Research Article / Araştırma Makalesi

Effect of Continuous Renal Replacement Therapy on Mortality in the Intensive Care Unit: A Retrospective Analysis

Yoğun Bakım Ünitesinde Uygulanan Sürekli Renal Replasman Tedavisinin Mortalite üzerine Etkisi: Retrospektif Analiz

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Abstract

Background: In this study, we aimed to retrospectively evaluate the demographic data, clinical diagnoses, laboratory values and scoring systems that may be effective in predicting mortality in patients undergoing continuous renal replacement therapy (CRRT) in our intensive care unit.
Materials and Methods: The data of patients who underwent CRRT in our tertiary intensive care unit were retrospectively analyzed. Digital archive data of Intensive Care Units, patients' medical history, laboratory results and nurse observation forms were analyzed. Acute Physiology and Chronic Health Evaluation II (APACHE II), Glasgow Coma score (GCS), Sequential Organ Failure Assessment (SOFA), Crp/Albumin ratio were analyzed at four time points (during ICU admission, before CRRT, after CRRT and discharge) and their effects on mortality were compared.
Results: A total of 107 patients were included in our study between 2017 and 2022 and 101 of these cases resulted in mortality. The change in CRP/Albumin values and GCS scores after CRRT compared to before CRRT was not significant ($p>0.05$), but the decrease in APACHE II ($p<0.01$) and SOFA ($p<0.01$) scores were found to be significant in predicting mortality. No significant difference was found in terms of gender and body mass index measurements, use of inotropic agents, length of intensive care unit stay, length of hospital stay and comorbidities ($p>0.05$). However, age was found to be a risk factor for mortality ($p<0.01$).
Conclusion: Although CRRT is performed in intensive care unit patients for many underlying causes and can improve APACHE II and SOFA scores, no statistically significant relationship was found between CRP/Albumin ratio in predicting the effect of CRRT on mortality

Key Words: Continuous renal replacement therapy, Acute kidney injury, Intensive care, CRP/Albumin ratio

Öz

Amaç: Bu çalışmada yoğun bakım ünitemizde sürekli renal replasman tedavisi (SRRT) uygulanan hastaların demografik verilerini, klinik tanılarını ve mortaliteyi öngörmede etkili olabilecek laboratuvar değerlerini ve skorlama sistemlerini retrospektif olarak değerlendirmeyi amaçladık**.**
Materyal ve Metod: Üçüncü basamak yoğun bakım ünitemizde SRRT uygulanan hastaların verileri retrospektif olarak incelendi. Yoğun Bakım Üniteleri'ne ait dijital arşiv verileri, hastaların doktor anamnezi, laboratuvar sonuçları ve hemşire gözlem formları incelendi. Hastalara dört zaman diliminde (yoğun bakım yatışında, SRRT öncesinde, SRRT sonrası ve taburculuk) Acute Physiology and Chronic Health Evaluation II (APACHE II), Glaskow Koma skoru (GKS), Sequential Organ Failure Assessment (SOFA), Crp/Albümin oranı incelenip, mortaliteye olan etkileri karşılaştırıldı.
Bulgular: Çalışmamıza 2017-2022 yılları arasında toplam 107 hasta dahil edildi ve bu olguların 101'i mortalite ile sonuçlanmıştır. SRRT öncesine göre SRRT sonrası CRP/Albümin değerlerinde ve GKS skorlarında değişim anlamlı bulunmamış ($p>0,05$), ancak APACHE II ($p<0,01$), ve SOFA ($p<0,01$) skorlarındaki düşüşün ise mortaliteyi öngörmede anlamlı bulunmuştur. Mortaliteye göre olguların cinsiyeti ve vücut kitle indeksi ölçümleri, inotropik ajan kullanımı, yoğun bakımda yatış süresi, hastanede kalış süresi ve ek hastalık açısından anlamlı fark bulunmadı ($p>0,05$). Ancak yaşın mortalite açısından risk faktörü olduğu saptandı ($p<0,01$).
Sonuç: SRRT yoğun bakım hastalarında birçok altta yatan sebep nedeniyle uygulanmakta, APACHE II ve SOFA skorlarını iyileştirebilmekle beraber; CRP/Albümin değerinin SRRT işleminin mortalite üzerindeki etkisini öngörmede istatiksel olarak anlamlı bir ilişki bulunamamıştır.

Anahtar Kelimeler: Sürekli renal replasman tedavisi, Akut böbrek hasarı, Yoğun bakım, CRP/Albümin

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Introduction

Renal failure is a common problem in patients in intensive care units. Renal replacement therapies (RRT) are needed for the treatment of this pathological condition characterized by decreased renal function. Inotropic agents are needed in the follow-up of patients diagnosed with acute or chronic renal failure because hypotension is common. Patients may not be able to undergo intermittent hemodialysis due to unstable hemodynamics. For this reason, continuous renal replacement therapies (CRRT), which allow long-term treatment even at very low blood flow rates, are more popularly used today (1).

C Reactive Protein (CRP) and albumin are important parameters for assessing mortality and morbidity in critically ill patients (2,3). The ratio of CRP to albumin has been used to predict the course of diseases such as sepsis or septic shock, especially in recent years, and it is thought to be related to mortality (4). Crp/Albumin ratio effectively indicates both malnutrition and inflammation and is a useful biochemical parameter in predicting prognosis in severely ill patients (5).

Due to the high cost of CRRT and the high mortality rate among patients with severe acute kidney injury, many studies have been conducted on mortality scoring systems and factors that may influence them to carefully identify patients who would benefit from CRRT (6,7).

In our study, we aimed to retrospectively evaluate the demographic data, clinical diagnoses, laboratory values and scoring systems that may be effective in predicting mortality in patients who underwent CRRT in our 3rd level intensive care unit between 2017 and 2022.

Materials and Methods

This study was planned retrospectively and the approval of Harran University Clinical Research Ethics Committee (decision dated 08.08.2022 and numbered 2022/15/05) was obtained before the study.

A total of 107 patients over the age of 18 who were hospitalized in the intensive care unit of the Department of Anesthesiology and Reanimation, Harran University Research and Application Hospital between 01.01.2017 and 31.12.2022 and underwent CRRT were included in the study.

CRRT initiation and termination decisions were determined according to the patient's clinical condition and acute kidney injury scoring systems (RIFLE and KDIGO).

Digital archive data, laboratory results and observation forms of the patients were analyzed. Demographic characteristics of the patients (gender, age, height and weight), comorbidities, reasons for intensive care unit hospitalization, use of inotropic agents, nutritional status, and mechanical ventilation needs were analyzed. Discharge and mortality status of the patients were evaluated. The total length of stay in the intensive care unit and hospital (days), the number and duration of CRRT sessions (hours), and the amount of fluid used in the CRRT procedure (ml) were recorded.

APACHE II, GKS, SOFA, acute kidney injury scoring systems (RIFLE and KDIGO) and laboratory values were evaluated in 4 time periods (intensive care unit admission, pre-CRRT, post-CRRT and discharge). Crp/albumin ratio was calculated by dividing Crp by albumin.

Statistical analysis

NCSS (Number Cruncher Statistical System) 2020 Statistical Software (NCSS LLC, Kaysville, Utah, USA) was used for statistical analysis of the data obtained. Quantitative variables were represented by mean, standard deviation, median, min and max values, and qualitative variables were represented by descriptive statistical methods such as frequency and percentage. Shapiro Wilks test and Box Plot graphs were used to evaluate the conformity of the data to normal distribution.

Student t-test was used for quantitative two-group evaluations with normal distribution and Mann Whitney-U test was used for those without normal distribution. Srise Chi-Square test, Fisher Exact test and Fisher's Freeman Halton test were used to compare qualitative data. In intragroup comparisons, Repeated Measures test was used for variables with normal distribution and Bonferroni test was used for post hoc comparisons; Friedman test was used for variables without normal distribution and Bonferoni Dunn test was used for post hoc comparisons. The results were evaluated at 95% confidence interval and significance was evaluated at $p<0.05$ level.

Results

The study was conducted in Harran University Research and Application Hospital between 01.01.2017 and 31.12.2022 with a total of 107 patients, 43% (n=46) female and 57% (n=61) male.

The mean age of the included patients was 66.00 ± 16.00 years (min:19, max:93) (Table 1).

When the indications for intensive care unit hospitalization were analyzed; 28% (n=30) COVID-19 pneumonia, 23.4% (n=25) respiratory failure, 21.5% (n=23) cardiac arrest, 9.3% (n=10) cerebrovascular accident, 7.5% (n=8) general condition disorder, 1.9% (n=2) alcohol intoxication, 0.9% (n=1) acute renal failure, 0,9% (n=1) aortic aneurysm, 0.9% (n=1) encephalitis, 0.9% (n=1) food poisoning, 0.9% (n=1) ileus, 1.9% (n=2) heart failure, 0.9% (n=1) postoperative care after liver transplantation and 0.9% (n=1) myocardial infarction. Of the cases, 5.6% (n=6) were discharged and 94.4% (n=101) were exitus (Table 1).

Inotropic agents were not used in 17.8% (n=19), 43.9% (n=47) used norepinephrine, 5.6% (n=6) used dopamine and 32.7% (n=35) used norepinephrine and dopamine together, 97.2% (n=104) were followed up with mechanical ventilation and 2.8% (n=3) did not need mechanical ventilation (Table 2).

Table 1. Distribution of Descriptive Characteristics of Patients and Reasons for Intensive Care Unit Hospitalization

		n (%)	*Mean ± SD Median (Min-Max)*
Gender	**Female**	46 (43,0)	
	Male	61 (57,0)	
Age (years)			66,00 ± 16,00
			69 (19 - 93)
Height (cm) (n=36)			169,72 ± 7,851
			170 (160 - 190)
Weight (kg) (n=36)			77,31 ± 15,291
			76,50 (60 - 120)
BMI (n=36)			26,79 ± 4,82
			25,35 (20,76 - 41,52)
Reason for intensive care admission	**AKI**		1 (0,9)
	Alcohol intoxication		2 (1,9)
	Aortic aneurysm		1 (0,9)
	COVID-19		30 (28,0)
	Encephalitis		1 (0,9)
	General condition disorder		8 (7,5)
	Food poisoning		1 (0,9)
	Ileus		1 (0,9)
	Heart failure		2 (1,9)
	Liver transplant		1 (0,9)
	Cardiac arrest		23 (21,5)
	Myocardial infarction		1 (0,9)
	Cerebrovascular event		10 (9,3)
	Respiratory failure		25 (23,4)
Discharge status	**Discharged**		6 (5,6)
	Exitus		101 (94,4)

SD: standard deviation; min: minimum; max: maximum; BMI: body mass index; AKI: Acute kidney injury; cm: centimeter; kg: kilogram COVID-19: Coronavirus disease 19

Table 2. Characteristics of Patients Receiving Continuous Renal Replacement Therapy

		n (%)	*Mean±Sd*
Use of inotropic agents (during CRRT)	**No**	19 (17,8)	
	Norepinephrine	47 (43,9)	
	Dopamine	6 (5,6)	
	Norepinephrine/dopamine	35 (32,7)	
Need for mechanical ventilation (during CRRT)	**Yes**	104 (97,2)	
	No	3 (2,8)	
Duration of intensive care unit stay (days)			27,00 ± 29,00
			16 (2 - 176)
Length of hospital stay (days)			30,00 ± 31,00
			18 (2 - 176)
Number of CRRTs			2,00 ± 2,00
			1 (1 - 14)
CRRT duration (hours)			46,00 ± 52,00
			32 (2 -310)
Nutrition (during CRRT)	**None**	22 (20,6)	
	Enteral	73 (68,2)	
	Parenteral	8 (7,5)	
	Enteral and Parenteral	4 (3,7)	

CRRT: continuous renal replacement therapy; SD: standard deviation; min: minimum; max: maximum;

Table 3. Comparison of APACHE II, GCS, SOFA Scores and Crp/Albumin Values According to Intensive Care Unit Hospitalization, Before-Post CRRT and Discharge

	APACHE II Score	
	Mean±SD	**Median (Min-Max)**
[1]Intensive care hospitalization	22,00 ± 9,00	23 (2 - 39)
[2] Before CRRT	31,00 ± 6,00	32 (11 - 42)
[3] After CRRT	29,00 ± 6,00	29 (9 - 44)
[4] Discharged	30,00 ± 7,00	31 (0 - 44)
P	*[a]0,001***	
Change Δ	Mean±SD	*P*
1-2	9,70 ± 8,94	*[aa]0,001***
1-3	7,55 ± 9,47	*[aa]0,001***
1-4	8,98 ± 9,92	*[aa]0,001***
2-3	-2,15 ± 4,76	*[aa]0,001***
2-4	-0,72 ± 5,40	*[aa]1,000*
3-4	1,43 ± 3,63	*[aa]0,001***
	GCS	
	Mean±SD	**Median (Min-Max)**
[1]Intensive care hospitalization	9,00 ± 5,00	8 (3 - 15)
[2] Before CRRT	5,00 ± 3,00	3 (1 - 15)
[3] After CRRT	5,00 ± 3,00	3 (3 - 15)
[4] Discharged	4,00 ± 3,00	3 (3 - 15)
P	*[b]0,001***	
Change Δ	Mean±SD	*P*
1-2	-4,20 ± 5,02	*[bb]0,001***
1-3	-4,37 ± 5,21	*[bb]0,001***
1-4	-5,32 ± 5,77	*[bb]0,001***
2-3	-0,18 ± 1,87	*[bb]0,634*
2-4	-1,12 ± 2,96	*[bb]0,001***
3-4	-0,94 ± 2,23	*[bb]0,005***
	SOFA Score	
	Mean±SD	**Median (Min-Max)**
[1]Intensive care hospitalization	6,00 ± 3,00	6 (0 - 11)
[2] Before CRRT	10,30 ± 2,10	11 (3 - 14)
[3] After CRRT	9,70 ± 2,30	10 (3 - 15)
[4] Discharged	11,70 ± 2,70	12 (0 - 17)
P	*[b]0,001***	
Change Δ	**Mean±SD**	***P***
1-2	4,62 ± 3,22	*[bb]0,001***
1-3	4,09 ± 3,39	*[bb]0,001***
1-4	6,01 ± 3,60	*[bb]0,001***
2-3	-0,53 ± 1,61	*[bb]0,001***
2-4	1,39 ± 1,85	*[bb]0,001***
3-4	1,93 ± 1,07	*[bb]0,001***
	Crp/Albumin	
	Mean±SD	**Median (Min-Max)**
[1]Intensive care hospitalization	2,76 ± 2,50	2,4 (0 - 8,5)
[2] Before CRRT	6,14 ± 4,44	5,2 (0,1 - 22,2)
[3] After CRRT	5,59 ± 4,13	4,6 (0,1 - 20,2)
[4] Discharged	7,86 ± 10,84	6,7 (0 - 107,9)
P	*[b]0,001***	
Change Δ	**Mean±SD**	***P***
1-2	3,37 ± 4,91	*[bb]0,001***
1-3	2,83 ± 4,68	*[bb]0,001***
1-4	5,10 ± 10,92	*[bb]0,001***
2-3	-0,54 ± 4,06	*[bb]0,234*
2-4	1,73 ± 10,71	*[bb]0,354*
3-4	2,27 ± 10,11	*[bb]0,034**

*a: Repeated Measures Test & aa Bonferroni Test & b Friedman Test &bb Dunn's test with Bonferroni correction **p<0.01 CRRT: Continuous Renal Replacement Therapy, APACHE II: Acute Physiology and Chronic Health Evaluation II, GCS: Glasgow Coma score, SOFA: Sequential Organ Failure Assessment, Mean: mean; SD: standard deviation; min: minimum; max: maximum*

Table 4. Diagnostic Screening Tests and ROC Curve Results for Crp/Albumin (Intensive Care Hospitalization) by Mortality

Diagnostic Screening						ROC Curve		
	Cut- off	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive	Alan	95% Confide nce	
Crp/Albu min								

Crp/Albumin (Intensive Care Hospitalization)				
				p
		< 0,41 (n=29)	> 0,41 (n=78)	
Use of inotropes	No	4 (14,3)	15 (19,0)	*d0,775*
	Yes	24 (82,8)	64 (81,0)	
Duration of intensive care unit stay (days)	*Mean±Ss*	37,00 ± 39,00	24,00 ± 24,00	*c0,171*
	Median (Min-			
Length of hospital stay (days)	*Mean±Ss*	38,00 ± 39,00	27,00 ± 28,00	*c0,256*
	Median (Min- Max)			
Additional disease	No	8 (28,6)	15 (19,0)	*g0,289*
	There is	20 (71,4)	64 (81,0)	
Discharge Status	Discharged	4 (14,3)	2 (2,5)	*d0,039**
	Eks	24 (85,7)	77 (97,5)	

*cMann-Whitney-U Testd Fisher Exact Test *p<0.05 **p<0.01*

Table 5. Comparison of Age, Sex, and Body Mass Index by Mortality

		Mortality		P
		Discharged (n=6)	Exitus (n=101)	
Age (years)	*Ort±Ss*	43,00±13,00	67,00±15,00	***c0,001***
	Medyan (Min-Maks)	45 (28-61)	70 (19-93)	
Gender	**Kadın**	2 (33,3)	44 (43,6)	***d0,698***
	Erkek	4 (66,7)	57 (56,4)	
BMI	*Ort±Ss*	23,83±0,55	26,96±4,91	***c0,350***
	Medyan (Min-Maks)	23,8 (23,4-24,2)	25,9 (20,8-41,5)	

*cMann-Whitney-U Test dFisher Exact Test **p<0,01 BMI: Body Mass Index*

Table 6. Comparison of Variables by Mortality

		Mortality		P
		Discharged (n=6)	Exitus (n=101)	
Use of inotropes	**No**	3 (50,0)	16 (15,8)	***d0,068***
	Yes	3 (50,0)	85 (84,2)	
Duration of intensive care stay (days)	*Ort±Ss*	23,00±12,00	27,00±30,00	***c0,735***
	Medyan (Min-Maks)	27 (5-33)	15 (2-176)	
Length of hospital stay (days)	*Ort±Ss*	31,00±19,00	30,00±32,00	***c0,448***
	Medyan (Min-Maks)	33 (8-58)	18 (2-176)	
Comorbidity	**No**	2 (33,3)	21 (20,8)	***d0,607***
	Yes	4 (66,7)	80 (79,2)	

cMann-Whitney-U Test dFisher Exact Test

The mean length of intensive care unit stay was 27.00 ± 29.00 days (min:2, max:176); the mean length of hospital stay was 30.00 ± 31.00 days (min:2, max:176); the mean number of CRRT sessions was 2.00 ± 2.00 (min:1, max:14); the mean amount of CRRT fluid used was 1675.00 ± 2708.00 ml; the mean duration of CRRT was 46.00 ± 52.00 hours (min:2; max: 310) hours.

The change in Crp/Albumin values and GCS scores after CRRT compared to before CRRT was not significant (p>0.05), but the decrease in APACHE II (p=0.001; p<0.01) and SOFA (p=0.002; p<0.01) scores was significant (Table 3). No significant difference was found in terms of gender and body mass index measurements, use of inotropic agents, duration of intensive care unit stay (days), duration of hospitalization and comorbidities (p>0.05). When Crp/Albumin ratio was evaluated according to mortality, the change in Crp/Albumin values of the patients in the exitus group before (p=0.014; p<0.05) and after (p=0.003; p<0.01) CRRT was statistically significantly higher than the discharge group (p=0.014; p<0.05) (Figure-1).

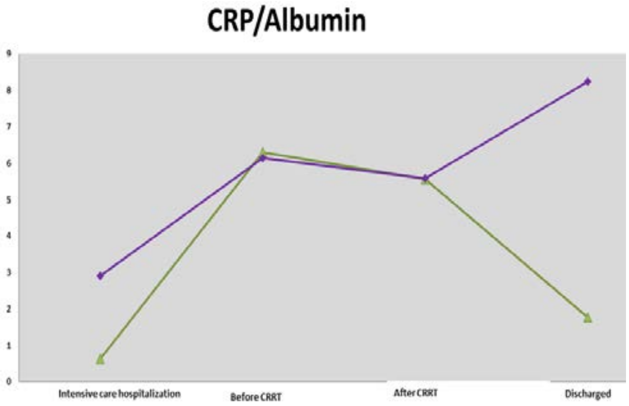

Figure 1. Distribution of Crp/Albumin values according to mortality (*CRRT: Continuous Renal Replacement Therapy)*

In the ROC analysis of Crp/Albumin ratio (intensive care unit admission) according to mortality, 0.41 was accepted as the cut-off value (sensitivity 76.24%; specificity 83.33%; positive predictive value 98.70% and negative predictive value 17.20%). Patients with a Crp/Albumin ratio above 0.41 (95% CI: 1.106-37.227; AUC: 77.1%) had a 6.417-fold higher mortality risk (95% CI: 1,106-37,227) (p=0.039; p<0.05) (Table 4) (Figure 2), while there was no statistically significant difference (p>0.05) with age, gender, use of inotropic agents, duration of intensive care unit stay (days), duration of hospitalization and comorbidity status of the patients according to the value of 0.41 (Table 4).

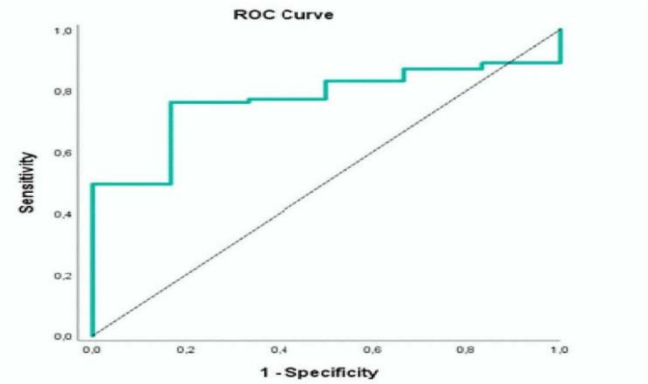

Figure 2. ROC curve for Crp/Albumin (Intensive Care Hospitalization) by Mortality

When the demographic variables of the patients were compared according to mortality; the age of the patients with exitus was found to be statistically significantly higher than those who were discharged (p=0.001; p<0.01), but there was no significant difference in terms of gender and body mass index (p>0.05) (Table 5).

According to mortality, inotrope use, length of intensive care unit stay, length of hospital stay, and comorbidity status were not statistically significant (p>0.05) (Table 6).

Discussion

In this study, we aimed to retrospectively evaluate patients who underwent CRRT in our intensive care unit in terms of mortality. 101 of a total of 107 patients in our study resulted in mortality.

Several studies have investigated the impact of RRT on mortality in critically ill patients. It was found that CRRT was associated with shorter survival within 60 days and longer duration of mechanical ventilation and vasopressor support compared to intermittent hemodialysis (IHD). This association persisted after adjustment for confounders through propensity scores methods. The study also showed that the difference in outcome was mainly due to the poorer outcome of less severely ill patients allocated to CRRT compared to those allocated to IHD (4).

It is known that the frequency of acute kidney injury (AKI) in patients hospitalized in intensive care units is as high as 50%. In case of severe AKI, RRT is performed at rates ranging between 8-23.5% (8). Another study analyzed the survival of patients who required CRRT in a surgical intensive care unit. The study found that the overall mortality rate was 53.7%, and that the duration of CRRT did not independently correlate with mortality(9).

In 2015, Hoste et al. reported the prevalence of AKI in intensive care units as 57.3% in the AKI-EPI study on AKI in seriously ill patients. In the same study, they found that the need for RRT was around 23.5% (8).

Wang et al. investigated the efficacy of APACHE II and SOFA scoring to predict the prognosis of critically ill patients undergoing CRRT for AKI. They found that the mean APACHE II score was 27.53 ± 7.9 and the mean SOFA score was 12.51 ± 3.52 and that the SOFA score was positively correlated with mortality in these patients, but there was no significant correlation between APACHE II score and mortality (10). In a similar study, the mean APACHE II score at admission to the intensive care unit was 26.1 and the mean SOFA score was 11.58 in patients who underwent CRRT (11).

Gjyzari et al. reported that APACHE II score did not change significantly before and after CRRT in terms of mortality in patients undergoing CRRT (7).

In our study, the mean APACHE II score was 22.00 ± 9.00 during intensive care unit hospitalization and 31.00 ± 6.00 before CRRT; the mean SOFA score was 6.00 ± 3.00 during intensive care unit hospitalization and 10.30 ± 2.10 before CRRT. In our study, no relationship could be established between APACHE II score during intensive care unit hospitalization and mortality. However, the APACHE II scores of the patients in the exclusion group before CRRT, after CRRT and at discharge were statistically significantly higher than those of the discharged patients. In our study, the SOFA scores of the patients before intensive care unit hospitalization and CRRT did not differ statistically according to mortality. In our study, there was no statistical difference in Crp/Albumin values of patients before and after CRRT according to mortality. However, we found that mortality increased in patients with a Crp/Albumin ratio above 0.41 during intensive care unit admission.

Bellomo et al. found that 82.5% of all patients undergoing

CRRT received vasopressor support during treatment (12). In our study, when the use of inotropic agents in patients who underwent CRRT was analyzed, 17.8% (n=19) did not use inotropes, 43.9% (n=47) used norepinephrine, 5.6% (n=6) used dopamine and 32.7% (n=35) used both norepinephrine and dopamine together. Since vasopressin was not available in our hospital, only norepinephrine and dopamine were used.

When we examined the literature in terms of treatment duration, Claure et al. reported that serious patients who underwent CRRT had a mean treatment duration of 24 hours(13). In our study, the duration of treatment was 46.00 ± 52.00 hours.

Age is a parameter in the APACHE II system and is considered an important risk factor independent of disease severity (14). In our study, we found that the ages of the patients who were exitus were statistically significantly higher than those who were discharged.

Intensive care mortality is significantly increased in the presence of AKI, mortality can be up to 90% in cases where CRRT is needed (15). In this regard, mortality was evaluated in the ELAIN study evaluating severe patients who underwent CRRT with a diagnosis of AKI and mortality was found in 47.1% of 231 patients included in the study(16). In our study, the mortality rate in patients who underwent CRRT was 94.4%. The reasons for the high mortality rate in our study were the high APACHE II, GCS and SOFA scores at the time of intensive care unit admission, the fact that the majority of the patients received inotropic agents and mechanical ventilation support, the high number of comorbidities, and the fact that the study was conducted in a tertiary intensive care unit.

In a study conducted in Korea on patients hospitalized in intensive care between 2015 and 1017, it was found that high Crp/Albumin ratio was associated with increased mortality and morbidity in intensive care patients (17). Karagöz et al. found that high Crp/Albumin ratio values had 72% sensitivity and 70% specificity in predicting mortality in the intensive care unit population in their study in intensive care unit patients (18). In a study conducted in hypertensive COVID- 19 patients, the Crp/Albumin ratio was found to be significantly higher in patients with exitus compared to survivors ($p<0.001$)(19). In another similar study, it was reported that Crp/Albumin ratio could be used as an independent predictor of in-hospital mortality in the same patient group (20).

Our study has some limitations. First, the study was planned retrospectively. The mortality rate of 94.4% and the inability to perform subgroup analyses also limited the examination of mortality-related parameters. Complications related to CRRT were not evaluated in our study due to insufficient data.

Beyond the retrospective evaluation of patients receiving CRRT hospitalized in the intensive care unit, we aimed to provide a detailed perspective on CRRT application in the light of the information in the literature. We think that our study may be a guide for different parameters in terms of mortality and morbidity in the application of CRRT in intensive care units.

In conclusion, CRRT is applied for many underlying reasons, and can improve APACHE II and SOFA scores in intensive care patients, although there is no statistically significant relationship in predicting the effect of CRP/Albumin ratio on mortality of CRRT procedure, also age is found as independent risk factor.

Ethical Approval: *This study was planned retrospectively and the approval of Harran University Clinical Research Ethics Committee (decision dated 08.08.2022 and numbered 2022/15/05) was obtained before the study.*

Author Contributions:
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