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Changes of body fluids volume and nutritional status in anemic CKD patients depending on hemoglobin improvement from recombinant human erythropoietin administration

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Objectives : Recombinant human erythropoietin (rhEPO) is an erythropoiesis-stimulating agent (ESA) commonly used in the treatment of anemia for chronic kidney disease (CKD) patients. Interestingly, rhEPO is known to have various pleiotropic effects in addition to increasing hemoglobin (Hb) levels. Here, we aimed to explore whether the improvement of anemia through rhEPO administration has an effect on body fluids or nutritional status.
Methods : The patients with CKD 4 or 5 who have Hb of less than 10 g/dL were enrolled in the study (n=30). The patients received subcutaneous injections of 6,000 ~ 10,000 units of rhEPO-alpha once every 2~4 weeks for 3 months. We used bioimpedance to estimate body fluid excess (OH, overhydration; ROH, relative overhydration) and nutritional status (PhA, phase angle). We conducted blood tests including brain natriuretic peptide, albumin, creatinine, ferritin, and transferrin saturation. Furthermore, we measured jugular vein (JV) distensibility through ultrasonography.
Results : Study results showed that Hb elevation was significantly associated with a decrease in ROH (r= -0.264, p=0.043). Moreover, it was significantly associated with an increase in PhA (r=0.292, p=0.025) (Table 1). During ESA treatment, as Hb increased, serum ferritin decreased (123.10 to 88.35 g/dL, p=0.010), while creatinine increased (2.98 to 3.15 g/dL, p=0.001) with statistical significance (Table 2).
Conclusions : Our study demonstrated that anemia improvement during ESA treatment decreased body fluid volume and increased nutritional status. The results suggest that in addition to anemia correction, the ESA treatment may provide the benefits of reducing body fluid excess and improving nutrition.

Table_1_ESA.png

Table 1. Correlation between the changes of Hb and other parameters

	Correlation coefficients	*P* value
MCV (fL)	-0.237	0.071
MCH (pg)	-0.012	0.929
MCHC (g/dL)	0.147	0.267
Ferritin (ng/mL)	-0.156	0.231
TSAT (%)	0.023	0.858
CO2 (mmol/L)	0.028	0.830
Cr (mg/dL)	-0.220	0.093
ALB (g/dL)	0.229	0.090
BNP (pg/mL)	0.007	0.957
OH (liter)	-0.249	0.058
ROH	***-0.264***	***0.043****
TBW (liter)	-0.202	0.124
ECW (liter)	-0.184	0.162
ICW (liter)	-0.099	0.452
E/I	-0.167	0.209
PhA	***0.292***	***0.025****
JV distensibility	0.128	0.325

MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; TSAT, transferrin saturation; Cr, creatinine; ALB, albumin; BNP, brain natriuretic peptide; OH, overhydration; ROH, relative overhydration; TBW, total body water; ECW, extracellular water; ICW, intracellular water, E/I, ratio of extracellular water /intracellular water; PhA, phase angle; JV, jugular vein, *p<0.05.

Table_1_ESA.png

Table 2. Changes of clinical parameters through ESA treatments

	Pre-ESA	Post-ESA	*P* value
Hb (g/dL)	***9.35***	***10.05***	***<0.001****
MCV (fL)	93.55	93.90	0.931
MCH (pg)	30.80	30.60	0.629
MCHC (mg/dL)	33.05	33.15	0.657
Ferritin (ng/mL)	***123.10***	***88.35***	***0.010****
TSAT (%)	25.35	26.45	0.793
Cr (mg/dL)	***2.98***	***3.15***	***0.001****
ALB (g/dL)	4.10	4.00	0.201
BNP (pg/mL)	688.00	624.50	0.405
OH (liter)	1.35	1.50	0.318
ROH	11.25	10.70	0.271
TBW (liter)	26.55	26.40	0.666
ECW (liter)	13.80	13.50	0.440
ICW (liter)	12.20	12.60	0.696
E/I	1.04	1.05	0.492
PhA	3.97	4.01	0.237
JV distensibility	3.57	3.41	0.530

ESA, erythropoiesis stimulating agent; Hb, hemoglobin; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; TSAT, transferrin saturation; Cr, creatinine; ALB, albumin; BNP, brain natriuretic peptide; OH, overhydration; ROH, relative overhydration; TBW, total body water; ECW, extracellular water; ICW, intracellular water, E/I, ratio of extracellular water/ intracellular water; PhA, phase angle; JV, jugular vein, *p<0.05, **p<0.01, ***p<0.001 .