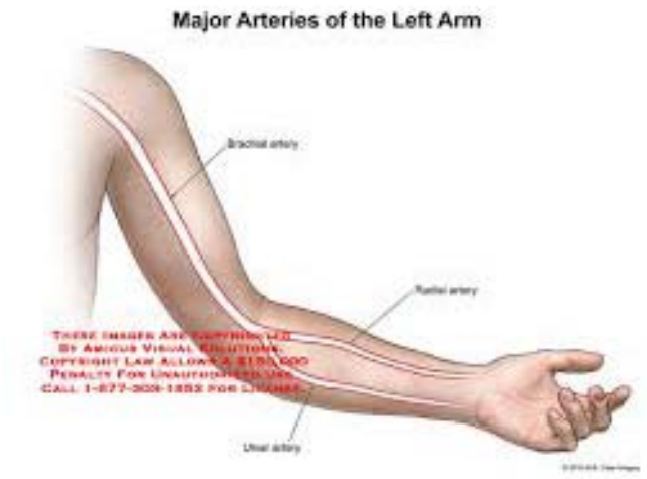


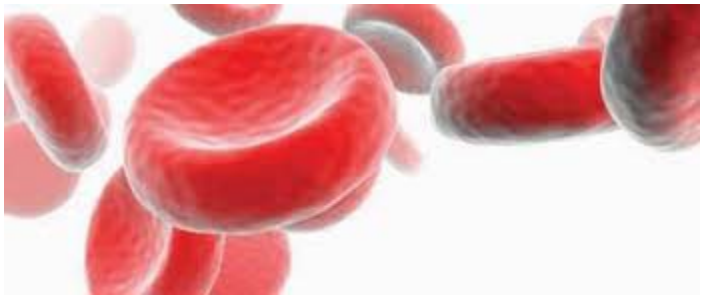
…..choosing PD: ± AVF

- Favorable PD for:
  - Infants or very young children
  - Patients with severe cardiovascular disease
  - Patients with difficult vascular access (e.g., diabetic patients)
  - Patients who desire greater freedom to travel
  - Patients who wish to perform home dialysis but do not have a suitable partner to assist them

left. Arm safe;
When and Why?

- In acute setting: VS In chronic setting:





Diagnosis and evaluation of anemia in CKD

Anemia diagnosis

- In adults with CKD when the Hb concentration is <13.0 g/dl in males and <12.0 g/dl in females.

Investigation of anemia

- In patients with CKD and anemia:
  - Complete blood count (CBC)
  - Absolute reticulocyte count
  - Serum ferritin level
  - Serum transferrin saturation (TSAT): Iron and TIBC
  - Serum vitamin B12 and folate levels

Causes of anemia in CKD

Easily correctable	Potentially correctable	Impossible to correct
ESA deficiency	Infection/ inflammation	Hemoglobinopathies
Absolute iron deficiency	Underdialysis	Bone marrow disorders
Vitamin B12/folate deficiency	Hemolysis	
Hypothyroidism	Bleeding	
ACEi/ARB	Hyperparathyroidism	
Non-adherence	PRCA	
	Malignancy	
	Malnutrition	

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Causes of iron deficiency

Chronic blood loss	Decreased dietary iron absorption	Increased iron demand	Depletion of iron stores
Blood retention by the dialysis lines and filter	Phosphate binders inhibit iron absorption	increased rate of erythropoiesis induced by ESAs	
Blood sampling for laboratory testing	H2 blockers, PPIs, functional achlorhydria impair iron absorption	Impaired release of iron from storage tissues (reticuloendothelial blockade)	
Accidents related to the vascular access	Uremic gut does not absorb iron optimally		
Surgical blood loss			
Occult GI bleeding			

Measurement of Hb concentration Without anemia

CKD patients	• when clinically indicated
CKD 3	• At least annually
CKD 4–5ND	• At least twice per year
CKD 5HD and CKD 5PD	• At least every 3 months

Measurement of Hb concentration; Not being treated with an ESA

CKD patients with anemia	• When clinically indicated
CKD 3–5ND and CKD 5PD	• At least every 3 months
CKD 5HD	• At least monthly

When I prescribe ESA?

CKD ND patients with Hb≥10.0 g/dl	• ESA therapy not be initiated.
CKD ND patients with Hb< 10.0 g/dl	• decision whether to initiate ESA therapy be individualized based on …
CKD 5D	• ESA therapy be used to avoid having the Hb fall< 9.0 g/dl

When I prescribe ESA?

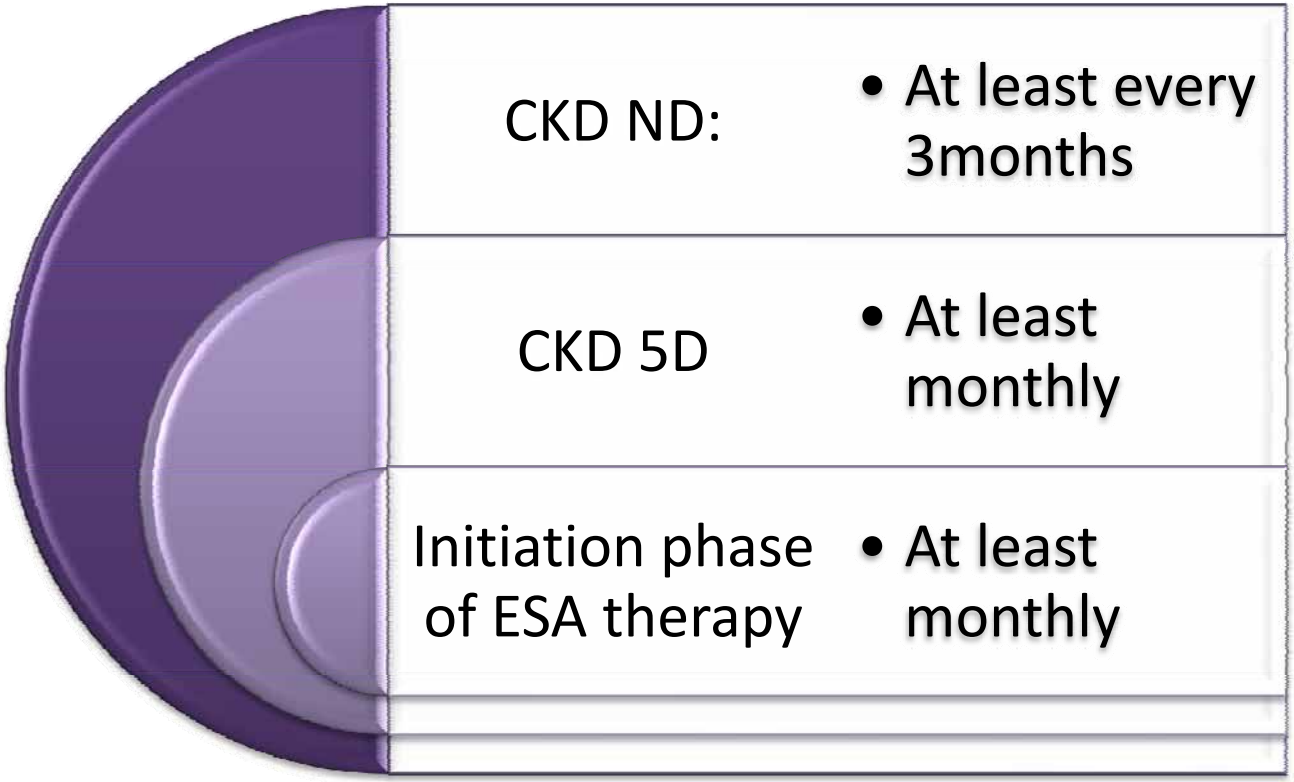
- In general, ESAs not be used to maintain Hb concentration above 11.5 g/dl in adult patients with CKD
- In all adult patients, ESAs not be used to intentionally increase the Hb concentration above 13 g/dl.

When I prescribe ESA?

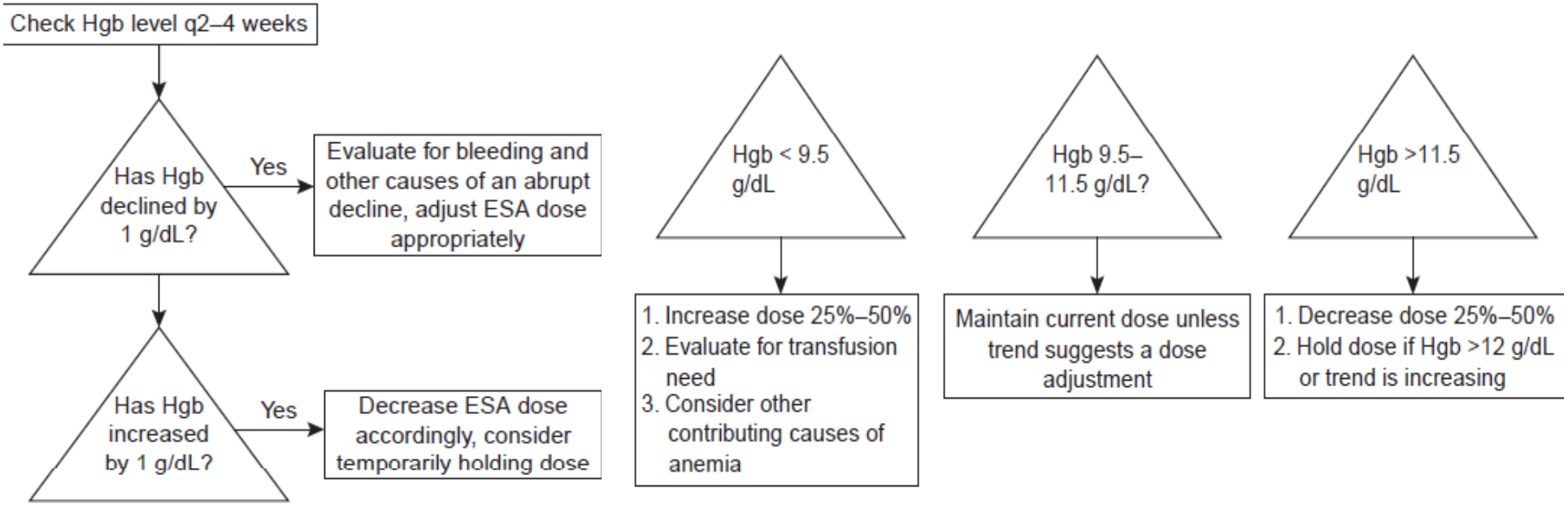
- For CKD ND patients, during the maintenance phase of ESA therapy measure Hb concentration at least every 3 months.
- For CKD 5D patients, during the maintenance phase of ESA therapy measure Hb concentration at least monthly

Dosing & Monitoring

- Patient on or not on dialysis: 50-100 units/kg IV/SC 3 times weekly initially



Flow chart for adjusting the ESA dose based on Hb results for dialysis patient



When I can use transfusion to treat anemia in CKD

Avoiding, when possible, red cell transfusions to minimize the general risks related to their use

In patients eligible for organ transplantation, avoiding, when possible, PC transfusion minimize the risk of allosensitization

The benefits of red cell transfusions may outweigh the risks in patients in:

ESA therapy is ineffective: hemoglobinopathies, bone marrow failure, ESA resistance

Risks of ESA therapy outweigh its benefits: previous or current malignancy, previous stroke

The decision to transfuse with non-acute anemia should not be based on any arbitrary Hb threshold, but should be determined by the anemia symptoms

URGENT TREATMENT OF ANEMIA

When rapid correction of anemia is required to stabilize the patient: acute hemorrhage, unstable coronary artery disease

When rapid pre-operative Hb correction is required

Patients are transfused when the benefits of red cell transfusions outweigh the risks

When I use Iron?

- Iron therapy for HD patients should be considered at a serum ferritin of <200 ng/mL or TSAT of <20%.
- Intravenous iron therapy should be used in PD patients when resistance to ESA is present and the serum ferritin is <100 ng/mL and the TSAT is <20%.

When I use Iron?

- One is to treat established iron deficiency with a repletive 1,000-mg dose administered over 8–10 consecutive hemodialysis treatments.
- Since iron deficiency occurs so frequently in HD patients, a weekly maintenance dose of 25–100 mg may be used.

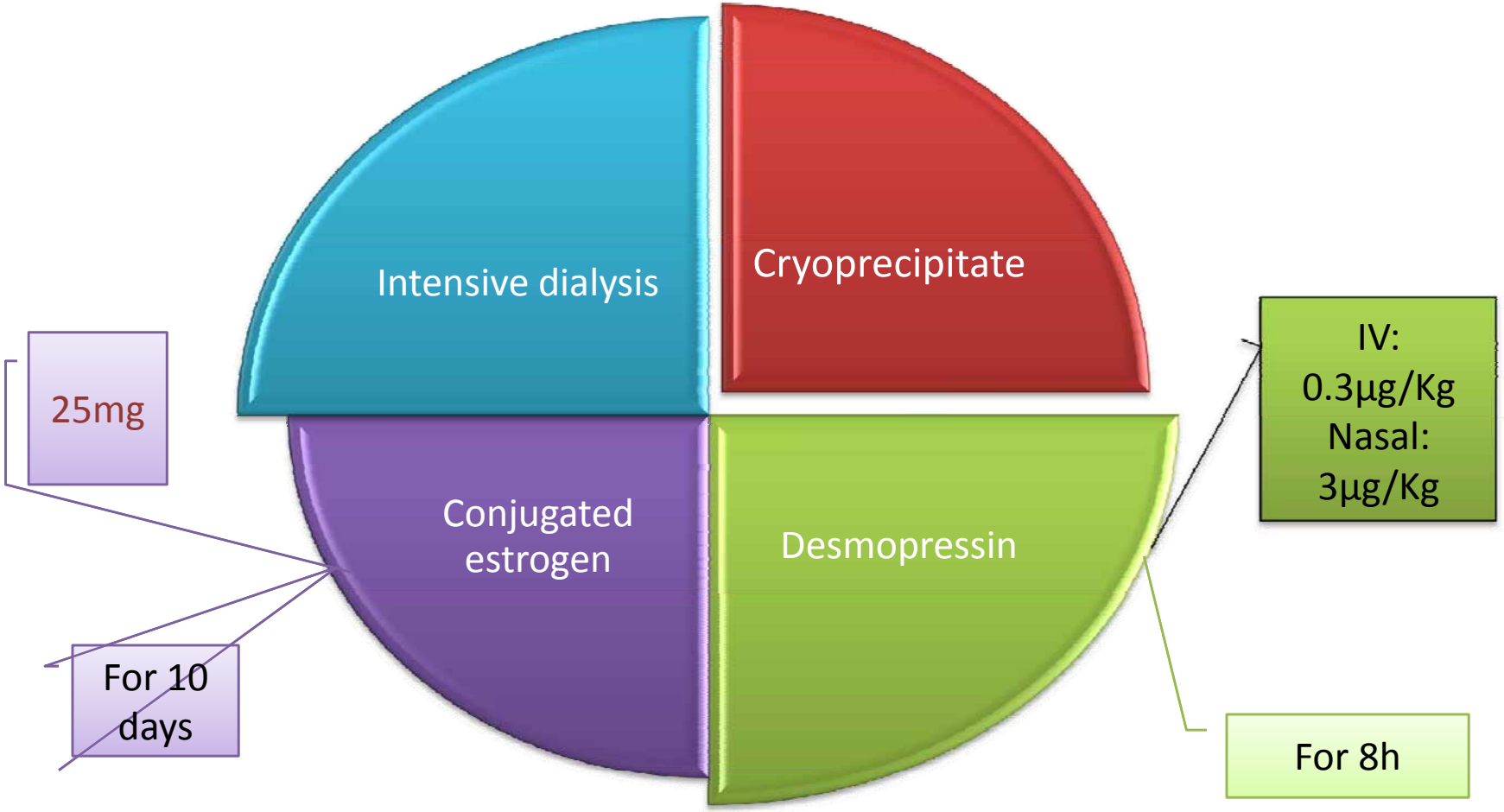
When I use Iron?

- For patients on peritoneal dialysis, oral iron is much more convenient than intravenous iron.
- Since these patients experience less chronic blood loss, oral iron may be sufficient to maintain iron stores.

How I do in bleeding?

Causes of bleeding	
Thrombasthenia	Anemia
Abnormal platelet aggregation	Abnormalities of von Willebrand factor
Impaired activation of the GP IIb–IIIa receptor	Hemodialysis

How I do in bleeding?



What I do in MBD?

- Measuring serum levels of calcium, phosphate, PTH, and alkaline phosphatase activity at least once in adults with GFR <45 mL/min/1.73 m2 in order to determine baseline value.

Ca/P ranges

- The normal range for P is 2.7 - 4.6 mg/dL .
- In dialysis patients: attempting to maintain predialysis P in the normal range.
- In clinical, most physicians and dietitians strive to maintain predialysis P: 3.0 - 5.5 mg/dL.

Continu…

- The normal range for serum calcium is 8.4 - 10.2 mg/dL.
- In dialysis patients, maintaining a stable PTH level over time, in a range of 2-9 times the upper limit of normal (for most assays this is approximately 150-600 pg/mL.

Case study for CKD-MBD-1

- Ca= 6.5 mg/dL P= 7.5mg/dL ?
- Alb= 3.5g/L
- Phosphorus Binders:
  - Calcium based: Calcium carbonate 500mg with 40% elemental calcium. Max dose:1.5 g of elemental calcium/d. Administered with meals.

Case study for CKD-MBD-1

- Non calcium based:
- Sevelamer HCL: tab 800mg 3times in day with meal. Max dose: 14g/d!!!
  - Give other drugs 1 hour before or 3 hours after drug.
  - Must not be crushed or chewed
- Sevelamer carbonate: not released yet in IRAN

Case study for CKD-MBD-1

- Lanthanum Carbonate: not available
- Magnesium products
- Sucroferric oxyhydroxide
- Aluminum carbonate and aluminum hydroxide

Case study for CKD-MBD-2

- Ca= 6mg/dL P= 5mg/dL Alb=4
- Check 25OH vit D
- Calcium elevating agents, fasting position
- In low level of 25OH vit D: levels <30 ng/mL warrant treatment with ergocalciferol or cholecalciferol

Case study for CKD-MBD-2

- The best method is prescription of:
  - In level of 15–29 ng/mL: 50,000 IU/ month for 6 months
  - In level of <15 ng/mL : 50,000 IU weekly for 2-3 months, then 50,000 IU monthly .
- Obese patients will generally require larger doses or longer repletion due to the fat soluble nature of the vitamin.

Case study for CKD-MBD-3 , 4

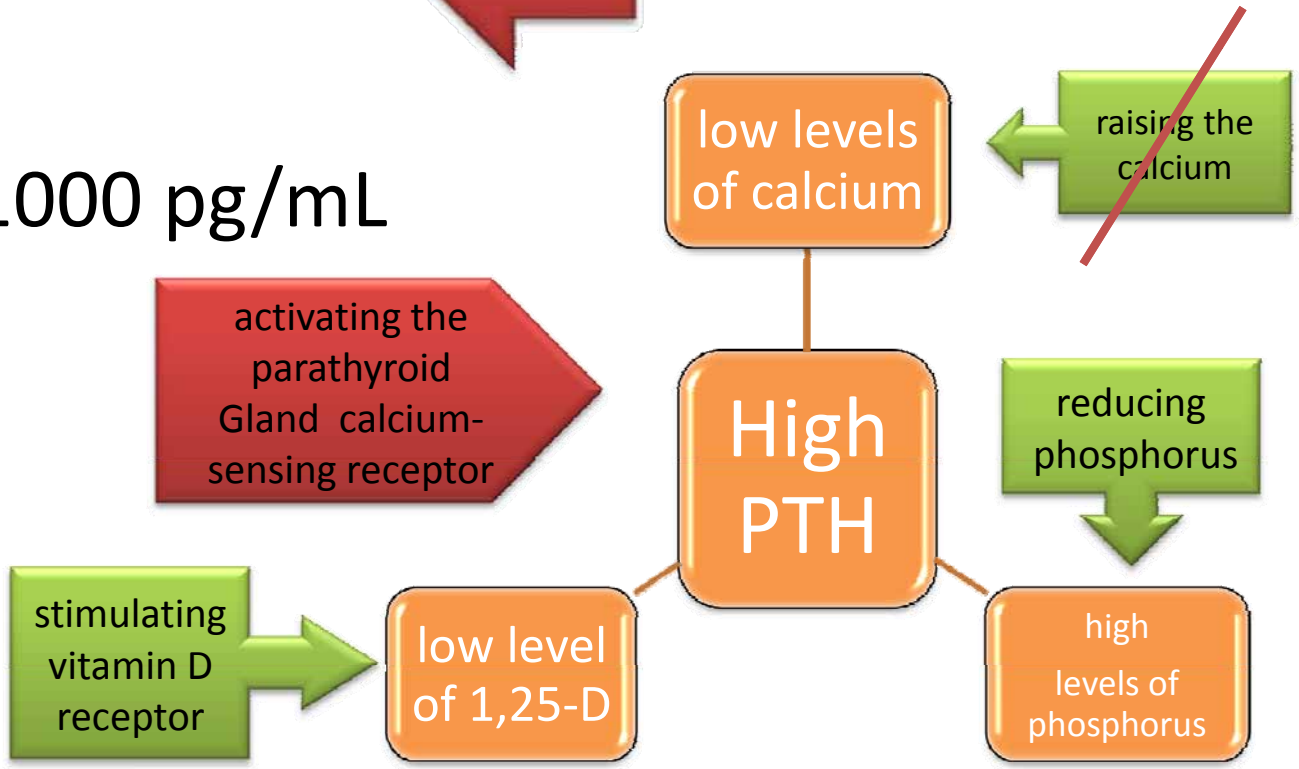
- Ca= 9mg/dL P= 4mg/dL Alb= 4
- Please RPO
- Ca= 11 P=4mg/dL Alb= 3
- Please adjust drugs

Case study for CKD-MBD-5

- Ca= 7.5mg/dL P= 8 mg/dL Alb= 4
- If PTH= 540 pg/mL

NL

- If PTH= 1000 pg/mL



Case study for CKD-MBD-5

Should not be initiated if ca <8.4 mg/dL

Maximum:180 mg /d

Cinacalcet: 30, 60, 90 mg

Max. PTH suppression

60-80%: 2- 4 h after each dose

30- 50% : at 24h

12-24 h after a dose: PTH measure

Result: fall in serum calcium + PTH suppression. Hypocalcemia of <7.5 mg/dL occurs in about 5% of patients

-500-1000 mg of elemental ca

-Increase or addition of active vit D

References


KIDNEY DISEASE
IMPROVING GLOBAL OUTCOMES
KDIGO


FIFTH EDITION
Handbook of
Dialysis

CKD to be continued….