

Impact of Nephrology Follow-Up on Survival and Clinical Outcomes in Patients Initiating Emergency Dialysis

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ABSTRACT

This study aimed to evaluate the clinical and laboratory characteristics of patients presenting with emergency dialysis requirements and to assess the impact of nephrology follow-up on patient outcomes. In this retrospective study, patients who were given an emergency hemodialysis indication in the emergency department were divided into two groups according to the presence or absence of nephrology follow-up within the past year. Dialysis indications, laboratory findings, mortality rates, and transition to routine dialysis were analyzed. The most common indications for emergency dialysis were severe metabolic acidosis and elevated creatinine levels. The 28-day mortality rate was significantly lower in patients with nephrology follow-up (16.2% vs. 36.2%, $p=0.001$). The transition rate to routine hemodialysis was also higher in this group ($p=0.024$). However, there was no statistically significant difference between the groups regarding 90-day mortality or hospital readmission rates. Regular nephrology follow-up reduces short-term mortality and increases the transition to planned dialysis in patients requiring emergency dialysis. However, more effective monitoring and early intervention strategies are needed to improve long-term outcomes.

Keywords: Emergency dialysis, Hemodialysis, Acute kidney injury, Chronic kidney disease, Nephrology follow-up, Mortality, Clinical outcomes.

Acil Diyaliz Başlangıcında Nefroloji İzleminin Sağlık ve Klinik Sonuçlar Üzerindeki Rolü

ÖZET

Bu çalışma, acil diyaliz gereksinimi ile başvuran hastaların klinik ve laboratuvar özelliklerini, nefroloji takibinin hasta sonuçları üzerindeki etkisini değerlendirmeyi amaçlamaktadır. Bu retrospektif çalışmada, acil serviste acil hemodiyaliz endikasyonu konulan hastalar, son bir yıl içinde nefroloji takibi bulunup bulunmamasına göre iki gruba ayrılarak karşılaştırılmıştır. Diyaliz endikasyonları, laboratuvar bulguları, mortalite oranları ve rutin diyaliz geçişleri analiz edilmiştir. Acil diyaliz endikasyonları arasında en sık ağır metabolik asidoz ve kreatinin yüksekliği saptanmıştır. Nefroloji takibi olan hastalarda 28 günlük mortalite oranı anlamlı olarak daha düşük bulunmuştur (%16,2 vs. %36,2, $p=0,001$). Rutin hemodiyaliz programına geçiş oranı nefroloji takibi olan grupta daha yüksek bulunmuştur ($p=0,024$). Ancak 90 günlük mortalite ve yeniden hastaneye yatış oranlarında gruplar arasında anlamlı fark izlenmemiştir. Düzenli nefroloji takibi, acil diyaliz gereksinimi olan hastalarda kısa dönem mortaliteyi azaltmakta ve planlı diyaliz geçişini artırmaktadır. Ancak uzun dönem sonuçlar için daha etkin izlem ve erken müdahale stratejilerine ihtiyaç vardır.

Anahtar Kelimeler: Acil diyaliz, Hemodiyaliz, Akut böbrek hasarı, Kronik böbrek hastalığı, Nefroloji takibi, Mortalite, Klinik sonuçlar.

Acute kidney injury (AKI) is a clinical syndrome characterized by a rapid decline in renal function occurring within hours or days across a broad etiological spectrum, leading to a decrease in

glomerular filtration rate (GFR) and accumulation of nitrogenous waste products in the blood¹. In AKI, as in chronic kidney disease (CKD), renal replacement therapy (RRT) becomes vital in specific clinical conditions. Hemodialysis indications include volume overload resistant to diuretics, Hyperkalemia unresponsive to medical therapy, Refractory metabolic acidosis, encephalopathy, pericarditis, or bleeding diathesis².

Hemodialysis is a treatment method based on the exchange of fluids and solutes between the patient's blood and a suitable dialysis solution via a semipermeable membrane. Aiming to restore fluid and solute balance to physiological limits³. According to the European Renal Association-European Dialysis

Date Received: 22.May.2025

Date Accepted: 20.July.2025

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and Transplant Association (ERA-EDTA). RRT was initiated in 81,327 end-stage renal disease (ESRD) cases in 2015, corresponding to an incidence rate of 119 per million populations⁴.

Although hospitalization rates among ESRD patients have declined, a significant increase in emergency department visits has been observed. Individuals with renal failure are approximately eight times more likely to present to the emergency department compared to the general population⁵. Repeated emergency visits by dialysis patients not only impose an additional financial burden on the healthcare system but also negatively affect service planning in emergency departments⁶. According to a study conducted in the United States, healthcare expenditures for dialysis patients amount to approximately \$36 billion annually, accounting for 7.2% of total healthcare costs⁷.

Emergency departments are the primary units where patients diagnosed with AKI receive intensive treatment. Patients not receiving regular dialysis or nephrology follow-up and presenting with AKI constitute a critical patient group.

Among RRT modalities, approximately 85% of patients undergo hemodialysis, 10% peritoneal dialysis, and 5% kidney transplantation. Mortality rates are particularly high in patients requiring emergency medical intervention with hemodialysis, reaching around 50%⁸.

Limited studies in the existing literature indicate that this patient group is associated with intensive utilization of medical resources and high healthcare costs. To minimize this burden, identifying the clinical characteristics of patients presenting to the emergency department and determining potential preventive measures are of great importance. This study aims to evaluate the demographic, clinical, and laboratory findings of patients who presented to the emergency department and were determined to require emergency dialysis. It also analyzes the outcomes of their treatment processes. The literature shows a lack of descriptive studies focusing on patients requiring emergency hemodialysis due to AKI or exacerbations of CKD. This study aims to contribute to the literature by providing a detailed analysis of the clinical characteristics of this specific patient group.

Material and Method

This retrospective cohort study was conducted to examine the demographic and clinical characteristics of patients who presented to our emergency department between January 2022 and September 2023 and were diagnosed with an emergency hemodialysis indication following nephrology

consultation. Ethical approval was obtained from the local Ethics Committee (KAEEK-2023-21/11).

Our hospital is a tertiary-level training and research hospital, receiving approximately 700,000 emergency admissions annually. It includes a 24-hour operational hemodialysis center, and bedside dialysis can also be performed in emergency and intensive care units.

All patients who underwent dialysis via central venous catheterization in the emergency department during the specified period were retrospectively reviewed. Data on patients' age, gender, history of chronic diseases, and dialysis indications were retrieved from the hospital's digital records. Patients were divided into two groups based on the presence or absence of nephrology follow-up and a known diagnosis of CKD: Group 1: Patients with nephrology follow-up within the past year, whose renal function was monitored by nephrology or internal medicine outpatient clinics and who were planned for RRT but had not yet started. Group 2: Patients without nephrology follow-up or not considered RRT candidates prior to emergency admission.

Dialysis indications identified in the emergency department and laboratory results requested by the attending physician were recorded for both groups. Differences between the groups were evaluated in terms of dialysis indications, laboratory findings, hospitalization requirements in hospital 28-day and 90-day mortality rates as well as adverse cerebrovascular and cardiac events. Additionally, the inclusion of patients in routine hemodialysis programs and the need for recurrent hospitalization were assessed.

Inclusion criteria: Patients aged 18 years or older who presented to the emergency department during the specified period were evaluated by emergency medicine specialists as requiring hemodialysis, underwent nephrology consultation, received an emergency hemodialysis indication from a nephrologist and underwent dialysis during their emergency follow-up. Patients lacking sufficient clinical information and those already receiving routine hemodialysis were excluded from the study.

Statistical Analysis

Statistical analyses were performed using SPSS 15.0 for Windows. Descriptive statistics were presented as frequency and percentage for categorical variables and as mean, standard deviation, minimum, maximum and median for numerical variables. Since the assumption of normal distribution was not met, the Mann-Whitney U test was used to compare numerical variables between groups. The chi-square test was used for comparisons of categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Among the 278 patients included in the study, 53.6% (n=149) were male and 46.4% (n=129) were female, with a mean age of 66.6 ± 15.8 years (range: 1–100 years). Diabetes mellitus was observed in 13.7% (n=38), hypertension in 16.5% (n=46) and malignancy in 2.1% (n=6) of patients. The proportion of patients with nephrology follow-up within the last year was 21.8% (n=67). The most common indications for emergency dialysis were severe metabolic acidosis (40.7%, n=113) and elevated creatinine (26.7%, n=74). Table I summarizes the patients' demographic characteristics and distribution of dialysis indications.

Table I. Demographic Characteristics and Dialysis Indications of Patients Presenting with Emergency Dialysis Requirement

Gender n (%)	Male	149 (53.6)
	Female	129 (46.4)
Age Mean.±SD (Min-Max)		66.6±15.8 (1-100)
Comorbidities n (%)	Diabetes mellitus	38 (13.7)
	Hypertension	46 (16.5)
	Coronary artery disease	17 (6.1)
	Chronic Renal Failure	209(75.2)
	Congestive Heart Failure	16 (5.7)
	Asthma/COPD	4 (1.4)
	Malignancy	6 (2.1)

Although patients with nephrology follow-up constituted a smaller portion of all dialysis indications, the majority of those requiring emergency dialysis did not have any nephrology follow-up. Refractory metabolic acidosis was identified as the most common dialysis indication, present in 15.9% of patients with nephrology follow-up and in 84.1% of those without. Elevated creatinine was the second most frequent indication, observed in 32.4% of patients with

nephrology follow-up and in 67.6% of those without. All patients who underwent dialysis due to uremic symptoms belonged to the group without nephrology follow-up (Table II).

Uremic symptoms were only identified in patients without a history of chronic kidney disease (CKD) (4.2%, $p<0.001$). Refractory metabolic acidosis was the most frequent indication in both groups with rates of 24.3% in patients with known CKD and 35.8% in those without. When comparing laboratory results between patients with and without nephrology follow-up, the significant differences were observed. Patients with nephrology follow-up had significantly higher white blood cell counts, neutrophil counts and IG values ($p<0.01$). Furthermore, eGFI levels were significantly lower and creatinine levels were notably higher in this group ($p<0.001$).

Although hemoglobin (Hb) and hematocrit (HCT) levels were lower in patients with nephrology follow-up, the difference approached but did not reach statistical significance. There were no significant differences between the groups in serum sodium, potassium or calcium levels. In terms of blood gas parameters, patients with nephrology follow-up had significantly lower PO_2 levels ($p=0.001$), while there were no significant differences in pH and HCO_3 levels. Lactate levels were significantly lower in patients with nephrology follow-up ($p<0.001$). Laboratory parameter distributions are presented in Table III.

Significant differences were identified in mortality and enrollment in routine dialysis programs between the two groups. The 28-day mortality rate was 14.9% in the nephrology follow-up group and 39.8% in the non-follow-up group, with this difference being statistically significant ($p=0.001$). However, 90-day mortality rates were 40.3% and 54% respectively, which did not reach statistical significance ($p=0.127$) (Table IV).

Table II. Association Between Emergency Dialysis Indications, Nephrology Follow-Up, and Known CKD History

Emergency Dialysis Indication	Nephrology Follow-Up		Known chronic kidney disease history		Previous Dialysis History	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)
Uremic symptoms (encephalopathy, bleeding, pericarditis)	0 (0.0%)	9 (100%)	1 (11.1%)	8 (88.9%)	0 (0.0%)	9 (100%)
Volume overload (dyspnea, distension)	13 (31.7%)	28 (68.3%)	13 (31.7%)	28 (68.3%)	2 (4.9%)	39 (95.1%)
Refractory metabolic acidosis	18 (15.9%)	95 (84.1%)	19 (16.8%)	94 (83.2%)	1 (0.9%)	112 (99.1%)
Hyperkalemia	10 (27.8%)	26 (72.2%)	9 (25.0%)	27 (75.0%)	0 (0.0%)	36 (100%)
Hypertensive urgency	2 (40.0%)	3 (60.0%)	3 (60.0%)	2 (40.0%)	0 (0.0%)	5 (100%)
Elevated creatinine	24 (32.4%)	50 (67.6%)	22 (29.7%)	52 (70.3%)	2 (2.7%)	72 (97.3%)

Table III. Relationship Between Nephrology Follow-Up Within the Last Year and Laboratory Parameters

	Nephrology Follow-Up (Past Year)						
	Yes			No			p
	Median	IQR		Median	IQR		
WBC (×10 ³ /μL)	10.09	7.48	13.47	12.95	9.055	18.03	0.001
NEUT (×10 ³ /μL)	7.93	5.43	11.65	10.33	6.26	15.285	0.006
NEUT%	79.8	74.6	88.7	82.55	72.88	88.2	0.650
LYMPH (×10 ³ /μL)	0.9	0.67	1.32	1.17	0.68	2.03	0.012
LUMPH%	9.4	5.5	15	9.15	5.425	17.1	0.764
HgB (g/dL)	9.6	8.1	11.2	9.95	8.6	12.5	0.064
HCT (%)	29.5	24.2	33.4	30.7	26.2	37.7	0.061
PLT (×10 ³ /μL)	256	195	323	238	176.75	325.75	0.645
IG%	0.65	0.4	1.375	1	0.6	1.775	0.002
IG (×10 ³ /μL)	0.07	0.03	0.14	0.13	0.07	0.31	0.001
Urea (mg/dL)	164.6	117.1	247.6	147.35	79.98	226.7	0.211
BUN (mg/dL)	76.9	54.7	115.7	68.6	37.3	105.1	0.175
Creatinine (mg/dL)	6.32	4.135	9.39	3.97	1.5	8	<0.001
eGFR	7.9	5	11.675	12.4	5.1	37.125	0.001
Calcium (mg/dL)	8.4	7.6	9.1	8.5	7.7	9.1	0.885
Sodium (mmol/L)	137	132	139	136.5	131	141	0.656
Potassium (mmol/L)	5.2	4.5	6.2	5	4.1	6	0.152
PH	7.28	7.19	7.34	7.25	7.12	7.34	0.082
PO2 (mmHg)	31.4	24.9	45	42	28.9	69.1	0.001
pCO2 (mmHg)	37.6	30.4	43.9	35.9	28.1	42.5	0.362
HCO3 (mmol/L)	17.2	13	22.8	16	10.375	21.7	0.091
Base excess (mmol/L)	-9.1	-14.2	-3.3	-10.7	-18.2	-4.15	0.083
Lactate (mmol/L)	1	0.5	1.6	1.8	0.8	4.7	<0.001

WBC = White Blood Cell. NEUT – neutrophils; NEUT% – neutrophil percentage; LYMPH – lymphocytes; LYMPH% – lymphocyte percentage; HgB – hemoglobin; HCT – hematocrit; PLT – platelets; IG – immature granulocytes; IG% – immature granulocyte percentage; BUN – blood urea nitrogen; eGFR – estimated glomerular filtration rate; PO₂ – partial pressure of oxygen; PCO₂ – partial pressure of carbon dioxide; HCO₃ – bicarbonate;

Table IV. Association Between Nephrology Follow-Up (Past Year) and Mortality and Patient Outcomes

	Nephrology Follow-Up				
	Yes		No		p
	n	%	n	%	
28 day mortality	10	14.9%	84	39.8%	0.003
90 day mortality	27	40.3%	114	54.0%	0.069
Readmission within 90 days	15	22.4%	38	18%	0.537
Enrollment in routine HD program	11	16.4%	20	9.5%	0.177

Chi-square Test

The rate of enrollment in routine hemodialysis programs was 16.4% in the nephrology follow-up group versus 9.5% in the other group and this difference was statistically significant ($p=0.024$). In contrast, 90-day readmission rates were 22.4% and 18% respectively. With no significant difference ($p=0.618$).

There were statistically significant differences in 28-day and 90-day mortality rates based on the type of emergency dialysis indication ($p<0.001$ and $p=0.001$, respectively). The 28-day mortality rate was highest in cases of severe metabolic acidosis and hyperkalemia (Table V).

Table VI. Association Between Emergency Dialysis Indications and Mortality. Readmission. and Routine Hemodialysis

Emergency Dialysis Indication	28 day mortality		90 day mortality		90 day readmission		Routine Hemodialysis Program	
	n	%	n	%	n	%	n	%
Uremic symptoms	3	33.3%	3	33.3%	2	22.2%	0	0.0%
Volume overload	9	22.0%	21	51.2%	5	12.2%	7	17.1%
Severe metabolic acidosis	59	52.2%	72	63.7%	23	20.4%	12	10.6%
Hyperkalemia	9	25.0%	19	52.8%	8	22.2%	2	5.6%
Hypertensive urgency	0	0.0%	0	0.0%	1	20.0%	0	0.0%
Elevated creatinine	14	18.9%	26	35.1%	14	18.9%	10	13.5%
	<0.001		0.001		0.911		0.064	

Among the 278 patients included in the study. 24.1% ($n=67$) had a known history of CKD. Although 85% ($n=57$) of these patients had received nephrology follow-up in the past year, only 7.4% ($n=5$) had a planned dialysis schedule. The remaining 62 patients (92.6%) were not enrolled in a dialysis program despite nephrology follow-up and had to initiate dialysis in the emergency department. As a result, all

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67 patients with a CKD history received their first dialysis in the emergency department.

Discussion and Conclusion

Acute kidney injury and exacerbations of chronic kidney disease (CKD) account for a significant portion of emergency department visits and frequently necessitate the initiation of hemodialysis under urgent rather than planned conditions. This scenario directly impacts both patient survival and the utilization of healthcare resources. Recent studies have shown that early nephrology follow-up and planned dialysis transitions can reduce mortality and decrease complication rates. However, evidence regarding the effectiveness of this process in current clinical practice remains limited. In this study, we compared the demographic characteristics, clinical findings, and outcomes of patients who presented with emergency dialysis needs to assess the role and effectiveness of nephrology follow-up.

The average age of patients presenting with emergency hemodialysis needs was 66.6 years, indicating a higher demand for such interventions among the elderly population. Similarly, Han et al. reported in their systematic review that age is a determining factor in emergency department use among chronic hemodialysis patients, with a mean age above 65 years⁵. The predominance of male patients in our study is consistent with U.S. database analyses, which also identify male gender as more common in CKD^{9,10}. The prevalence of diabetes and hypertension as comorbidities aligns with known etiologies of CKD and is also supported by European dialysis reports⁴. However, the fact that only 21.8% of patients were under nephrology follow-up in the past year suggests either delayed diagnosis or insufficient regular monitoring.

Severe metabolic acidosis was the most common indication for emergency dialysis in our study, consistent with findings in the literature^{11,12}. Nevertheless, some studies have identified hyperkalemia and volume overload as more frequent reasons for dialysis initiation in emergency settings¹³. This discrepancy may reflect the patient profile of our institution and possibly systemic gaps in monitoring, which allow metabolic imbalances to progress to critical levels. These findings indicate areas for improvement not only at the individual but also at the organizational level.

It was noted that patients under nephrology follow-up represented a minority of emergency dialysis cases, while patients without follow-up frequently presented with severe metabolic derangements. The dominance of life-threatening conditions such as refractory metabolic acidosis in the non-follow-up group

supports the view that regular nephrology follow-up can prevent critical clinical consequences, not just biochemical imbalances. Previous studies have also shown that nephrology follow-up is associated with lower hospital admission and complication rates⁷. Similarly, systematic reviews have indicated that patients under regular dialysis follow-up present to emergency departments mainly due to technical issues rather than metabolic complications¹⁴. Our finding that all patients undergoing dialysis for uremic symptoms were from the non-follow-up group supports this observation.

Interestingly, uremic signs and symptoms were observed only in patients without a history of CKD. This suggests that dialysis needs in these individuals become apparent only after reaching a symptomatic stage, resulting in delayed intervention. This observation highlights the importance of early diagnosis. As AKI and CKD exacerbations can trigger systemic inflammation and organ dysfunction¹⁵. The fact that refractory metabolic acidosis was the most frequent dialysis indication in both groups suggests that follow-up alone may not suffice in preventing metabolic deterioration under current healthcare practices.

Higher levels of WBC, neutrophils and IG in patients under follow-up may indicate a higher incidence of inflammatory or infectious conditions. Moreover, the lower eGFR and higher creatinine levels in this group suggest that nephrology follow-up is more commonly performed in patients with advanced disease stages.

Although hemoglobin and hematocrit levels were lower in patients under nephrology follow-up, the differences were not statistically significant. This may reflect the more advanced CKD stage in this group. The lack of significant differences in electrolyte levels between the groups indicates a comparable metabolic burden at presentation. It has been previously noted that electrolyte imbalances support the decision to initiate dialysis but are not sufficient as standalone indicators^{16,17}.

Blood gas analysis showed that PO₂ levels were significantly lower in patients with nephrology follow-up, possibly reflecting greater pulmonary dysfunction or anemia. Singbartl and Joannidis have emphasized that tissue oxygenation capacity declines in progressive kidney disease, contributing to systemic complications¹. Conversely, higher lactate levels in patients without follow-up may indicate more pronounced circulatory stress and hypo perfusion. Han et al. have reported that lactate levels have prognostic value in emergency admissions and are associated with increased mortality^{18–20}.

The significantly lower 28-day mortality in patients with nephrology follow-up highlights the protective effect of early nephrology intervention on short-term survival. This finding is supported by a study by Fang

et al. which demonstrated that fluid overload prior to continuous RRT increased 28-day mortality in sepsis-associated AKI²¹. The importance of early intervention and appropriate fluid management is thus underscored. Additionally, the elevated 28-day mortality observed in our patients who started dialysis emergently aligns with findings from other studies, which report a 28-day mortality rate of 22.7% in such cases²².

However, the lack of significant difference in 90-day mortality suggests that mid-term outcomes are influenced not only by follow-up but also by comorbidities and continuity of care. This highlights the need for a comprehensive patient management strategy to improve long-term survival.

The significantly higher rate of enrollment in routine dialysis programs among patients with nephrology follow-up demonstrates the role of monitoring in facilitating planned dialysis transitions. Previous reports also emphasize the positive effect of planned dialysis initiation on survival⁴. Nonetheless, the absence of significant differences in 90-day hospital readmission rates suggests that long-term outcomes depend on more complex factors. Cardiovascular and infectious complications are among the most common causes of readmissions in dialysis patients. Approximately 34% of dialysis patients hospitalized for cardiovascular events are readmitted within 30 days, and only 43% of these readmissions are due to cardiovascular causes, indicating a multifactorial etiology²².

Finally, it was observed that most patients with a known history of CKD who were under nephrology follow-up had not been enrolled in a routine dialysis program and underwent their first dialysis session in the emergency department. This finding implies that the mere presence of nephrology follow-up is insufficient; rather, the effectiveness of the follow-up process is what matters. Without a proactive approach to dialysis planning in high-risk individuals, emergency admissions and complication rates are likely to increase. Therefore, prioritizing not only outpatient monitoring but also proactive dialysis planning is essential in the management of CKD.

Regular nephrology follow-up plays a critical role in reducing short-term mortality and promoting planned transition to dialysis in patients requiring emergency dialysis. Our study shows that patients without nephrology monitoring present with more severe clinical conditions, particularly life-threatening metabolic derangements. However, the mere presence of follow-up is not sufficient; what is essential is the effectiveness of the monitoring process and proactive planning. To improve long-term outcomes, comprehensive patient management strategies, including early nephrology engagement and timely RRT planning, must be integrated into clinical practice.

Researcher Contribution Statement:

Idea and design: S.E.; Data collection and processing: E.D.; Analysis and interpretation of data: S.E., E.D.; Writing of significant parts of the article: E.D.

Support and Acknowledgement Statement:

None applicable.

Conflict of Interest Statement:

There is no conflict of interest between authors

Ethics Committee Approval Information:

Approving Committee: UNIVERCITY OF HEALTH SCIENCE TURKEY, BURSA SEHİR TRAINING AND RESEARCH HOSPITAL ETHICALS COMİTEE

Approval Date: 11/2023

Decision No: KAEK-2023-21/11

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