

# Evaluation of patients receiving hemodialysis in an emergency service

## Acil serviste hemodiyaliz alan hastaların değerlendirilmesi

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### Abstract

**Aim:** Acute kidney injury (ARH) is an important emergency with high mortality and morbidity depending on patient characteristics, comorbidity and clinical situation. Rapid recognition of acute renal failure (ARF) and initiation of renal replacement therapy (RRT) is one of the most important factors determining the survival of these patients. The initiation of RRT in the emergency department depends on the correct indications in the critical patient, the correct use of resources and effective nephrological follow-up. This study aims to determine the hemodialysis indications of patients undergoing hemodialysis for the first time in the emergency service and to investigate the effect of this application on routine hemodialysis and survival.

**Methods:** We carried out a retrospective cohort study with patients who underwent hemodialysis for the first time by central venous catheterization in the emergency service between January 01, 2019 and December 31, 2019. Age, gender, presence of chronic disease, symptoms and laboratory values of the patients were recorded from the patient files in the hospital automation system. Data regarding the hospitalization or discharge of the patients after emergency hemodialysis were collected. Patient follow-up was carried out from the patient records, and the nephrology follow-ups were examined for 3 months after emergency hemodialysis. Their routine hemodialysis and 28-day mortality were evaluated.

**Results:** A total of 185 patients were included in the study. 55.1% of the patients (n=102) were male and the mean age was 65.63 (15.92) years. While 49.2% (n=91) of the patients were included in the routine hemodialysis program, mortality developed in 22.7% (n=42) on the 28<sup>th</sup> day. No statistically significant relationship was found between the current systemic diseases, hemodialysis indications and undergoing routine hemodialysis program (P=0.327, P=0.45).

**Conclusion:** Although there was no statistically significant relationship between the dialysis indications of the patients and their inclusion in the routine dialysis program, emergency hemodialysis is an important procedure. The clinical condition and laboratory values of the patients should be evaluated synchronously. Physicians should not be late in initiating hemodialysis in the follow-up and treatment of electrolyte disorders and intoxications; the treatment of the patient should be decided as quickly as possible.

**Keywords:** Emergency departments, Dialysis, Acute kidney injuries, Hyperkalemia

### Öz

**Amacı:** Akut renal hasar (ARH) hasta karakteristiklerine, komorbiditesine ve klinik durumuna bağlı olarak yüksek mortalite ve morbiditeye sahip önemli bir acildir. Akut böbrek yetmezliğinin (ABY) hızla tanınması, renal replasman tedavisinin (RRT) başlanması, bu hastaların hayatta kalımını belirleyen önemli unsurlardan biridir. RTT'nin acil serviste başlanması ise kritik hastada doğru endikasyonların konulmasına, kaynakların doğru kullanımına ve nefrolojik takibin etkin şekilde sağlanmasına bağlıdır. Bu çalışmanın amacı acil serviste ilk kez hemodiyaliz alan hastaların hemodiyaliz endikasyonlarını belirlemek ve bu uygulamanın hastaların rutin hemodiyalize alınması ve sağ kalımları üzerine etkisini araştırmaktır.

**Yöntemler:** 01 Ocak 2019- 31 Aralık 2019 tarihleri arasında acil serviste santral kateterizasyon işlemi yapılan ve hemodiyaliz uygulanan hastalar retrospektif olarak incelendi. Hastalara ait yaş, cinsiyet, kronik hastalık varlığı, acile geliş semptomları, laboratuvar değerleri hastane otomasyon sisteminde kayıtlı hasta dosyaları üzerinden kaydedildi. Hastaların acil hemodiyaliz sonrası hastaneye yatış ya da taburculuklarına ait veriler toplandı. Hasta kayıtlarından hasta takibi gerçekleştirilerek hastaların acil diyaliz alımı sonrası 3 aylık sürede nefroloji poliklinik takipleri incelenerek rutin hemodiyaliz programına alınmaları ve 28 günlük mortaliteleri değerlendirildi. 18 yaş üzerinde olup acil serviste kateterizasyonu sağlanarak ilk diyalizi acilde serviste alan hastalar çalışmaya dahil edildi.

**Bulgular:** Çalışmaya toplam 185 hasta dahil edildi. Hastaların %55,1'i (n=102) erkek olup ortalama yaş 65,63 (15,92) olarak saptandı. Hastaların %49,2'si (n=91) sonrasında rutin hemodiyaliz programına alınırken, %22,7'sinde ise (n=42) 28. günde mortalite geliştiği gözlemlendi. Hastaların mevcut sistemik hastalıkları ve hastaların diyalize alınma endikasyonları ile rutin hemodiyaliz programına alınması arasında da istatistiksel olarak anlamlı bir ilişki saptanmadı (P=0,327, P=0,45).

**Sonuç:** Bu çalışmada her ne kadar hastaların diyalize alınma endikasyonları ile rutin diyaliz programına alınmaları arasında istatistiksel olarak anlamlı bir ilişki çıkmamasına rağmen acil hemodiyaliz önemli bir prosedürdür ve hastanın klinik tablosu ve laboratuvar değerleri eş zamanlı değerlendirilmelidir. Özellikle elektrolit bozuklukları ve intoksikasyonların takip ve tedavisinde hemodiyaliz için geç kalınmaması ve hastanın tedavisine hızla karar verilmelidir.

**Anahtar kelimeler:** Acil servisi, Diyaliz, Akut böbrek hasarı, Hiperkalemi

## Introduction

Acute renal injury (ARI) is an important emergency with high mortality and morbidity depending on patient characteristics, comorbidity and clinical status [1]. These patients may be admitted to emergency services with different specific or nonspecific symptoms. A quick diagnosis of acute renal failure (ARF) and the initiation of renal replacement therapy (RRT) are important in determining the survival of these patients. While the RIFLE classification is frequently used in the definition of ARI, the KDIGO (Kidney Disease; Improving Global Outcomes) classification that regulates all the classifications was published in 2012 [2].

According to KDIGO, if any of the following criteria is fulfilled, it is defined as ARI.

1. At least 0.3 mg / dl decrease in absolute serum creatinine (SCr) level within the last 48 hours
2. 1.5 and above decrease in absolute serum creatinine level in the last 7 days compared to basal value
3. Having urine output below 0.5ml / kg / hour for 6 hours

The start time of the RRT is controversial. The results of studies conducted in terms of the effects of early and late RRT on patients' mortality are contradictory [3, 4]. There are data about early RRT application being effective in relieving inflammatory factors that play an important role in ARI development. This can stop renal damage and reduce mortality. Simultaneously, it can remove foreign bodies that aggravate renal damage [5].

Starting RRT in the emergency service depends on the correct indications in the critical patient, the correct use of the resources and the effective provision of nephrology follow-up [6]. In determining the need for emergency hemodialysis in patients diagnosed with ARI in the emergency room, the presence of uremic symptoms is very important. Although the indications for starting RRT are quite controversial, the currently accepted indications are hypervolemia not responding to conservative treatment, hyperkalemia (potassium [K] $>$  6.5 mg / dl), metabolic acidosis, the presence of uremic symptoms (uremic pericarditis, uremic encephalopathy, bleeding disorders, nausea, vomiting and itching), and having blood urea nitrogen (BUN)  $>$  100 mg / dl [7]. Hemodialysis in the emergency room is an important treatment option in patient management in poisoning with lipid-soluble drugs such as salicylate, methanol, theophylline, phenobarbital, carbamazepine, which are highly bound to proteins and have a high dispersion volume [8,9].

It is possible to encounter prerenal azotemia, which often develops because of volume loss, in the emergency room. Increased arterial pressure secondary to intravascular volume loading, especially as in cardiorenal syndrome, in patients with congestive heart failure, may result also in ARI [10]. In the presence of this loading, emergency hemodialysis remains viable as a vital treatment modality.

The aim of our study is to determine the demographic features and hemodialysis indications of patients who received hemodialysis for the first time in the emergency room and to investigate the effect of this application on routine hemodialysis and survival of patients.

## Materials and methods

Patients who underwent central catheterization and hemodialysis for the first time in our emergency service between January 01, 2019 and December 31, 2019 were examined in this retrospective cohort study. Ethical approval was obtained From Bursa Yuksek Ihtisas Trainig and Research Hospital Ethics Committee before the study (2011-KAEK-25 2020/03-07). Patients' age, gender, presence of chronic illness and emergency symptoms were recorded via the patient automation system. Potassium, calcium, BUN, creatinine values were recorded in the biochemical tests while PH, lactate, base and anion deficit values were recorded in the blood gas analysis of the patients in the emergency department. The reasons for emergency dialysis were grouped based on clinical findings, vital signs, and laboratory values. Data regarding the hospitalization or discharge of the patients after emergency hemodialysis were collected. Patient follow-up was carried out from the patient records. Examining nephrology follow-up for 3 months after emergency dialysis, routine hemodialysis and 28-day mortality of the patients were evaluated. Patients over 18 years of age who received the first dialysis by catheterization in the emergency room were included in the study. The presence of ARI was evaluated based on the KDIG classification. Chronic renal failure (CRF) cases, patients under 18 years of age, those who received routine hemodialysis and needed additional dialysis in the emergency room and pregnant women were excluded from the study. Emergency hemodialysis was performed on 1126 patients in one year. A total of 907 patients were excluded from the study because they were followed-up with the diagnosis of CRF, which included former nephrology follow-up, and had a history of peritoneum or hemodialysis. Of the remaining 219 patients, 34 others were excluded from the study for various other reasons (Figure 1).

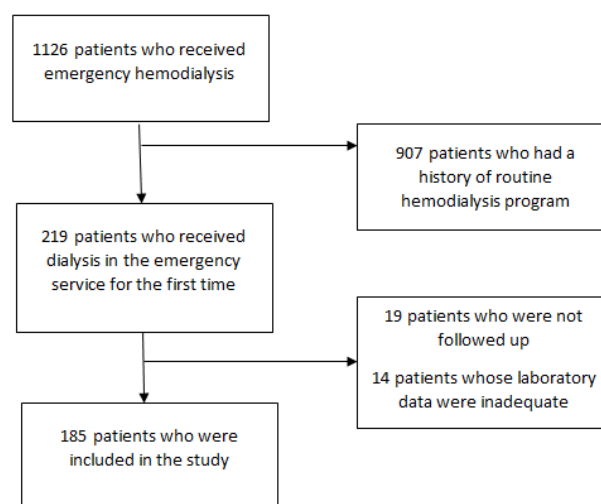


Figure 1: Identifying the cohort

## Statistical analysis

The data of the study were analyzed using SPSS for Windows (22.0) software. All values were shown as the mean and standard deviation (SD). Kolmogorov-Smirnov test was used for the normality of data. Independent sample t-test was used to test whether there was a statistically significant difference between the two independent groups by examining the means. The one-way ANOVA test was used to investigate whether there were any significant differences compared to the mean of more than two independent groups. Chi-square and Fisher's exact tests

were used to analyze whether there was a relationship between categorical variables. Parametric variables were analyzed with Pearson test; non-parametric variables were analyzed with Spearman test. *P*-values <0.05 were considered statistically significant.

### Results

A total of 185 patients were included in the study. Among them, 55.1% (n=102) of the patients were male while 44.9% (n=83) were female, and the mean age was 65.63 (15.92) years. The mean BUN was 79.99 (0.30) mg / dL, and the mean serum potassium level was 5.31(1.35) mEq / L (Table 1). The most common comorbidities in patients were hypertension (25.4%) and heart failure (16.2%). The most common indication of dialysis was hypervolemia (29.7%) and metabolic acidosis (22.2%) (Table 2).

While 49.2% (n=91) of patients were included in the routine hemodialysis program, mortality developed in 22.7% (n=42) on 28th day (Table 3).

No statistically significant relationship was found in the chi-square analysis performed to analyze the relationship between the gender of patients and their inclusion in the routine hemodialysis program (*P*=0.153). Similarly, no statistically significant relationship was found between the current systemic diseases of patients and the indications for dialysis, and their inclusion in routine hemodialysis program (*P*=0.327, *P*=0.45) (Table 4).

There was no statistically significant relationship between the patients' inclusion in the routine hemodialysis program and 28-day mortality (*P*=0.905).

In the independent sample t test performed to analyze the difference between 28-day mortality and the mean laboratory values, a statistically significant difference was found between 28-day mortality and BUN values (Table 5).

Table 1: Distribution of variables

n=185	Minimum	Maximum	Mean (SD)
Age	23	93	65.63(15.92)
BUN	195	236.4	79.9 (40.30)
GFR	1.17	129	13.47(16.81)
Potassium	2.4	9.4	5.31(1.35)
Creatinine	0.31	25.71	6.51(3.82)
Calcium	4.25	15.93	8.27(1.34)
PH	6.91	7.56	7.28(0.12)
Lactate	0.2	14.1	2.51(2.43)
BE	-25.3	9.3	-7.67(7.26)
Anion gap	-9.8	29.11	7.25(5.77)

BUN: Blood urea nitrogen, GFR: Glomerular filtration rate

Table 2: Systemic disease and dialysis indication data of patients

Comorbid diseases	Frequency	Percent
No	24	13
Hypertension	47	25.4
Diabetes Mellitus	21	11.4
Malignancy	19	10.3
Coronary artery diseases	14	7.6
Heart failure	30	16.2
COPD	11	5.9
Cerebrovascular Disease	6	3.2
Other	13	7
Total	185	100
Dialysis indications	Frequency	Percent
Metabolic acidosis	41	22.2
Hyperkalemia	34	18.4
Uremic encephalopathy	31	16.8
Hypervolemia	55	29.7
Pericardial effusion	4	2.2
Hypercalcemia	6	3.2
Intoxication	2	1.1
Contrast nephropathy	12	6.5
Total	185	100

Table 3: Data regarding the status of patients

Variables	Yes		No	
	n	%	n	%
Routine hemodialysis program inclusion	91	49.20%	94	50.80%
28-day mortality	42	22.70%	143	77.30%

Table 4: Relationship between current systemic disease, hemodialysis indication and inclusion of routine dialysis program

		n	Routine dialysis program inclusion		Total	Chi-Square Analysis
			Yes	No		
Systemic Disease	No	n	15	9	24	X <sup>2</sup> =9.184 P=0.327
		%	16.50%	9.60%	13.00%	
	HT	n	20	27	47	
		%	22.00%	28.70%	25.40%	
	DM	n	12	9	21	
		%	13.20%	9.60%	11.40%	
	Malignancy	n	8	11	19	
		%	8.80%	11.70%	10.30%	
	Coronary artery diseases	n	10	4	14	
		%	11.00%	4.30%	7.60%	
	Heart failure	n	13	17	30	
		%	14.30%	18.10%	16.20%	
	COPH	n	5	6	11	
%		5.50%	6.40%	5.90%		
CVD	n	4	2	6		
	%	4.40%	2.10%	3.20%		
Other	n	4	9	13		
	%	4.40%	9.60%	7.00%		
hemodialysis indication	Metabolic acidosis	n	22	19	41	X <sup>2</sup> =6.800 P=0.450
		%	24.20%	20.20%	22.20%	
	Hyperkalemia	n	13	21	34	
		%	14.30%	22.30%	18.40%	
	Uremic encephalopathy	n	14	17	31	
		%	15.40%	18.10%	16.80%	
	Hypervolemia	n	30	25	55	
		%	33.00%	26.60%	29.70%	
	Pericardial effusion	n	1	3	4	
		%	1.10%	3.20%	2.20%	
	Hypercalcemia	n	4	2	6	
		%	4.40%	2.10%	3.20%	
	Intoxication	n	0	2	2	
%		0.00%	2.10%	1.10%		
Contrast nephropathy	n	7	5	12		
	%	7.70%	5.30%	6.50%		
Total	n	91	94	185		
	%	100.00%	100.00%	100.00%		

Table 5: Analysis of the data regarding 28-day mortality and laboratory values

	mortality	n	Mean (SD)	<i>P</i> -value
Creatinine	yes	42	6.31(4.23)	0.699
	no	143	6.57(3.71)	
BUN	yes	42	93.64(48.27)	0.033
	no	143	75.98(36.88)	
GFR	yes	42	11.33(8.28)	0.351
	no	143	14.09(18.56)	
Potassium	yes	42	5.39(1.41)	0.637
	no	143	5.28(1.34)	
Calcium	yes	42	8.56(1.69)	0.110
	no	143	8.18(1.21)	
PH	yes	42	7.26(0.13)	0.175
	no	143	7.29(0.11)	
Lactate	yes	42	3.18(3.01)	0.090
	no	143	2.31(2.20)	
BE	yes	42	-8.99(7.68)	0.181
	no	143	-7.28(7.11)	
Anion gap	yes	42	8.76(6.26)	0.054
	no	143	6.81(5.56)	

\*independent sample t test

### Discussion

Investigating the age, gender and concomitant diseases of the patients who were diagnosed with ARI in the emergency department and who were taken to emergency hemodialysis are crucial. In a study conducted by Bektaş et al. [7], the mean age of patients diagnosed with ARF in the emergency service was 63.7 (15.9) years and 57% were male. In another study by Golestaneh et al. [11], the mean age of patients who received hemodialysis in the emergency room was 61.6 (15.0) years and 56.8% were male. In our study, age and gender data were consistent with the literature. Race and geography play a role in comorbid diseases associated with renal failure. In a study conducted in our country, the most common comorbid disease associated with renal failure was hypertension [12]. Similarly, in the studies conducted in Africa, the most common comorbid disease was hypertension

[13,14]. In a study conducted in Canada, the most common comorbid diseases in patients receiving hemodialysis were diabetes mellitus (DM) and coronary artery disease [15]. In another study in the United States, it was found that hemodialysis inclusion was more common in black and Hispanic people, and the most common comorbidities in this population were DM and heart failure [11]. In our study, hypertension was the most frequent, followed by heart failure, which is consistent with the literature.

There are studies showing that early hemodialysis decreases mortality especially in the presence of septic table in patients with ARF. Carl et al. [16] used BUN level in early hemodialysis decision in their study. They evaluated patients undergoing hemodialysis with a BUN value below 100 mg/dL in the early dialysis class and found a significant difference in mortality compared to late dialysis. In our study, a significant correlation was found between 28-day mortality and BUN values.

In patients with cardiac insufficiency, shortness of breath that develops secondary to hypervolemia is a frequent reason for emergency admittance. Emergency hemodialysis in these patients provides significant relief in patients' symptoms, but often causes routine dialysis needs. In a study carried out jointly in 24 hemodialysis centers in Spain using cardiac loading for the treatment, it was reported that early hemodialysis had an important effect on intensive care hospitalization and survival [17]. In addition, in another study with 2308 patients, 185 ARF cases were examined and late dialysis was found to extend the length of stay in intensive care units [18]. In this study, in the patients who underwent hemodialysis due to hypervolemia, 54.5% needed to be included in the routine hemodialysis program, however, no significant decrease was obtained in data regarding mortality. To exclude renal dysfunction in the emergency department, a single blood sample is not always sufficient; the need for hemodialysis appears to be independent of creatinine, especially in electrolyte disorders according to the clinical condition of the patient. In patients with cardiac involvement and resistant hyperpotassemia, there is an urgent need for hemodialysis in the treatment of high potassium, regardless of the creatinine values [19,20]

In our study, hyperkalemia is an important indication of hemodialysis and 34 patients underwent hemodialysis for K<sup>+</sup> lowering therapy. The need for routine hemodialysis did not develop in the follow-up of 61.7% of these patients. Hyperpotassemia, an emergency with high mortality, was effectively treated. Similarly, in hypercalcemia and hypermagnesemia, emergency hemodialysis should be kept in mind in treatment-resistant cases [21,22]. In our study, 6 patients underwent emergency hemodialysis due to hypercalcemia.

Another important indication of emergency hemodialysis is intoxications. Treatment in poisoned patients includes the steps of vital support, dealing with organ dysfunction and removal of suspected toxins. In addition to enteric decontamination, lipid therapy after the use of antidotes is also on the agenda. Hemodialysis, on the other hand, is an important mechanism for extracorporeal drug removal, which is common in the world. It has been used successfully in medications, as well as metals such as arsenic and mercury

[23,24]. In our study, although we only have 2 cases of intoxication, we think that effective and regular hemodialysis use is important in patient survival regardless of starting routine hemodialysis.

Contrast nephropathy is an important cause of ARF that develops as a result of contrast-containing procedures. In studies conducted, contrast nephropathy appears due to basal values of patients and comorbid diseases, and the need for urgent hemodialysis develops in 9.9% [12,23]. In our study, a total of 12 patients underwent hemodialysis with a pre-diagnosis of contrast nephropathy, and seven were included in the routine hemodialysis program. It is significant in terms of showing that contrast nephropathy may play a role in irreversible renal damage and the patient should be closely monitored after contrasting procedures.

### Limitations

There are some limitations in this study. As our patients were retrospectively examined, we had data loss. As a result of the central catheterization of our patients, we did not have the opportunity to follow the dialysis activities. In routine nephrology follow-ups, changes in the indications for dialysis and underlying pathologies for existing renal damage could not be followed.

### Conclusion

Emergency hemodialysis is an important procedure and the patient's clinical condition and laboratory values should be evaluated simultaneously. The physicians should not be late for initiating hemodialysis in the follow-up and treatment of electrolyte disorders and intoxications. Treatment of the current clinical condition and providing nephrology follow-up may prevent morbidity in patients and constitute a major step for renal replacement treatments.

Consequently, although there was no statistically significant relationship between the indications for dialysis inclusion and routine dialysis program, more than half of the patients were not included in the routine hemodialysis program. This issue should be studied in further prospective multicenter studies.

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