



VITAMIN D DEFICIENCY IS AN INDEPENDENT RISK FACTOR FOR ANEMIA IN PATIENTS WITH END-STAGE RENAL DISEASE

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INTRODUCTION AND OBJECTIVES

- Anemia** remains the **most prevalent complications in end-stage renal disease (ESRD) patients**.
- In early-stage CKD patients, several studies have suggested that vitamin D deficiency is independently associated with anemia prevalence but it was not clear whether this association exists in patients with ESRD.
- Our study aimed to investigate **whether 25-hydroxyvitamin D [25(OH)D3] deficiency increases anemia risk in ESRD patients**.

METHODS

- We reviewed the medical records of **117 ESRD patients, who received Renal transplantation (RTx)** at Yonsei University Health System between April 2002 and June 2004 and performed **measurement of 25(OH)D3 levels at the time of RTx**.
- Anemia** was defined as a hemoglobin level **< 10g/dL**.
- Independent association between 25(OH)D3 and hemoglobin levels was evaluated and odds ratios (ORs) for anemia were estimated by multivariate linear regression analysis and logistic regression analysis respectively.

RESULTS

Table 1. Baseline clinical characteristics of patients and biochemical variables according to 25(OH)D3 levels

Variable	Total	Group 1 25(OH)D3 < 10 ng/mL	Group 2 25(OH)D3 ≥ 10ng/mL	P [§]
N (%)	410	171 (41.7%)	239 (58.7%)	
Demographic data				
Age (years)	40.7 ± 11.4	40.8 ± 10.5	41.3 ± 11.3	0.662
Male sex, n (%)	262 (63.9%)	95 (55.5%)	167 (69.9%)	0.003
Anemia (Hb <10g/dL)	175 (42.7%)	103 (60.2%)	72 (30.1%)	<0.001
Dialysis (%)				
Hemodialysis	199 (48.5%)	58 (34.0%)	162 (68.8%)	0.395
Peritoneal dialysis	78 (19.0%)	22 (24.5%)	14 (6.3%)	
No dialysis	133 (32.4%)	91 (53.2%)	63 (26.3%)	
Duration of dialysis (months)	20.4 ± 37.3	16.8 ± 33.1	23.3 ± 40.5	0.236
Season of RTx				
Spring	90 (22.0%)	51 (29.8%)	39 (16.3%)	0.718
Summer	107 (26.1%)	29 (17.0%)	78 (32.6%)	
Autumn	101 (24.6%)	37 (21.6%)	64 (26.8%)	
Winter	112 (27.3%)	54 (31.6%)	58 (24.3%)	
Co-morbidities (%)				
Diabetes	77 (18.8%)	38 (22.2%)	39 (16.3%)	0.132
Hypertension	364 (88.8%)	155 (90.6%)	209 (87.4%)	0.313
Medications				
Use of ESA	191 (46.5%)	92 (53.8%)	99 (41.4%)	0.013
ESA dose, units/months	16956.5 ± 17252.2	20656.2 ± 17627.7	10970.7 ± 16146.2	0.003
ESA dose/Hb index	1842.9 ± 1935.3	2227.5 ± 1929.9	1133.0 ± 1718.4	0.001
Biochemical data				
25(OH)D3 (ng/mL)(median)	11.1 ± 6.4	6.5 ± 1.8	17.2 ± 5.6	<0.001
Hb (g/dL)	9.9 ± 1.9	9.7 ± 2.0	10.5 ± 1.6	<0.001
iPTH (pg/mL)(median)	168.3 ± 164.9	152.3 ± 220.7	225.2 ± 243.0	0.677
Serum iron (ug/dL)	77.1 ± 55.3	77.9 ± 47.1	72.5 ± 58.5	0.814
TIBC (μg/dL)	202.8 ± 85.6	194.1 ± 84.1	209.9 ± 86.7	0.785
Transferrin saturation	38.0 ± 86.4	33.3 ± 21.8	41.3 ± 11.6	0.357
Ferritin (ng/mL)	193.2 ± 143.9	190.6 ± 156.2	196.5 ± 128.3	0.391
ALP (IU/L)	60.6 ± 26.1	58.1 ± 23.3	63.7 ± 27.0	0.676
Phosphate (mg/dL)	5.3 ± 1.4	5.0 ± 1.4	5.7 ± 1.3	0.001
Calcium (mg/dL)	7.7 ± 1.0	7.4 ± 0.9	8.1 ± 1.0	0.001
Albumin (g/dL)	3.9 ± 0.4	3.8 ± 0.4	4.0 ± 0.4	0.001
eGFR (mL/min/1.73 m ²)	4.9 ± 2.7	4.9 ± 2.2	4.7 ± 1.7	0.567
hs-CRP (mg/L)(median)	0.15 ± 2.2	0.13 ± 2.3	0.19 ± 2.0	0.560

§P-value comparisons between group 1 and group 2.

Results are expressed as mean ± standard deviation, median ± interquartile range or n (%)

25(OH)D3, 25-hydroxyvitamin D; ESA, erythrocyte stimulating agent; Hb, hemoglobin; iPTH, intact parathyroid hormone; TIBC, total iron binding capacity; TSAT, transferrin saturation; ALP, alkaline phosphatase; eGFR, estimated glomerular filtration rate; hs-CRP, high-sensitivity C-reactive protein

Figure 1. Box plots of the 2 groups according to hemoglobin levels. Box plots represents maximum, third quartile, median, and first quartile from top to bottom

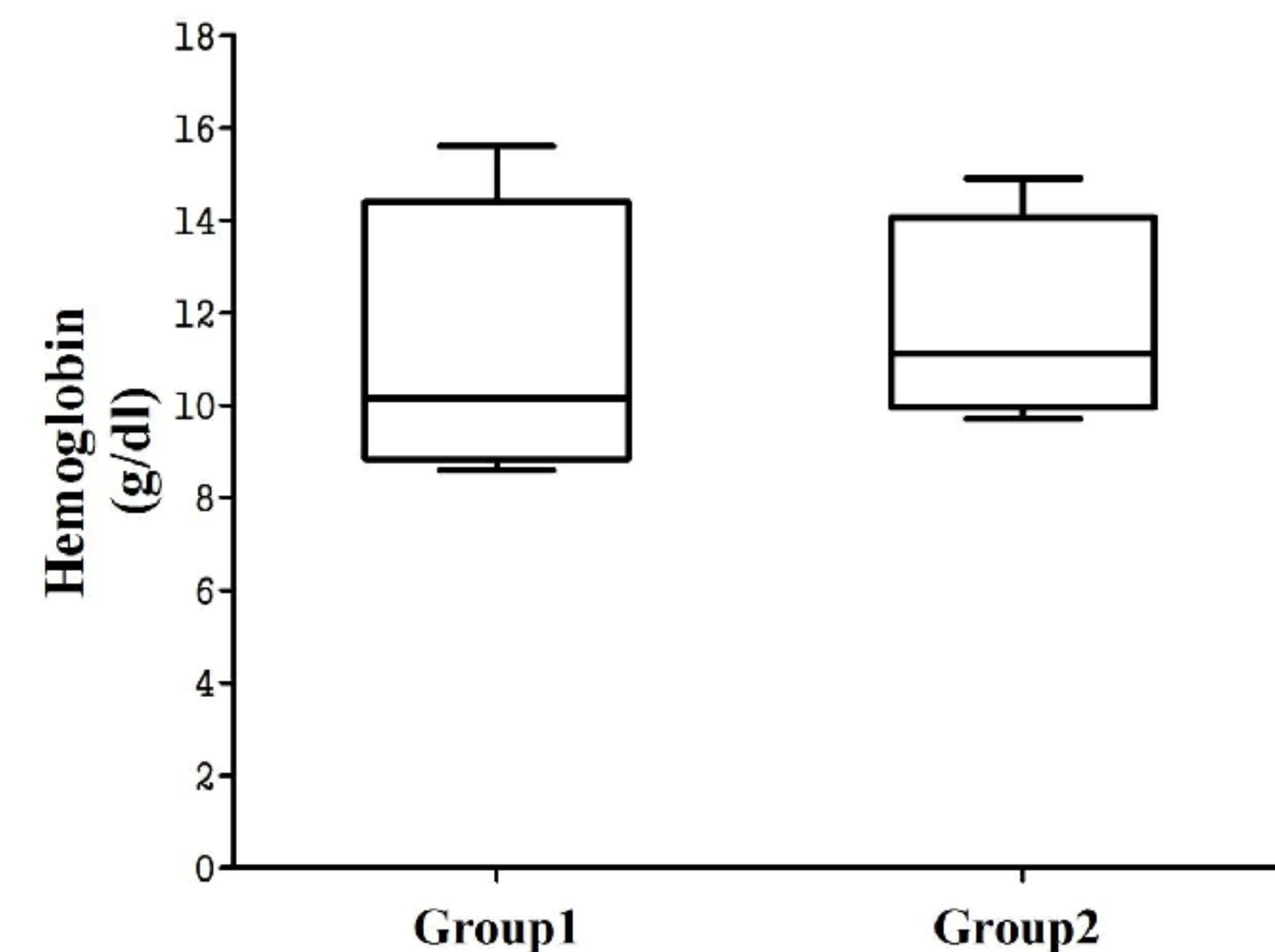


Table 2. Multivariate linear regression analysis with hemoglobin as the dependent variable

	β	P-value
25(OH)D3	0.035	0.039
Age	0.020	0.408
Sex (male/female)	0.202	0.677
Log iPTH	-0.349	0.073
Phosphate	-0.179	0.340
ALP	-0.003	0.689
Log CRP	-0.192	0.283
Ferritin	0.002	0.120
ESA dose	-0.001	0.031

25(OH)D3, 25-hydroxy vitamin D; iPTH, intact parathyroid hormone; ALP, alkaline phosphatase; CRP, C-reactive protein; ESA, erythrocyte stimulating agent

Table 3. Multivariate linear regression analysis with ESA dose/Hb index as the dependent variable

	β	P-value
25(OH)D3	-0.590	0.016
Age	-0.342	0.345
Sex (male/female)	-0.243	0.266
Log iPTH	-0.401	0.073
Phosphate	0.712	0.130
ALP	0.301	0.628
Log CRP	0.401	0.636
Ferritin	0.602	0.899

ESA, erythrocyte stimulating agent; Hb, hemoglobin; 25(OH)D3, 25-hydroxy vitamin D; iPTH, intact parathyroid hormone; ALP, alkaline phosphatase; CRP, C-reactive protein

Table 4. ORs for developing anemia (hemoglobin <10g/dL) using logistic regression analysis

	OR (95% CI)	P-value
25(OH)D3 <10 vs ≥10	3.283 (1.040-10.362)	0.043
Age (per 1 year increase)	0.965 (0.918-1.015)	0.965
Gender (male vs female)	0.436 (0.127-1.495)	0.170
Log PTH (per 1 pg/mL increase)	1.322 (0.775-2.256)	0.520
Phosphate (per 1 mg/dL increase)	0.874 (0.560-1.363)	0.552
ALP (per 1 IU/L increase)	1.003 (0.981-1.026)	0.762
Log CRP (per 1 mg/L increase)	1.156 (0.743-1.799)	0.520
Ferritin (per 1 ng/mL increase)	1.103 (0.993-1.033)	0.219
ESA use (yes vs no)	2.960 (0.843-10.395)	0.090

ORs, Odds ratio; CI, confidence interval; 25(OH)D3, 25-hydroxy vitamin D; iPTH, intact parathyroid hormone; ALP, Alkaline phosphatase; CRP, C-reactive protein; ESA, erythrocyte stimulating agent

CONCLUSION

- 25(OH)D3 deficiency significantly associated with anemia in patients with ESRD.**
- Randomized controlled trials are needed to determine if vitamin D supplementation can improve anemia in these patients.

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