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Understanding post-transplant anemia in kidney transplant recipients: insights from a Vietnamese cohort

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Objectives : This study aimed to investigate the primary risk factors associated with post-transplant anemia (PTA) in Vietnamese kidney transplant recipients (KTRs) over time
Methods : Our study included 120 KTRs who underwent their first kidney transplant between 2021 and 2023, with average follow-up of 20.1±10.8 months, ranging from 1 to 36 months. We collected data on haemoglobin, serum creatinine, urinary tract infection and administering medications multiple times, including the initial outpatient check-up, every three months during the first year and every six months in the second and third years.
Results : The incidence of anemia was 66.3% in early post-transplant phase, decreasing to 22.9% in late post-transplant period. Independent factors associated with anemia included hypertension, fasting blood glucose, triglycerides, blood level of tacrolimus, and dose of Mycophenolate mofetil (Table 1). Antiviral agents were found to reduce risk of anemia by 42%. Particular infections increased risk of anemia, such as urinary tract infection (HR: 2.19), cytomegalovirus (HR: 1.85), Epstein-Barr virus (HR: 2.31), while BK virus and JC virus reduced risk (HR: 0.53 and 0.72, respectively). Higher albumin and protein levels were associated with a lower incidence of anemia by 10% (Table 1). Using multiple Cox regression model, anemia (< 110 g/L) was linked to an 8.2 times greater risk for IKF among KTRs in comparison to individuals who did not have anemia (Tbale 2, Model 1). Moreover, the severity of anemia was associated with an 11.63-fold higher risk of IKF for moderate anemia and a 10.08-fold higher for severe anemia (Table 2, Model 2).
Conclusions : Various independent transplant risk factors were associated with PTA, highlighting the importance of factors such as age, hypertension, glucose levels, and specific viral infections. Additionally, the study underscored a strong correlation between the severity of anemia and impaired kidney function, emphasizing the substantial impact of anemia on the recipients' overall health.

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Table 1. Independent factors associated with post-transplantation anemia in Vietnamese kidney transplant recipients over time

Factors	HR	(95.0% CI)	p-value
Age	0.98	(0.97 - 0.99)	<0.01
Male	0.96	(0.72 - 1.82)	0.78
Clinical parameters			
eGFR	0.98	(0.97 - 0.98)	<0.001
Hypertention	2.15	(1.45 - 3.18)	<0.001
Hyperglycemia*	2.38	(1.83 - 3.08)	<0.001
Triglycerides	1.27	(1.13 - 1.43)	<0.001
Serum albumin	0.90	(0.88 - 0.93)	<0.001
Serum protein	0.91	(0.89 - 0.93)	<0.001
Administering medications			
Dose of Tacrolimus	1.17	(1.13 - 1.21)	<0.001
Dose of Mycophenolate Mofetil	1.003	(1.003 - 1.004)	<0.001
Blood level of Tacrolimus	1.14	(1.11 - 1.17)	<0.001
Antiviral agents	0.58	(0.46 - 0.74)	<0.001
Infections			
Urinary tract infection	2.19	(1.35 - 3.53)	<0.01
BK virus	0.52	(0.38 - 0.72)	<0.001
JC virus	0.72	(0.35 - 0.99)	0.04
Cytomegalovirus (CMV)	1.85	(1.33 - 2.57)	<0.001
Epstein-Barr virus (EBV)	2.31	(1.22 - 4.37)	0.01

eGFR, Estimated glomerular filtration rate
*Fasting Glucose > 7.0 mmol/L

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Table 2. Risk factors associated with impaired kidney function in Vietnamese kidney transplant recipients over time.

	Factors*	HR	(95.0% CI)	p-value
Model 1	Age	1.02	(1.01 - 1.04)	< 0.01
	Antiviral agents	0.64	(0.43 - 0.97)	0.03
	Blood level of tacrolimus	1.21	(1.16 - 1.27)	< 0.001
	Hemoglobin less than 110 g/L	8.20	(4.93 - 13.66)	< 0.001
Model 2	Age	1.04	(1.02 - 1.06)	< 0.001
	Dose of Tacrolimus	1.07	(1.01 - 1.14)	0.03
	Dose of Mycophenolate mofetil	1.001	(1.000 - 1.002	< 0.01
	Serum protein	0.95	(0.92 - 0.99)	0.02
	Severity of anemia			
	Normal	(Ref)		
	Mild	6.98	(4.26 - 11.44)	< 0.001
	Moderate	11.64	(6.50 - 20.83)	< 0.001
	Severe	10.09	(2.33 - 43.62)	< 0.01

Model 1: The models incorporated the risk factors and anemia (Hemoglobin [Hb] < 110 g/L).
Model 2: The models incorporated the risk factors and severity of anemia. The severity of anemia was classified according to WHO (2011) guidelines as follows: Normal (Hb ≥ 120 g/L for females; Hb ≥ 130 g/L for males); Mild (110 g/L ≤ Hb < 120 g/L for females; 110 g/L ≤ Hb < 130 g/L for males); Moderate (80 g/L ≤ Hb < 110 g/L for both sexes); and Severe (Hb < 80 g/L for both sexes).
*Risk factors included to the models were age, urinary tract infection, hypertension, fasting blood glucose, triglycerides, blood level of tacrolimus, dose of tacrolimus, dose of mycophenolate mofetil, albumin, and protein. Only statistically significant risk factors have been presented in the table.
**Impaired kidney function was classified according to KDIGO (2023) as eGFR less than 60 ml/min/1.73m^3.