Rev Nefrol Dial Traspl. 2023;43(2):69-78

90 day and 1-year mortality and renal outcomes of patients who started hemodialysis treatment for the first time

Mortalidad a los 90 días y al año y resultados renales de pacientes que iniciaron tratamiento con hemodiálisis por primera vez

Kubilay Karaboyun[1], Sinem Girgin[2], Mürvet Yılmaz[3]

RESUMEN

Objetivo: Este estudio tiene como objetivo investigar la mortalidad a 90 días y 1 año y los factores que afectan la mortalidad en pacientes que han iniciado tratamiento de diálisis por primera vez. **Métodos:** Se evaluaron pacientes que iniciaron hemodiálisis intermitente por primera vez en la unidad de hemodiálisis. Se excluyeron del estudio los pacientes que recibieron tratamiento de hemodiálisis por cualquier motivo anteriormente, los pacientes que se sometieron a hemodiálisis por intoxicación con alcohol metílico, litio o hongos y los pacientes que iniciaron diálisis en la unidad de cuidados intensivos. Los datos clínicos y de laboratorio se obtuvieron de los pacientes al momento del ingreso, del sistema de registro electrónico de datos y de las historias clínicas de los pacientes. Se utilizaron análisis de regresión logística univariados y multivariados para identificar factores predictivos para variables dependientes de mortalidad a 90 días y 1 año. **Resultados:** 229 pacientes fueron incluidos en este estudio. 133 (58,8%) de los pacientes eran hombres, 96 (41,9%) eran mujeres y la mediana de edad fue de 64 años. Mientras que 166 pacientes tenían enfermedad renal preexistente, 63 pacientes no tenían enfermedad renal previa. El número de pacientes que fallecieron dentro de los 90 días, que se refiere a la mortalidad a corto plazo, fue de 49 (21,4%). 73 pacientes (31,9%) fallecieron en un año (mortalidad a largo plazo). Al cabo de un año, el 38% de todo el grupo de pacientes continuaba recibiendo terapia de reemplazo renal, mientras que el 10% de todos los pacientes con ERC no requerían diálisis y solo el 9,17% de los pacientes presentaban recuperación renal. En el análisis multivariante establecido para la mortalidad a corto plazo, los siguientes parámetros mostraron características predictivas significativas: fracción de eyección (OR = 3,80, IC 95%: 1,05-13,72, p=0,042), PCR (OR = 0,20, IC 95%: 0,04 -0,92, p= 0,039), edad (OR = 0,21, IC 95%: 0,05-0,91, p= 0,038) y presión arterial diastólica (OR = 0,08, IC 95%: 0,02-0,28, p< 0,001). El análisis multivariado para la mortalidad a largo plazo indicó que la presión arterial sistólica (OR = 0,26, IC 95%: 0,08-0,82, p= 0,022), la presión arterial diastólica (OR = 0,21, IC 95%: 0,68-0,66, p= 0,008), y el potasio (OR = 0,27, IC 95%: 0,10-0,70, p= 0,007) fueron marcadores predictivos independientes. **Conclusión:** Los pacientes con ERC que aún no han

Correspondencia:
Kubilay Karaboyun
ORCID:
0000-0002-1783-8075
kubilaykaraboyun@gmail.com

Financiamiento:
Ninguno.

Conflicto de intereses:
Ninguno que declarar.

Recibido: 25-12-2022
Corregido: 27-01-2023
Aceptado: 12-05-2023

1) Department of Medical Oncology, Tekirdag Namik Kemal University, Faculty of Medicine, Tekirdağ, Turkey.

2) Department of Nephrology, Bakırköy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkey.

3) Department of Nephrology, Hacettepe University, Faculty of Medicine, Ankara, Turkey.

iniciado tratamiento con hemodiálisis deben ser seguidos de cerca, ya que la hipervolemia, la hipotensión y la inestabilidad hemodinámica aumentan el riesgo de muerte, según nuestro estudio. Además, recomendamos que las condiciones clínicas como la inestabilidad hemodinámica o la sepsis, que pueden causar hipotensión en AKI-D, deben abordarse lo antes posible y optimizar cuidadosamente el balance de líquidos y electrolitos en aquellos pacientes que determinamos que están en riesgo.

Palabras clave: enfermedad renal crónica, insuficiencia renal aguda, hemodiálisis, IRA adquirida en el hospital, IRA adquirida en la comunidad, mortalidad.

ABSTRACT

Aim: This study aims to investigate the 90-day and 1-year mortality and the affecting factors of mortality in patients who have started dialysis treatment for the first time. **Methods:** Patients who started intermittent hemodialysis for the first time in the hemodialysis unit were evaluated. Patients who received hemodialysis treatment for any reason before, patients who underwent hemodialysis due to methyl alcohol, lithium, or mushroom poisoning, and patients who started dialysis in the intensive care unit were excluded from the study. The clinical and laboratory data were obtained from the patients, at admission time, from the electronic data record system and patients' charts. Univariate and multivariate logistic regression analyses were used to identify predictive factors for 90-days and 1-year mortality-dependent variables. **Results:** 229 patients were included in this study. 133(58.8%) of the patients were male, 96(41.9%) were female, and the median age was 64 years. While 166 patients had pre-existing renal disease, 63 patients had no prior renal disease. The number of patients who died within 90 days, which refers to short-term mortality, was 49 (21.4%). 73 patients (31.9%) died in one year (long-term mortality). At the end of one year, 38% of the whole group of patients continued receiving renal replacement therapy, while 10% of all CKD patients had not a requirement of dialysis, and only 9.17% of the patients had renal recovery.

In the multivariate analysis established for short-term mortality, the following parameters showed significant predictive features: ejection fraction (OR = 3.80, 95% CI: 1.05-13.72, p=0.042), CRP (OR = 0.20, 95% CI: 0.04-0.92, p= 0.039), age (OR = 0.21, 95% CI: 0.05-0.91, p= 0.038), and diastolic blood pressure (OR = 0.08, 95% CI: 0.02-0.28, p< 0.001). The multivariate analysis for long-term mortality indicated that systolic blood pressure (OR = 0.26, 95% CI: 0.08-0.82, p= 0.022), diastolic blood pressure (OR = 0.21, 95% CI: 0.68-0.66, p= 0.008), and potassium (OR = 0.27, 95% CI: 0.10-0.70, p= 0.007) were independent predictive markers. **Conclusion:** Patients with CKD who have not yet started hemodialysis treatment should be followed closely, as hypervolemia, hypotension, and hemodynamic instability increase the risk of death, according to our study. In addition, we recommend that clinical conditions such as hemodynamic instability or sepsis, which may cause hypotension in AKI-D, should be addressed as soon as possible, and optimizing the fluid-electrolyte balance carefully in those patients we determined to be at risk.

Keywords: chronic kidney disease, acute kidney injury, hemodialysis, hospital-acquired AKI, community-acquired AKI, mortality.

INTRODUCTION

National government support for Renal Replacement Therapy (RRT), which started after the 1970s in the US, has led to a tendency to early initiation of dialysis in chronic kidney disease (CKD) patients until the 2010s [1,2].

Several studies have shown that initiating early dialysis did not provide a meaningful survival advantage in patients with CKD [3,4].

It is known that initiating early hemodialysis treatment may worsen the patient's residual kidney function more rapidly, lead to adverse cardiovascular events or sudden death, and also affect patients' survival through infections and catheter-related complications [5,6,7,8]. On the other hand, some studies claim that starting early dialysis in patients with CKD provides at least a modest improvement in mortality [2,9,10]. In addition, volume overload, fluid-electrolyte, and potassium homeostasis disturbances are frequently present in patients not hastened for dialysis treatment. Cardiac arrhythmias and cardiovascular diseases caused by these disturbances can be considered as the causes that increase mortality in delayed initiation of dialysis [11].

In the context of mortality associated with

dialysis treatment, acute kidney injury requiring dialysis (AKI-D), which represents the more extreme version of acute kidney injury (AKI), is known to be at high risk for mortality, morbidity, and end-stage renal disease [12,13,14].

The relationship between AKI requiring dialysis and short or long-term mortality in hospitalized patients or critically ill Intensive Care Unit (ICU) patients has been demonstrated in many studies [15,16,17]. At the same time, there are conflicting data on the long-term outcomes and mortality of CA-AKI [18,19].

In this study, in patients who started on hemodialysis for the first time, we aimed to investigate 1-) the short (90 days) and long-term (one year) mortality, 2-) the relationship between clinical-biochemical variables at admission and mortality, 3-) kidney disease outcomes of the patients after one year from the first dialysis.

METHODS

In this study, we analyzed retrospectively patients who had started intermittent hemodialysis for the first time in the hemodialysis unit of the tertiary care hospital. The study population consisted of patients starting dialysis while on ambulatory patient follow-up due to CKD, those starting on urgent dialysis with CA-AKI diagnosis, and general ward patients requiring hemodialysis on admission (HA-AKI).

We excluded patients with the following criteria from the study: 1-) Patients who had previously received dialysis treatment for any reason. 2-) Patients who received hemodialysis due to drug intoxication (digoxin, lithium, methyl alcohol, etc.). 3-) patients who underwent hemoperfusion due to mushroom poisoning, and 4-) patients who started on dialysis in the intensive care unit.

In addition, patients with missing clinical-biochemical data were also excluded from the study.

The clinic and demographic characteristics of the patients: age, gender, type, and cause of kidney disease, indication for dialysis, duration of dialysis, vascular access for dialysis, concomitant diseases and medications, and complications were recorded.

If the patients had kidney disease before dialysis or if the serum creatinine values of patients were high within three months before the date of dialysis, or if the kidney sizes of patients were small on renal ultrasonography, were recorded as having previous kidney disease (**Group 1**).

Patients who did not meet these criteria were categorized as having no previous kidney disease (**Group 2**). Systolic and diastolic blood pressures during dialysis and ejection fractions (EF) of patients who underwent echocardiography were obtained from the dialysis charts.

The biochemical data of the patients on the day of dialysis: serum glucose, urea, creatinine, calcium, phosphorus, parathormone, sodium, potassium, and albumin levels), hemogram parameters, C-reactive protein (CRP), hepatitis serologies (HBsAg, anti-HBs, AntiHCV) and blood gas values (pH, PCO2, HCO3) were obtained from the hospital electronic data record system.

We determined and recorded the patient's survival at 90 days and one year and renal disease outcomes (recovery, CKD without dialysis, and Renal Replacement Therapy) in the living patients at the end of one year.

STATISTICS

Statistical analyzes were performed using SPSS Statistic software 24 (SPSS Inc., Chicago, III).

Continuous variables are summarized as mean or median (interquartile range).

The categorical measurements were summarized as numbers (percentage of the diagnostic group). All continuous variables were categorized according to optimal or international cutoffs. Optimal cutoff values were determined by the receiver operating characteristic (ROC) curve and the area under the curve (AUC).

Univariate and multivariate logistic regression analyses were used to identify predictive factors for short-term and long-term mortality-dependent variables.

The Odds Ratio (OR) was reported with the corresponding 95% confidence intervals (95% CI). The receiver operating characteristic curve (ROC curve) and ROC-AUC were calculated to compare the independent prognostic factors. Statistical significance was accepted as $p < 0.05$.

RESULTS

A total of 229 patients were included in the study. 133 (58.8%) of the patients were male, 96 (41.9%) were female, and the median age was 64 years. 91.8% of the patients had at least one comorbid disease. While 166 patients (72.5%) had pre-existing renal disease (Group 1), 63 patients (27.5%) had no prior renal disease (**Group**

2). The most common reasons for dialysis were hypervolemia (41%) and uremic symptoms (24%). A non-tunneled jugular catheter was used in 60.3% of patients as the vascular access route for hemodialysis, while a femoral catheter was used in 35.4%. Catheter-related complications (infection or thrombosis) were detected in 19 patients (**Table 1**).

Table 1

Clinical Parameters	**Pre-existing CKD (Group 1)**		**No Prior CKD (Group 2)**	
	n	**%**	**n**	**%**
Number of Patients	166	72.5	63	27.5
Age	64.0*	50-75**	62*	52-71**
Sex (Female)	58		38	16.6
Comorbid Disease				
Diabetes Mellitus	66	28.9	26	11.4
Essential Hypertension	122	53.2	37	16.2
Coronary Artery Disease	50	21.8	17	7.4
No Comorbidity	16	6.9	5	2.2
Etiology of AKI				
Prerenal	48	20.9	24	10.5
Renal	43	18.7	27	11.8
Postrenal	6	2.6	5	2.2
Indication for Dialysis *A/B/C/D/E****	80/45/12/12/15	34.9/19.6/5.2/5.2/6.6	15/11/13/16/6	6.6/4.8/5.7/7/2.6
Vascular access for dialysis				
Femoral	52	22.7	29	12.7
Jugular	104	45.4	34	14.5
AVF	10	4.3	0	0
Complications of Vascular access				
Infection	14	6.1	2	0.9
Thrombosis	2	0.9	1	0.4
Ejection Fraction (<50)	55	24	10	4.3
Systolic Blood Pressure (mmHg)	146*	130-161**	130*	107-143**
Diastolic Blood Pressure (mmHg)	80*	67-90**	73*	60-90**
Number of patients died within 90 days	35	15.3	14	6.1
Number of patients died in 1 year	50	21.8	23	10.1
Renal outcome of living patients at the end of the one year after first dialysis				
Ongoing RRT	78	34.1	9	4
CKD (not requiring dialysis)	16	6.9	7	3.1
Renal Recovery	0	0	21	9.2

 ISSN 0326-3428

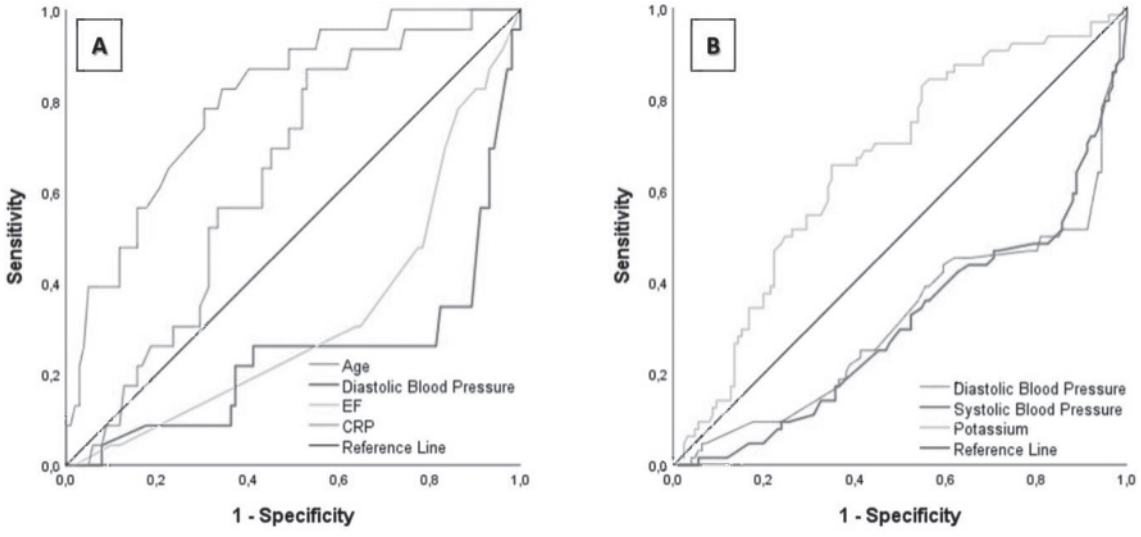
Laboratory Parameters	IQR(50th)	IQR(25th-75th)	IQR(50th)	IQR(25th-75th)
Glucose (mg/dL)	108	91-135	110	88-149
Urea (mg/dL)	208	170-166	187	146-233
Creatinine (mg/dL)	7.4	5.95-9.4	7.1	6.4-10.2
Calcium (mg/dL)	7.95	7.24-8.56	8.3	7.55-8.95
Phosphorus (mg/dL)	6.20	5.04-7.24	5.59	4.68-8.20
Parathormone (pg/mL)	261	164-467	136	64-296
Sodium (mg/dL)	136	132-139	134	129-137
Potassium (mg/dL)	4.67	4.08-9-5.26	4.71	4.05-6.00
Albumin (mg/dL)	3.40	3.00-3.71	3.4	2.7-3.9
Hemoglobin	8.95	8.12-10.20	9.28	8.17-10.90
Platelet	215000	153500-278500	241000	165000-313000
CRP (mg/dL)	2.77	0.70-7.08	4.23	1.08-10.73
Ph	7.31	7.23-7.38	7.31	7.24-7.37
Pco2	35	29-41	34	27-40
Bicarbonate	18	13-22	17	12-20

*Inter Quartile Range (IQR), 50th; **Inter Quartile Range (IQR), 25-75th; ***A: Hypervolemia, B: Uremic Findings, C: Hyperpotasemia, D: Anuria, E: Acidosis, AKI, Acute Kidney Injury; AVF, Arteriovenous Fistula; CRP, C-reactive protein, RRT, Renal Replacement Therapy

Forty-nine (21.40%) patients died within the first 90, and 73 (31.9%) patients died within the first year (**Table 1**). At the end of one year, 38% of the patients continued to receive renal replacement therapy. In contrast, 10% of all patients had CKD not requiring dialysis, and only 9.17% had renal recovery (normal renal functioning).

Ideal cut-off values for predicting 90-day and one-year mortality.

ROC-AUC curves determined the ideal cut-off values of laboratory variables for predicting short-term (90 days) and long-term (one year) mortality. For predicting mortality within 90 days, the ideal cut-off value was 63.5 years (AUC: 0.812) for age, 114 mmHg (AUC: 0.724) for systolic blood pressure, 60 mmHg for diastolic blood pressure (AUC: 0.747), 7,15 mg/dL (AUC: 0.681) for creatinine, 291500 (AUC: 0.584) for platelet, 1.55 mg/dL (AUC: 0.659) for CRP, and 29 mmHg (AUC: 0.659) for pCO2 (**Figure 1 A**).



In terms of predicting mortality within one year, the ideal cut-off value was 63.5 years (AUC: 0.768) for age, 120 mmHg (AUC: 0.692) for systolic blood pressure, 60 mmHg (AUC: 0.684) for diastolic blood pressure, 7.35 mg/dL (AUC: 0.615) for creatinine, 256 500 (AUC: 0.602) for platelets, 2.26 mg/dL (AUC: 0.622) for CRP, and 29.5 mmHg (AUC: 0.587) for pCO2, 20.5 (AUC: 0.592) for bicarbonate.

The International cut-off values, for ejection fraction, potassium, and albumin were considered (**Figure 1 B**).

Univariate and multivariate analysis of factors predicting mortality within 90 days:

In the univariate analysis the age (OR [odds ratio] = 0.56, 95% CI: 0.02-0.16, p <0.001), etiology of AKI (OR = 1.07, 95% CI: 1.01-1.13, p=0.013), vascular access for dialysis (OR=3.18, 95% CI: 1.71-5.92, p< 0.001), EF (OR=3.55, 95% CI: 1.53-8.27, p= 0.003), systolic blood pressure (OR=0.12, 95% CI: 0.06-0.27, p< 0.001), diastolic blood pressure (OR=0.09, 95% CI: 0.04-0.20, p< 0.001), creatinine (OR=0.22, 95% CI: 0.11 -0.44, p<0.001), potassium (OR=0.38, 95% CI: 0.20-0.73, p=0.004), albumin (OR=4.67, 95% CI: 2.20-9.99, p<0.001), platelet (OR=0.44, 95% CI: 0.22-0.87, p=0.018), CRP (OR=0.15, 95% CI: 0.06-0.39, p<0.001), pCO2 (OR=2.07, 95% CI: 1.06-4.05, p<0.001) showed to be significant for predicting short-term mortality (**Table 2**).

Table 2. Univariate analyses of factors for patients died within 90 days and 1 year

	Category		**Univariate analysis of patients died within 90 days**		**Univariate analysis of patients died in one year**	
Variable	**died within 90 days**	**died in one year**	OR (95% CI)	***P***	OR (95% CI)	***P***
Age	<63.5 vs ≥63.5	<63.5 vs ≥63.5	0.56 (0.02-0.16)	**<0.001**	0.16 (0.08-0.31)	**<0.001**
Sex	Female vs Male		1.30 (0.68-2.50)	0.430	1.21 (0.68-2.13)	0.520
Pre-existing kidney disease or not	Group 1 vs Group 2		1.00 (0.55-1.84)	0.990	1.45 (0.84-2.48)	0.694
Aetiology of AKI	Prerenal / Renal / Post-Renal		1.37 (1.04-1.78)	**0.024**	1.27 (1.01-1.60)	**0.045**
Indication for Dialysis	A/B/C/D/E/F*		1.15 (0.95-1,39)	0.141	1.12 (0.91-1.39)	0.288
Vascular access for dialysis	Femoral / Juguler / AVF		3.18 (1.71-5.92)	**<0.001**	2.38 (1.40-4.05)	**0.001**
Ejection Fraction	< 50 vs ≥ 50		3.55 (1.53-8.27)	**0.003**	2.50 (1.24-5.03)	**0.010**
Systolic Blood Pressure(mmHg)	< 114 vs ≥ 114	< 120 vs ≥ 120	0.12 (0.06-0.27)	**<0.001**	0.18 (0.09-0.35)	**<0.001**
Diastolic Blood Pressure(mmHg)	< 60 vs ≥ 60	< 60 vs ≥ 60	0.09 (0.04-0.20)	**<0.001**	0.09 (0.04-0.21)	**<0.001**
Laboratory Parameters						
Glucose (mg/dL)	< 108 vs ≥ 108		0.93 (0.57-1.45)	0.249	0.57 (0.32-1.02)	0.056
Urea (mg/dL)	< 208 vs ≥ 208		1.00 (0.59-1.85)	0.473	0.86 (0.49-1.51)	0.634
Creatinine (mg/dL)	< 7.15 vs ≥ 7.15	< 7.35 vs ≥ 7.35	0.22 (0.11-0.44)	**<0.001**	0.36 (0.20-0.65)	**0.001**
Calcium (mg/dL)	< 8.08 vs ≥ 8.08		0.93 (0.49-1.75)	0.817	0.92 (0.53-1.61)	0.779
Phosphorus (mg/dL)	< 6 vs ≥ 6		0.94 (0.47-1.91)	0.869	1.22 (0.66-2.28)	0.524
Parathormone (pg/mL)	< 230 vs ≥ 230		1.45 (0.68-3.11)	0.337	1.10 (0.57-2.12)	0.774
Sodium (mg/dL)	< 135 vs ≥ 135		1.15 (0.61-2.17)	0.672	1.27 (0.72-2.22)	0.412
Potassium (mg/dL)	< 5.1 vs ≥ 5.1		0.38 (0.20-0.73)	**0.004**	0.38 (0.22-0.68)	**0.001**
Albumin (mg/dL)	< 3.5 vs ≥ 3.5		4.67 (2.20-9.99)	**<0.001**	4.69 (2.19-9.99)	**<0.001**
Haemoglobin	< 9,1 vs ≥ 9,1		0.69 (0.36-1.30)	0.246	0.69 (0.36-1.30)	0.246
Platelet	< 291,500 vs ≥ 291500	< 256,500 vs ≥ 256,500	0.44 (0.22-0.87)	**0.018**	0.46 (0.26-0.82)	**0.009**
CRP (mg/dL)	<1.55 vs ≥ 1.55	<2.26 vs ≥ 2.26	0.15 (0.06-0.39)	**<0.001**	0.39 (0.21-0.71)	**0.002**
Ph	< 7.31 vs ≥ 7.31		1.10 (0.58-2.07)	0.791	1.55 (0.87-2.74)	0.136
Pco2	<29 vs ≥ 29	<29.5 vs ≥ 29.5	2.07 (1.06-4.05)	**0.034**	2.51 (1.36-4.65)	**0.003**
Bicarbonate	< 18 vs ≥ 18	< 20.5 vs ≥ 20.5	1.69 (0.87-3.28)	0.122	2.49 (1.25-4.98)	**0.010**

 ISSN 0326-3428

s Significant values are indicated in bold. **AKI:** Acute Kidney Injury, **CRP**: C-reactive protein, * **A:** Hypervolemia, **B:** Uremic Findings, **C:** Hyperpotasemia, **D:** Anuria, **E:** Acidosis

In the multivariate model established with significant variables in the univariate model; EF (OR = 3.80, 95% CI: 1.05-13.72, p=0.042), CRP (OR = 0.20, 95% CI: 0.04-0.92, p= 0.039), age (OR = 0.21, 95% CI: 0.05-0.91, p= 0.038), and diastolic blood pressure (OR = 0.08, 95% CI: 0.02-0.28, p< 0.001) remained independent predictive for short-term mortality (**Table 3**).

Table 3: Multivariate analyses of factors for patients died within 90 days and 1 year

			Multivariate analysis of patients died within 90 days		Multivariate analysis of patients died in 1 year	
Variable	Category		OR (95% CI)	*P f*	OR (95% CI)	*P f*
Age	<63.5 vs ≥63.5		0.21 (0.05-0.91)	**0.038**		
Systolic Pressure (mmHg)	-	< 120 vs ≥ 120	-	-	0.26 (0.08-0.82)	**0.022**
Diastolic Pressure(mmHg)	<60,5 vs ≥60,5		0.08 (0.02-0.28)	**<0.001**	0.21 (0.68-0.66)	**0.008**
Ejection Fraction	< 50 vs ≥ 50		3.80 (1.05-13.72)	**0.042**		
CRP	<1.55 vs ≥ 1.55	-	0.20 (0.04-0.92)	**0.039**		
Potassium	-	< 5.1 vs ≥ 5.1			0.27 (0.10-0.70)	**0.007**

s Significant values are indicated in bold, **Pf.:** Forward: LR method, **CRP:** C-reactive protein.

Univariate and multivariate analysis of factors predicting mortality within One year:

Univariate analysis for mortality within one year showed that age (OR = 0.16, 95% CI: 0.08-0.31, p< 0.001), etiology of AKI (OR = 1.06, 95% CI: 1.01-1.10, p= 0.015), indication for dialysis (OR = 1.21, 95%) CI: 1.02-1.44, p= 0.026), vascular access for dialysis (OR = 2.38, 95% CI: 1.40-4.05, p= 0.001), EF (OR = 2.50, 95% CI: 1.24-5.03, p = 0.010), systolic blood pressure (OR = 0.18, 95% CI: 0.09-0.35, p< 0.001), diastolic blood pressure (OR = 0.09, 95% CI: 0.04-0.21, p< 0.001), creatinine (OR = 0.001) 0.36, 95% CI: 0.20-0.65, p= 0.001), potassium (OR = 0.38, 95% CI: 0.22-0.68, p= 0.001), albumin (OR = 4.69, 95% CI: 2.19-9.99, p< 0.001), platelets (OR = 0.46, 95% CI: 0.26-0.82, p= 0.009), CRP (OR = 0.39, 95% CI: 0.21-0.71, p= 0.002), pCO2 (OR = 2.51, 95% CI) : 1.36-4.65, p= 0.003), and bicarbonate (OR = 2.49, 95% CI: 1.25-4.98, p< 0.001) were predictive (**Table 2**).

Established multivariate analysis for one-year mortality indicated that systolic blood pressure (OR = 0.26, 95% CI: 0.08-0.82, p= 0.022), diastolic blood pressure (OR = 0.21, 95% CI: 0.68-0.66, p= 0.008), and potassium (OR = 0.27, 95% CI: 0.10-0.70, p= 0.007) were independent predictive (**Table 3**).

DISCUSSION

In this study, we investigated the 90-day and 1-year mortality and mortality-affecting factors of patients having started hemodialysis for the first time.

In the multivariate model, we established: age (≥63.5 years), diastolic blood pressure (<60.5mmHg), EF (<50), and CRP (≥1.55) together could predict mortality within 90 days.

Regarding mortality within one year: systolic blood pressure (<120 mmHg), diastolic blood pressure (<60.5 mmHg), and potassium (≥ 5.1 mg/dL) showed to be independent predictive in multivariate analysis. Moreover, we found the mortality rates within 90 days and one year to be approximately 20% and 30%, respectively.

At the end of one year, we detected renal recovery in 9% of the patients; approximately 40% continued renal replacement therapy, and 10%

had chronic kidney disease not requiring dialysis.

Despite our study including both HA-AKI and CA-AKI patients, it is noteworthy that it represents the short and long-term outcomes of patients who started dialysis for the first time in the outpatient hemodialysis unit.

Previous studies indicated that hypotension increases mortality in patients with AKI [20]. Lins R L et al. . showed that hypotension increases mortality in hospitalized patients with episodes of AKI [21]. Sepsis, as the possible reason for hypotension, can be claimed as the main culprit of this increase in mortality. Hypotension due to sepsis has been shown to increase mortality consistently in AKI, particularly in intensive care unit patients [22].

On the other hand, in addition to sepsis, hemodynamic instability due to cardiorenal syndrome or hypovolemia may also be associated with mortality. Considering that more than 60% of the patients in our study had pre-existing CKD, it can be put forward that these patients have an increased risk of death related to hemodynamic instability caused by volume overload. There is evidence that the prognosis is poor in patients with volume overload who start dialysis later. In a study by Bouchard et al. ., patients who started dialysis due to hypervolemia had a higher risk of death in their 60-day follow-up than patients who underwent hemodialysis for other indications [23]. Similarly, in a study comparing continuous and conventional dialysis, patients who started on dialysis for electrolyte dysregulation had better survival outcomes than patients on dialysis due to volume overload [24].

In our study, systolic or diastolic hypotension was associated with higher mortality in our patient group who started on hemodialysis for the first time.

Bell JS et al. . reported higher CRP, diabetes, and lower systolic blood pressure as high-risk factors for CA-AKI [25]. Duarte, Inês, et al. . found hypoalbuminemia and higher CRP as predictors for mortality in AKI-D patients [26]. Consistent with the literature, we found high levels of CRP, hypoalbuminemia, and hypotension to be factors predicting mortality in our study.

Most studies in the literature report that age is a factor that increases in-hospital mortality in AKI. Lu, R. H. et al. . reported that in-hospital mortality in hospitalized patients with AKI increased in older people [27]. Ejaz, Taymmia, et al. . reported that sepsis and age increased the risk for mortality in HA-AKI [28]. The present study determined that a higher age at hospital admission was a factor in predicting mortality in our patient population.

With a decrease in GFR, potassium tends to rise due to deficiencies in potassium homeostasis.

It is known that increasing hyperkalemia is directly related to oxidative stress, cardiac disease development, and mortality by stimulating the arrhythmogenic effect and aldosterone release. In a study that included 234 AKI patients by Abebe et al. ., they reported that those with hyperkalemia were significantly associated with higher mortality [29]. In a study based on electronic health records, Nakhoul, Georges, et al. . reported the effects of hyperkalemia on mortality in approximately 35 000 patients; the overall mortality of patients with potassium levels >5.5 mmol was higher [30]. In our study, hyperkalemia was an independent predictor of mortality at one-year mortality.

It has been reported in previous studies that the risk of all-cause death due to tunneled catheters increases in dialysis patients [31,32]. Femoral vascular accesses cause more infection-related complications than jugular vascular accesses, probably due to their location.

It has been reported that the risk of bacteremia increases weekly for femoral catheters but does not increase until the third week for jugular catheters [33]. In our center, approximately 60% of the patients entered hemodialysis with a jugular catheter, and catheter infection was detected in 6.55%. According to the literature, dialysis via a femoral catheter was associated with mortality in our study.

This study has some limitations. The retrospective design is the main limitation of the study. In addition, the included patients with CKD were in different stages of the disease, and the cause of death of those who died is unknown, adding additional limitations. On the other hand, the strength of the present study is that the patients included were a particular group, representing the severe form of AKI requiring dialysis.

Very few studies investigated the factors that predict and affect prognosis in patients starting dialysis for the first time outside the ICU. We found hyperkalemia, hypotension, EF, and age to be predictors of death. We recommend dealing with early management of clinical conditions such

as hemodynamic instability or sepsis that may cause hypotension in patients starting hemodialysis treatment and that the fluid-electrolyte balance should be optimized carefully in the patients at risk that we have determined. In addition, patients with CKD who have not yet started hemodialysis treatment should be followed closely, as hypervolemia, hypotension, and hemodynamic instability increase the risk of death, according to our study.

BIBLIOGRAPHY

1) Rosansky SJ, Clark WF. Has the yearly increase in the renal replacement therapy population ended? *J Am Soc Nephrol.* 2013;24(9):1367-1370. doi:10.1681/ASN.2013050458
2) Fu, E. L., Evans, M., Carrero, J. J., Putter, H., Clase, C. M., Caskey, et al. . Timing of dialysis initiation to reduce mortality and cardiovascular events in advanced chronic kidney disease: nationwide cohort study. *BMJ*. 2021;375: e066306. Published 2021 Nov 29. doi:10.1136/BMJ-2021-066306
3) Cooper BA, Branley P, Bulfone LCooper, B. A., Branley, P., Bulfone, L., Collins, J. F., Craig, J. C., Fraenkel, M. B., et al. . A randomized, controlled trial of early versus late initiation of dialysis. *N Engl J Med.* 2010;363(7):609-619. doi:10.1056/NEJMoa1000552
4) Mehrotra, R., Rivara, M., & Himmelfarb, J. (2013). Initiation of dialysis should be timely: neither early nor late. *Seminars in dialysis*, 26(6), 644–649. https://doi.org/10.1111/sdi.12127
5) Wang, A. Y., & Lai, K. N. (2006). The importance of residual renal function in dialysis patients. *Kidney International*, 69(10), 1726–1732. https://doi.org/10.1038/sj.ki.5000382
6) McIntyre C. W. (2009). Effects of hemodialysis on cardiac function. *Kidney International*, 76(4), 371–375. https://doi.org/10.1038/ki.2009.207
7) Burton JO, Jefferies HJ, Selby NM, McIntyre CW. Hemodialysis-induced cardiac injury: determinants and associated outcomes. *Clin J Am Soc Nephrol.* 2009;4(5):914-920. doi:10.2215/CJN.03900808
8) Chan KE, Maddux FW, Tolkoff-Rubin N, Karumanchi SA, Thadhani R, Hakim RM. Early outcomes among those initiating chronic dialysis in the United States. *Clin J Am Soc Nephrol*. 2011;6(11):2642-2649. doi:10.2215/CJN.03680411
9) Churchill DN. An evidence-based approach to earlier initiation of dialysis. *Am J Kidney Dis.* 1997;30(6):899-906. doi:10.1016/s0272-6386(97)90102-5
10) Wingard RL, Pupim LB, Krishnan M, Shintani A, Ikizler TA, Hakim RM. Early intervention improves mortality and hospitalization rates in incident hemodialysis patients: RightStart program. *Clin J Am Soc Nephrol.* 2007;2(6):1170-1175. doi:10.2215/CJN.04261206
11) Hung SC, Lai YS, Kuo KL, Tarng DC. Volume overload and adverse outcomes in chronic kidney disease: clinical observational and animal studies. *J Am Heart Assoc.* 2015;4(5): e001918. Published 2015 May 5. doi:10.1161/JAHA.115.001918
12) Bellomo R, Kellum JA, Ronco C. Acute kidney injury. *Lancet.* 2012 Aug 25;380(9843):756-66. doi: 10.1016/S0140-6736(11)61454-2. Epub 2012 May 21. PMID: 22617274.
13) Sumnu, A., Ozturk, S., Cavdar, E., İlal Mert, F. T., Cebeci, E., Karaali, Z., et al. . Role of ankle-brachial index measured by simple automatic sphygmomanometers in predicting postoperative kidney function in patients undergoing major cardiac surgery. *Revista de Nefrología, Diálisis y Trasplante*, 41(3), 192-201.
14) Karaboyun, K., İriağaç, Y., Çavdar, E., Avci, O., & Şeber, E. S. (2022). Comparison of three equations for estimating glomerular filtration rate as predictors of cisplatin-related acute kidney injury in lung cancer patients with normal renal function. *J Can Res Ther.* DOI: 0.4103/jcrt.jcrt_1405_22
15) Vijayan A, Abdel-Rahman EM, Liu KD, Goldstein SL, Agarwal A, Okusa MD, et al. . Recovery after Critical Illness and Acute Kidney Injury. *Clin J Am Soc Nephrol*. 2021 Oct;16(10):1601-1609. doi: 10.2215/CJN.19601220. Epub 2021 Aug 30. PMID: 34462285; PMCID: PMC8499012.
16) Srisawat N, Sileanu FE, Murugan R, Bellomod R, Calzavacca P, Cartin-Ceba R, et al. . Acute Kidney Injury-6 Study Group. Variation in risk and mortality of acute kidney injury in critically ill patients: a multicenter study. *Am J Nephrol*. 2015;41(1):81-8. doi: 10.1159/000371748. Epub 2015 Feb 10. PMID: 25677982
17) Thakar CV, Christianson A, Freyberg R, Almenoff P, Render ML. Incidence and outcomes of acute kidney injury in intensive care units: a Veterans Administration study. *Crit Care Med*. 2009 Sep;37(9):2552-8. doi: 10.1097/CCM.0b013e3181a5906f. PMID: 19602973
18) Inokuchi R, Hara Y, Yasuda H, Itami N, Terada Y, Doi K. Differences in characteristics and outcomes between community- and hospital-acquired acute kidney injury: a systematic review and meta-analysis. *Clin Nephrol*. 2017;88((10)):167–82

19) Huang, L., Xue, C., Kuai, J., Ruan, M., Yang, B., Chen, X., et al. . Clinical Characteristics and Outcomes of Community-Acquired versus Hospital-Acquired Acute Kidney Injury: A Meta-Analysis. Kidney & blood pressure research. *Karger* 44(5), 879–896. https://doi.org/10.1159/000502546

20) Khalil, M. A. M., Awan, S., Azmat, R., Khalil, M. A. U., Naseer, N., & Tan, J. (2018). Factors Affecting Inpatient Mortality in Elderly People with Acute Kidney Injury. *The Scientific World Journal,* 2018, 2142519. https://doi.org/10.1155/2018/2142519

21) Lins, R. L., Elseviers, M. M., Daelemans, R., Arnouts, P., Billiouw, J. M., Couttenye, et al. . Re-evaluation and modification of the Stuivenberg Hospital Acute Renal Failure (SHARF) scoring system for the prognosis of acute renal failure: an independent multicentre, prospective study. Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association - *European Renal Association*, 19(9), 2282–2288. https://doi.org/10.1093/ndt/gfh364

22) H. Neveu, D. Kleinknecht, F. Brivet, P. Loirat, and P. Landais, "Prognostic factors in acute renal failure due to sepsis. Results of a prospective multicentre study," *Nephrology Dialysis Transplantation*, vol. 11, no. 2, pp. 293–299, 1996

23) Bouchard J., Soroko SB., Chertow GM., Himmelfarb J., Ikizler TA., Paganini EP. Et al. . Fluid accumulation, survival and recovery of kidney function in critically ill patients with acute kidney injury, *Kidney Int*. 2009 Aug;76(4):422-7

24) Mehta RL., McDonald B., Gabbai FB., Pahl M., Pascual MT., Farkas A. et al. . Continuous vs. intermittent dialysis for acute renal failure in the ICU: Results from a randomized multicenter trial, *Kidney Int*. 2001 Sep;60(3):1154-63

25) Bell JS, James BD, Al-Chalabi S, Sykes L, Kalra PA, et al. . Community- versus hospital-acquired acute kidney injury in hospitalized COVID-19 patients. *BMC Nephrol*. 2021 Jul 23;22(1):269. doi: 10.1186/s12882-021-02471-2. PMID: 34301204; PMCID: PMC8299737.

26) Duarte, I., Gameiro, J., Resina, C., & Outerelo, C. (2020). In-hospital mortality in elderly patients with acute kidney injury requiring dialysis: a cohort analysis. *International urology and nephrology*, 52(6), 1117–1124. https://doi.org/10.1007/s11255-020-02482-2

27) Lu, R. H., Fang, Y., Gao, J. Y., Cai, H., Zhu, M. L., Zhang, et al. . Zhongguo wei Zhong bing ji jiu yi xue, *Chinese critical care medicine*. Zhongguo weizhongbing jijiuyixue, 23(7), 413–417.

28) Ejaz, T., Butt, B., Raja, K. M., & Abbass, M. (2021). Outcomes and Predictors of In-hospital Mortality in Critically Ill Acute Kidney Injury Patients: A Tertiary Care Center Experience. *Saudi Journal of kidney diseases and Transplantation: an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia*, 32(6), 1736–1743. https://doi.org/10.4103/1319-2442.352436

29) Abebe A, Kumela K, Belay M, Kebede B, Wobie Y. Mortality and predictors of acute kidney injury in adults: a hospital-based prospective observational study. *Sci Rep*. 2021 Aug 2;11(1):15672. doi: 10.1038/s41598-021-94946-3. PMID: 34341369; PMCID: PMC8329200

30) Nakhoul Gn., Huang H., Arrigain S., Jolly Se., Schold Jd., Nally Jv Jr., Et al. ., Serum Potassium, End-Stage Renal Disease, and Mortality İn Chronic Kidney Disease, *Am J Nephrol.* 2015;41(6):456-63

31) Foley RN, Chen SC, Solid CA, Gilbertson DT, Collins AJ. Early mortality in patients starting dialysis appears to go unregistered. *Kidney Int*. 2014;86(2):392-398. doi:10.1038/ki.2014.15

32) Arif, F. M., Sumida, K., Molnar, M. Z., Potukuchi, P. K., Lu, J. L., et al. . Early Mortality Associated with Inpatient versus Outpatient Hemodialysis Initiation in a Large Cohort of US Veterans with Incident End-Stage Renal Disease. *Nephron*, 137(1), 15–22. https://doi.org/10.1159/000473704

33) Oliver MJ., Callery SM., Thorpe KE., Schwab SJ., Churchill DN., Risk of bacteremia from temporary hemodialysis catheters by the site of insertion and duration of use: a prospective study. *Kidney Int* 2000; 58: 2543-2545