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Early Hemoglobin Levels after Kidney Transplantation Predict Clinical Outcomes: A Nationwide Cohort Study

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Objectives : The association between early hemoglobin levels after kidney transplantation (KT) and long-term outcomes is uncertain. We investigated the impact of early post-transplant hemoglobin levels on the clinical outcomes.
Methods : We analyzed hemoglobin levels at 6 months after KT of 7,501 kidney transplant recipients (KTRs) from a nationwide cohort, the Korean Organ Transplant Registry. Factors associated with hemoglobin levels were analyzed using multivariate linear regression. KTRs were divided into 5 hemoglobin categories: <10, 10 to <11, 11 to <12, 12 to <13 (reference group), and ≥13g/dL. The primary outcome is a composite of all-cause mortality, cardiovascular events, and graft loss. The multivariable Cox regression model was used to investigate the effect of hemoglobin levels on the composite outcome.
Results : The mean age was 49.6 ± 11.6 and male ratio was 60.4%. The prevalences of diabetes and cardiovascular diseases were higher and that of hypertension was lower in hemoglobin levels <10 g/dL. Female sex (β= –0.32), deceased donor KT (β= –0.15), and age (β= –0.12) had the highest standardized coefficients among significant factors associated with hemoglobin levels. The incidences of the composite outcome and each component were the highest in hemoglobin levels <10 g/dL (all P< 0.05). Hemoglobin levels <10 g/dL were associated with an increased risk of the composite outcome (adjusted hazard ratio [aHR] 3.36, 95% confidence interval [CI] 2.23–5.06, P< 0.001). Hemoglobin levels <10 g/dL were also an independent risk factor for each component of the primary outcome. Interestingly, hemoglobin levels ≥13 g/dL were significantly associated with better survival (aHR 0.43, 95% CI 0.21–0.87, P= 0.019).
Conclusions : The post-transplant anemia below 10g/dL was an independent predictor of composite outcome including all-cause mortality, cardiovascular event, and graft loss. Hemoglobin levels >13g/dL showed a protective effect on patient survival. Appropriate monitoring and correction of hemoglobin should be a target of management in the early post-transplant.

Figure.jpg

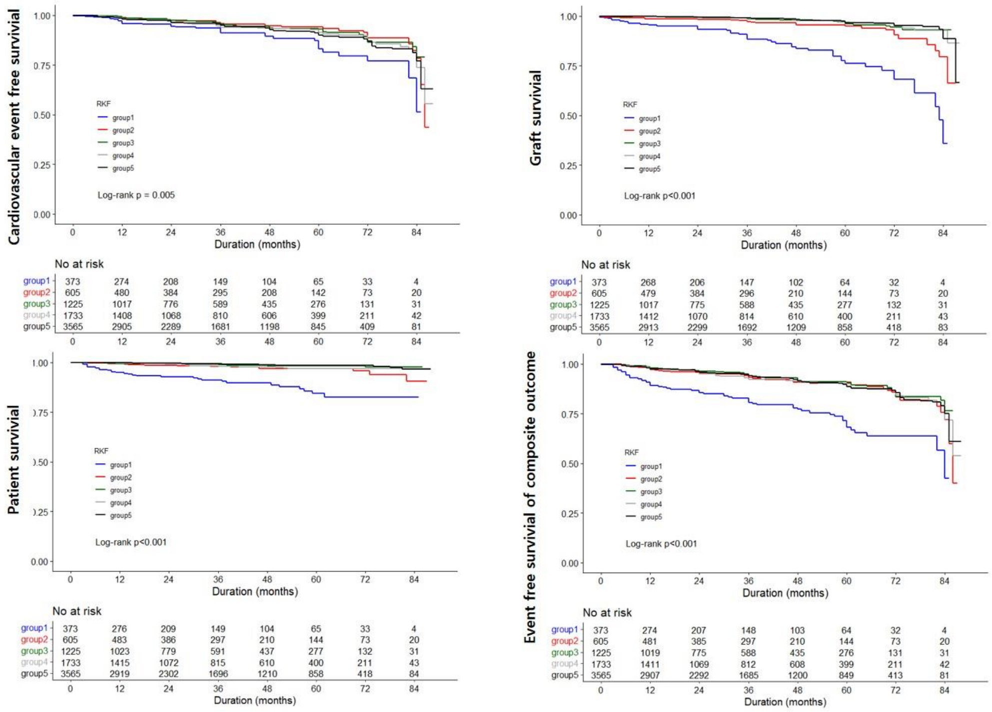
Cardiovascular event free survivial
Log-rank p = 0.005
Graft survivial
Log-rank p<0.001
Patient survivial
Log-rank p<0.001
Event free survivial of composite outcome
Log-rank p<0.001
RKF
group1
group2
group3
group4
group5
Duration (months)
No at risk

Figure.jpg

Table 1. Cox regression analyses of clinical outcomes according to early hemoglobin levels

	Unadjusted		Adjusted*	
	HR (95% CI)	P value	aHR (95% CI)	P value
All-cause mortality				
< 10g/dL	5.737 (3.10810.590)	<0.001	4.300 (2.151–8.595)	0.005
10–11g/dL	1.213 (0.534–2.755)	0.644	1.231 (0.519–2.920)	0.638
11–12g/dL	0.622 (0.283–1.366)	0.237	0.688 (0.306–1.550)	0.367
12–13g/dL	Reference		Reference	
≥ 13g/dL	0.459 (0.245–0.860)	0.015	0.431 (0.214–0.869)	0.019
Cardiovascular events				
< 10g/dL	2.128 (1.357–3.337)	0.001	1.937 (1.068–3.510)	0.029
10–11g/dL	0.822 (0.495–1.364)	0.448	0.793 (0.409–1.541)	0.495
11–12g/dL	0.968 (0.673–1.393)	0.861	1.035 (0.668–1.603)	0.879
12–13g/dL	Reference		Reference	
≥ 13g/dL	1.215 (0.922–1.601)	0.168	1.302 (0.927–1.829)	0.128
Graft loss				
< 10g/dL	10.056 (5.922–17.077)	<0.001	11.478 (6.084–21.657)	<0.001
10–11g/dL	2.676 (1.448–4.946)	0.002	2.979 (1.426–6.224)	0.004
11–12g/dL	1.228 (0.664–2.268)	0.513	1.849 (0.942–3.632)	0.074
12–13g/dL	Reference		Reference	
≥ 13g/dL	1.007 (0.605–1.678)	0.978	1.102 (0.609–1.995)	0.748
Composite outcomes				
< 10g/dL	3.447 (2.467–4.817)	<0.001	3.360 (2.232–5.058)	<0.001
10–11g/dL	1.065 (0.712–1.592)	0.760	1.030 (0.625–1.696)	0.908
11–12g/dL	0.943 (0.684–1.302)	0.723	1.025 (0.706–1.488)	0.898
12–13g/dL	Reference		Reference	
≥ 13g/dL	1.064 (0.831–1.363)	0.622	1.076 (0.801–1.444)	0.627

*Adjusted for age, sex, body mass index, hypertension, diabetes, cardiovascular disease, tumor, transplantation type (living-donor transplantation ref.), dialysis vintage, induction immunosuppressant (basiliximab ref.), albumin, phosphorous, donor age, donor gender, donor hypertension, donor diabetes, donor cardiovascular disease and the number of human leukocyte antigen mismatch.