

Objectives:

- Parathyroid hormone (PTH) is strong predictor of low levels of hemoglobin (Hb) in dialysis patients with severe hyperparathyroidism .
- In non-dialysis CKD-patients inverse association exists between PTH and Hb
- Non severely increased PTH doubles the risk of having Hb <10.0 mg/dL.
- Higher phosphorus (P) levels associated with a greater likelihood for anemia both in early CKD-stages patients and in subjects with normal kidney function
- FGF-23 may play a role in the mechanisms leading to anemia through its interplay with serum P, vitamin D and suppression of Klotho.
- Low Klotho levels associated with senescence, cell toxicity, premature aging, vascular calcifications and deficiency in activated vitamin D.
- Vitamin D deficiency causes anemia.

Aim of the study is to evaluate the role of P, PTH, FGF-23, Klotho and vitamin D on hemoglobin levels of patients with CKD not on dialysis.

No previous study has assessed simultaneously these variables in the same study-population.

Methods:

This is a retrospective observational cohort study in hospitalized patients and in outpatients. Exclusion criteria were: stage 5 CKD on dialysis, polycystic kidney disease, past or recent therapy with iron, erythropoietin stimulating agents, or vitamin D sterols, history of bleeding, treatment with warfarin. Presence of anemia was established on levels of Hb ≤ 11.0 g/dL. This value entered in statistical analysis. Blood samples were collected in the morning in fasting state. Variables of interest were glucose, Hb, iron, ferritin, transferrin saturation (TSAT %), calcium, P, PTH, Vitamin D, FGF-23, Klotho, 24/h proteinuria, 24/h phosphaturia, alkaline phosphatase, uric acid, homocysteine, hs-CRP, triglycerides, total cholesterol, HDL-cholesterol, LDL-cholesterol. Variables significantly associated with Hb at univariate analysis entered into logistic regression analysis to identify predictors of anemia

	No anemia (n=93; 54.7%)	Anemia (n=77; 45.3%)
Female	59 (63.4)	46 (59.7)
Age (yrs)	50.6 ± 3.9	50.8 ± 4.8
e-GFR (ml/min)	32.2 ± 9	28.7 ± 3.1 ♥
Hemoglobin (mg/dL)	12.3 ± 0.7	10.8 ± 0.1 ♥
Iron Saturation (%)	21.7 ± 8.9	20 ± 7.7
Ferritin (ng/mL)	145.9 ± 106.4	189.5 ± 143 ♦
PTH (pg/mL)	59.3 ± 7.5	92.6 ± 27 ♥
Serum P (mg/dL)	4.7 ± 0.3	4.8 ± 0.4
KLOTHO (pg/mL)	884.3 ± 100.2	888.8 ± 113.7
FGF-23 (pg/mL)	10.4 ± 1.3	10.4 ± 1.8
Serum Calcium (mg/dL)	10 ± 0.7	9.6 ± 0.5 ♥
Vitamin D (ng/mL)	34.9 ± 11.6	34.8 ± 14.1
Vitamin D Insufficiency/Deficiency	10 (43.5)	37 (48.1)
C-Reactive Protein (m/L)	9.1 ± 3.3	8.9 ± 3.6
Serum Albumin (mg/dL)	4.3 ± 0.6	4.3 ± 0.5
Fibrinogen (mg/dL)	337.4 ± 117.4	351.4 ± 120.5

TABLE 2

	O.R.	95% C.I.for O.R.	Sig.
Calcium (unit increase)	0,23	[0.12; 0.45]	<0.001
Normal PTH (≤ 60 pg/ml)		ref.	
High PTH (>60 pg/ml)	14,98	[5.3 ; 42.39]	<0.001
Normal P ($\leq 4,5$ mg/dL)		ref.	
High P (> 4.6 mg/dL)	0,39	[0.15 ; 0.99]	0,048

Results:

- N.170 patients were evaluated
- Clinical characteristics and biochemistry of patients are in table 1.
- Results of logistic regression analysis are in table 2.

Conclusions:

PTH is stronger predictor of anemia in CKD-patients even when its concentration is not severely increased.
The predictive role of P is marginal compared to PTH
FGF-23, Klotho and vitamin D do not play a role
High serum calcium has a protective action on anemia.

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