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Original Article

One-year survival factors of patients with end-stage kidney disease in Bali, Indonesia

Made Sindy Astri Pratiwi [1]✉, Ni Nyoman Gita Kharisma Dewi [1], Made Priska Arya Agustin [1], Putu Itta Sandi Lesmana Dewi [1], Cindy Fahira [1], I Wayan Sunaka [2]

[1] *Intern Doctor, Department of Internal Medicine, Wangaya Regional General Hospital, Denpasar, Bali, Indonesia*
[2] *Internist, Department of Internal Medicine, Wangaya Regional General Hospital, Denpasar, Bali, Indonesia*

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CORRESPONDENCE

Phone: +6281236505735
E-mail: sindyastri4@gmail.com

A B S T R A C T

Background: End-stage kidney disease (ESKD) is a global health challenge contributing to 2.2–7 million deaths annually due to inadequate treatment access. Identifying determinants of survival is critical for improving patient outcomes. To date, no study in Bali has evaluated the one-year survival of ESKD patients.

Purpose: This study aimed to identify factors associated with one-year survival among patients with ESKD in Bali, Indonesia.

Methods: A retrospective cohort study was conducted at Wangaya Regional General Hospital from November 2024 to March 2025, involving 210 patients aged ≥18 years diagnosed with ESKD between 2022 and 2024. Survival status was assessed over one year. Predictive factors, including age, gender, diabetes mellitus, control compliance, dialysis status, haemoglobin, blood urea nitrogen (BUN), serum creatinine (SC), and estimated glomerular filtration rate (eGFR), were analysed using Kaplan-Meier and Cox proportional hazards regression.

Results: Within one year, 24.3% of ESKD patients died. The mean survival time was 9.74 months (95% CI: 9.15–10.33). Multivariate analysis identified age ≥55 years (p=0.043), non-compliance with nephrology follow-up (p<0.001), haemoglobin ≤8 g/dL (p=0.023), and BUN ≥183.5 mg/dL (p<0.001) as independent predictors of mortality.

Conclusions: Older age, poor compliance, anemia, and elevated BUN were significant predictors of one-year mortality in ESKD patients. Early identification and management of these factors are essential to reduce mortality and improve patient care.

INTRODUCTION

End-stage kidney disease (ESKD) represents a major global health challenge, placing an increasing burden on healthcare systems worldwide due to its rising incidence and high associated mortality.[1] The insidious onset of ESKD often leads to delayed diagnosis and suboptimal management. Studies have reported that fewer than 10% of patients with stage 3 chronic kidney disease (CKD) are aware of their condition, with many diagnosed only after progressing to stage 4 when clinical symptoms become evident.[2] Globally, approximately 2–7 million ESKD patients die each year due to inadequate access to renal replacement therapy (RRT).[3] In Indonesia, ESKD prevalence has been increasing significantly. Data from the Indonesian Renal Registry (2022) revealed that in 2021, approximately 200,000 patients were undergoing dialysis, underscoring the growing demand for nephrology care.[4] However, national studies evaluating survival outcomes among ESKD patients remain scarce, especially those that consider patients who opt not to undergo dialysis.

One-year survival is a critical outcome indicator for ESKD patients. Previous research in Indonesia reported a one-year survival rate of 91.5% among hemodialysis patients.[5] Other studies have documented 5-year and 10-year mortality rates ranging from 15.8% to 27.3% depending on the dialysis modality.[6] Multiple clinical and demographic factors have been implicated in influencing survival, including advanced age, female gender, diabetic nephropathy, and dialysis adequacy.[5,6] Notably, limited engagement with nephrologists has been associated with inappropriate dialysis initiation, contributing to increased one-year mortality rates.[7]

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Despite these findings, there is a paucity of recent studies in Indonesia assessing one-year survival and its determinants among ESKD patients, particularly in Bali. Identifying predictive factors for survival is essential to optimise nephrology care and improve patient outcomes. This study aimed to evaluate the factors associated with one-year survival among ESKD patients in Bali, Indonesia, to provide evidence that could inform clinical decision-making and strategies to reduce ESKD-related mortality.

METHOD

Study Design

This study was a retrospective cohort study design.

Setting and Respondent

This study was conducted at Wangaya Regional General Hospital, Bali, Indonesia, from November 2024 to March 2025, involving adult patients aged 18 years or older who were diagnosed with end-stage kidney disease (ESKD) and received treatment at the hospital during the study period. A total of 210 patients who fulfilled the eligibility criteria were included in the analysis. Inclusion criteria comprised patients diagnosed with ESKD between 2022 and 2024 based on clinical and laboratory assessments consistent with Kidney Disease: Improving Global Outcomes (KDIGO) guidelines, having complete medical records with baseline laboratory parameters and treatment data, and including those receiving or not receiving renal replacement therapy (RRT). Patients were excluded if they had acute kidney injury (AKI) or other terminal illnesses such as metastatic cancer, decompensated liver cirrhosis, or human immunodeficiency virus (HIV) infection.

The Variable, Instrument, and Measurement

The primary outcome of this study was the one-year survival status of patients with end-stage kidney disease (ESKD), classified as either alive or deceased. Independent variables included sociodemographic factors such as age and gender, as well as clinical factors including the presence of diabetes mellitus, compliance with nephrology visits, dialysis status (categorized as hemodialysis, peritoneal dialysis, or no dialysis), hemoglobin level, blood urea nitrogen (BUN), serum creatinine (SC), and estimated glomerular filtration rate (eGFR). Laboratory values were obtained from baseline medical records, and eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula. Compliance with nephrology visits was defined as attending at least 75% of scheduled appointments within the first year following diagnosis.

Data Analysis

Descriptive statistics were used to summarise patient demographics and clinical characteristics, with continuous variables presented as means and standard deviations or medians with interquartile ranges, and categorical variables as frequencies and percentages. Receiver Operating Characteristic (ROC) curve analysis determined optimal cut-off points for continuous variables. Survival analysis was performed using the Kaplan–Meier method with log-rank tests for group comparisons, and Cox proportional hazards regression was applied to identify independent predictors of one-year mortality. Variables with p-values <0.10 in univariate analysis were included in the multivariate model, and statistical significance was set at p ≤0.05. All analyses were performed using SPSS version 25.0.

Ethical Consideration

This study was approved by the Ethics Committee of Wangaya Regional General Hospital (approval number: 000.9.2/531/RSUDW).

RESULTS

A total of 210 patients diagnosed with end-stage kidney disease (ESKD) were included in the study and followed for one year. The median age of the participants was 55 years, with 51.9% aged ≥55 years and 61.9% being male. Half of the patients (50.0%) had type 2 diabetes mellitus, and the majority (71.9%) were compliant with nephrology follow-up. Most patients (81.4%) underwent dialysis therapy, and 57.1% had hemoglobin levels ≥8 g/dL (Table 1).

Laboratory parameters of renal function showed mean blood urea nitrogen (BUN) of 171.8 ± 80.4 mg/dL, mean serum creatinine (SC) of 10.6 ± 6.0 mg/dL, and mean estimated glomerular filtration rate (eGFR) of 6.7 ± 3.7 mL/min/1.73m². ROC curve analysis determined optimal cut-off points of 183.5 mg/dL for BUN, 9.4 mg/dL for SC, and 5.5 mL/min/1.73m² for eGFR (Table 2)

Table 1. Baseline characteristics of patients with end-stage kidney disease (n = 210)

Characteristic	Result
Age	
≥ 55 years	109 (51.9)
< 55 years	101 (48.1)
Gender	
Male	130 (61.9)
Female	80 (38.1)
Type II Diabetes Mellitus	
Present	105 (50.0)
Absent	105 (50.0)
Control compliance	
Compliant	151 (71.9)
Non-compliant	59 (28.1)
Dialysis status	
Yes	171 (81.4)
No	39 (18.6)
Hemoglobin level	
<8 g/dL	92 (42.9)
≥8 g/dL	118 (57.1)

Exp: Hb, hemoglobin.

Table 2. Renal function laboratory parameters and ROC-derived cut-off values

Parameter	Mean ± SD	Median	Range	Cut-off value
BUN (mg/dL)	171.8 ± 80.4	155.0	30.0 –448.0	183.5
Serum Creatinine (mg/dL)	10.6 ± 6.0	9.1	3.1 – 35.0	9.4
eGFR (mL/min/1.73m²)	6.7 ± 3.7	6.0	1.0 – 15.0	5.5

Exp: BUN, blood urea nitrogen; SC, serum creatinine; eGFR, estimated glomerular filtration rate; SD, standard deviation.

During the one-year follow-up period, 51 patients (24.3%) died, while 159 patients (75.7%) survived (Table 3). Kaplan–Meier analysis estimated an overall mean survival time of 9.74 months (95% CI: 9.15–10.33) (Table 4), and the survival probability curve is presented in Graphic 1.

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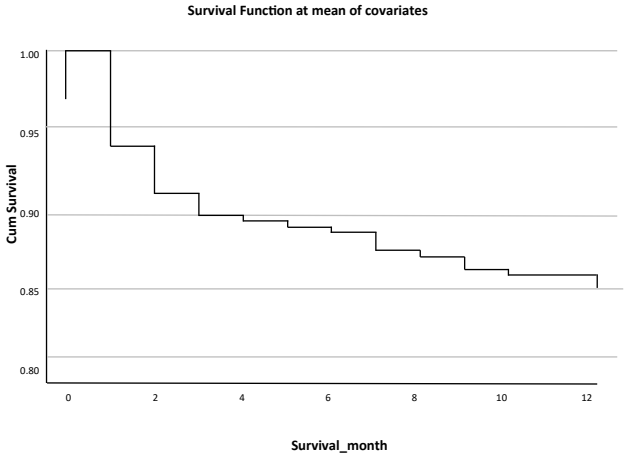
Table 3. One-year survival status of ESKD patients (n=210)

Survival Status	Result
Alive	159 (75.7)
Deceased	51 (24.3)

Table 4. Average one-year survival of patients with end-stage kidney disease

Estimation (months)	Value
Mean (months)	9.738
Standard Error	0.300
95% CI (Lower)	9.149
95% CI (Upper)	10.327



Graphic 1. Kaplan–Meier curves based on Cox regression models on mean values of covariates in ESKD patients during 12 months of follow-up

The log-rank test revealed that patients aged ≥55 years had a significantly lower survival rate compared to those <55 years (p=0.045). Compliance with nephrology visits was strongly associated with survival, with non-compliant patients showing a markedly reduced mean survival of 5.98 months versus 11.21 months among compliant patients (p<0.001). Patients receiving dialysis had a significantly longer survival compared to those not on dialysis (p=0.010), and higher hemoglobin levels (≥8 g/dL) were associated with improved survival (p=0.002). Furthermore, renal function markers including BUN ≥183.5 mg/dL, SC ≥9.4 mg/dL, and eGFR ≤5.5 mL/min/1.73m² were significantly associated with reduced survival (p<0.001, p=0.029, and p=0.028, respectively) (Table 5).

In multivariate Cox proportional hazards regression analysis, age ≥55 years (HR=1.82; 95% CI: 1.02–3.25; p=0.043), non-compliance with nephrology visits (HR=8.00; 95% CI: 4.38–14.63; p<0.001), hemoglobin ≤8 g/dL (HR=1.95; 95% CI: 1.10–3.48; p=0.023), and BUN ≥183.5 mg/dL (HR=4.00; 95% CI: 2.18–7.36; p<0.001) emerged as independent predictors of one-year mortality (Table 6). Other variables, including dialysis status, serum creatinine, and eGFR, were not retained in the final model.

Table 5. Kaplan–Meier survival analysis of ESKD patients (Log-rank test)

Characteristic	Mean ± SE survival (months)	95% CI	p-value
Age			
≥55 years	9.28 ± 0.44	8.43 – 10.14	0.045
<55 years	10.29 ± 0.41	9.42 – 11.04	
Gender			
Male	9.89 ± 0.38	9.15 – 10.64	0.429
Female	9.49 ± 0.50	8.50 – 10.47	
Type II DM			
Present	9.41 ± 0.44	8.54 – 10.28	0.279
Absent	10.07 ± 0.41	9.26 – 10.87	
Control compliance			
Compliant	11.21 ± 0.21	10.79 – 11.62	<0.001
Non-compliant	5.98 ± 0.72	4.58 – 7.39	
Dialysis status			
Yes	10.15 ± 0.31	9.55 – 10.74	0.010
No	7.95 ± 0.85	6.28 – 9.62	
Hemoglobin level			
≥8 g/dL	10.46 ± 0.36	9.76 – 11.15	0.002
<8 g/dL	8.82 ± 0.51	7.82 – 9.81	
BUN			
≥183.5 mg/dL	8.21 ± 0.55	7.12 – 9.29	<0.001
<183.5 mg/dL	10.84 ± 0.30	10.26 – 11.43	
Serum Creatinine			
≥9.4 mg/dL	9.15 ± 0.48	8.21 – 10.09	0.029
<9.4 mg/dL	10.27 ± 0.37	9.56 – 10.99	
eGFR			
≤5.5 mL/min/1.73m²	9.08 ± 0.48	8.13 – 10.03	0.028
>5.5 mL/min/1.73m²	10.34 ± 0.36	9.64 – 11.04	

Exp: SE, standard error; CI, confidence interval; BUN, blood urea nitrogen; eGFR, estimated glomerular filtration rate.

Table 6. Multivariate Cox proportional hazards regression for predictors of one-year mortality

Predictor	Hazard Ratio (HR)	95% CI	p-value
Age ≥55 years	1.82	1.02 – 3.25	0.043
Non-compliance	8.00	4.38 – 14.63	<0.001
Hemoglobin ≤8 g/dL	1.95	1.10 – 3.48	0.023
BUN ≥183.5 mg/dL	4.00	2.18 – 7.36	<0.001

Exp: HR, hazard ratio; CI, confidence interval; BUN, blood urea nitrogen.

DISCUSSION

This study found that 24.3% of ESKD patients died within 12 months, regardless of dialysis status. This mortality rate is higher than the 8.5% reported in previous studies,[5] and aligns with findings that survival decreases with age, female gender, diabetic nephropathy, and inadequate dialysis. A separate long-term study in severe CKD patients reported a one-year survival of 83.3%, with age, gender, comorbidities, and cancer contributing to reduced survival.[8]

Older age (≥55 years) was identified as a significant predictor of mortality in this cohort. This finding supports earlier evidence linking aging to declining health-related quality of life (HRQoL), progressive renal function loss, increased depression, and reduced physical autonomy, all of which worsen survival outcomes.[9,10] In contrast, gender was not associated with survival differences in this study, which is consistent with previous research suggesting age and dialysis adequacy are more critical determinants of survival than sex.[5] However, other studies have shown lower QoL in females in developing countries due to social and physical factors.[11]

Dialysis status was associated with longer survival in univariate analysis, but not retained as an independent predictor in the multivariate model. Patients who do not undergo dialysis are at risk of uremic toxin accumulation, which can trigger pulmonary vascular remodelling, systemic inflammation, and endothelial dysfunction, ultimately increasing mortality.[15] Furthermore, renal interstitial fibrosis and tubular atrophy in non-dialysis patients may exacerbate reactive oxygen species production and inflammation, leading to more advanced kidney damage and poor survival outcomes.[16]

Type 2 diabetes mellitus (DM) is a common cause of ESKD, with approximately 40% of DM patients progressing to kidney failure.[12] While DM status alone was not a predictor in this study, other research has emphasised HbA1c as a more reliable indicator of glucose control and survival.[13] yperglycemia and hypoglycemia contribute to DKD progression through microvascular damage and inflammation.[14] The next factor that can affect ESKD mortality is dialysis status. Patients on dialysis have a longer survival time than those who do not undergo dialysis. However, based on Cox regression, this variable is not a predictor of one-year mortality in ESKD patients. In patients who do not undergo dialysis, ESKD conditions can trigger pulmonary circulation dysfunction and remodelling through uremic toxins, changes in vasoregulation, systemic inflammation, and endothelial dysfunction.[15] If patients do not undergo dialysis, renal interstitial fibrosis and renal tubular atrophy are consistent with decreased GFR. These changes will cause tubular epithelial cells to be stimulated to synthesise reactive oxygen species, which increase inflammation and fibrosis. These changes will indirectly increase patient mortality.[16]

Compliance with nephrology care was a strong determinant of survival. Non-compliant patients had significantly higher mortality, in line with studies showing that missed follow-ups are associated with increased risk of death.[17] Educational interventions on the importance of regular visits and dialysis adherence have been shown to improve survival outcomes.[18] Similarly, anemia (Hb <8 g/dL) was linked to higher mortality, supporting findings that anemia in ESKD exacerbates cardiovascular events, malnutrition, and systemic inflammation.[19,20]

Renal function markers, particularly elevated blood urea nitrogen (BUN), were strong predictors of mortality, reflecting impaired renal clearance and systemic catabolic states.[21] In contrast, serum creatinine and estimated glomerular filtration rate (eGFR), although significant in univariate analysis, were not retained in the multivariate model. This may relate to the limitations of creatinine as a marker, as up to 10% of creatinine clearance occurs via distal tubular secretion, and this contribution can vary with declining GFR.[22] Additionally, proximal tubular secretion accounts for a substantial portion of creatinine excretion, potentially masking early declines in GFR and leading to underestimation of renal impairment in advanced disease.[23] Nonetheless, studies show that reduced eGFR is associated with higher mortality, particularly in patients not undergoing dialysis,[24,25] and rapid declines in eGFR in elderly individuals have been linked to a 50–80% increase in mortality risk.[26]

CONCLUSIONS AND RECOMMENDATION

This study demonstrated that the mean one-year survival time of patients with end-stage kidney disease (ESKD) was 9.7 months. Age ≥55 years, poor compliance with nephrology follow-up, hemoglobin levels <8 g/dL, and elevated blood urea nitrogen (BUN) were identified as independent predictors of mortality. Early identification and management of these risk factors are essential to reduce mortality and improve the quality of care in ESKD patients. Future research should evaluate survival across different stages of chronic kidney disease (CKD) and investigate additional prognostic factors such as electrolyte imbalances, serum albumin levels, and cardiovascular comorbidities.

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