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TANAFFOS

Mortality Rate and Its Contributing Factors in Post-Surgical and Medical Patients with AKI Underwent CRRT

Fatemeh Yassari [1], Batoul Khoundabi [2,3], Farin Rashid Farokhi [4], Rajesh Chandra Mishra [5], Ahsina Jahan Lopa [6], Seyed MohammadReza Hashemian [1]

[1] Chronic Respiratory Diseases Research Center (CRDRC), National Research Institute of Tuberculosis and Lung Disease (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran, [2] Iran-Helal Institute of Applied Science and Technology, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran, [3] Research Center For Health Management in Mass Gathering, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran, [4] Telemedicine Research Center, NRITLD, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [5] Consultant Intensivist & Internist Ahmedabad Khyati Multi-Specialty Hospitals, Ahmedabad Shaibya Comprehensive Care Clinic, Ahmedabad, India, [6] Department of ICU and Emergency, Shahabuddin Medical College Hospital, Dhaka, Bangladesh

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Correspondence to: Hashemian SMR
Address: Chronic Respiratory Diseases Research Center (CRDRC), National Research Institute of Tuberculosis and Lung Disease (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran
Email address: iran.criticalcare@yahoo.com

Background: Acute kidney injury (AKI) requires continuous renal replacement therapy (CRRT), which is one of the most important problems in medical and surgical patients. Therefore, it is very important to identify the influencing factors to reduce the dimensions of the problem**.** This study was conducted to investigate the mortality rate in medical and surgical patients with AKI requiring CRRT treatment.

Materials and Methods: In this observational study, which was conducted as a cross-sectional analytical study, 100 patients with AKI requiring CRRT treatment, including medical and surgical patients, were selected from 2018 to 2021 at Masih Daneshvari Hospital. The mortality rate was estimated. Also, the effective factors were investigated and compared between the dead and surviving patients.

Results: 85 cases (85%) of the patients died. Most underlying and demographic variables had no statistically significant difference between the dead and surviving patients (P>0.05). However, in the cases of primary calcium (P=0.001), primary leukocyte (P=0.037), bicarbonate during hospitalization (P=0.025), bicarbonate during AKI (P=0.028), magnesium during hospitalization (P=0.038), and magnesium at the end of CRRT (P=0.019), the differences were statistically significant.

Conclusion: In conclusion, mortality is observed in 5 out of 6 patients with acute kidney failure who need CRRT treatment, which is related to risk factors such as bicarbonate, magnesium, leukocyte, and calcium levels. Therefore, multifaceted planning is needed to reduce its dimensions to improve the prognosis of this group of patients.

Keywords: Acute kidney injury (AKI); Continuous renal replacement therapy (CRRT); Mortality

INTRODUCTION

Acute kidney injury is a common and important complication in hospitalized patients so that 5 to 7 percent of hospitalized patients and 30 percent of patients in intensive care units (ICU) suffer from AKI. It leads to a significant increase in the number of hospital deaths, especially in people who are hospitalized in ICU in whom the death rate reaches 50 percent (1). AKI means an increase of at least 0.3 mg/dl in patients' creatinine or an increase of more than 50% in baseline values in a period of 24 to 48 hours or a decrease in urinary output to 0.5 cc/kg per hour for 6 hours (2). Azotemia is divided into 3 categories: pre-renal, renal, and post-renal. In many cases,

pre-renal and post-renal azotemia have a better prognosis than intra-renal cases (3).

Dialysis is necessary and essential when medical care fails to control volume increase, hyperkalemia, acidosis, decreased urinary output, and uremic complications such as stricture, pericardial effusion, encephalopathy, and uremic bleeding (3,4). Blood dialysis is performed for 3 to 4 hours a day and 3 to 4 times a week, but in critical patients, continuous renal replacement therapy (CRRT) is used to prevent blood pressure drop and rapid volume transfer.

In the CRRT method, a large volume of plasma is passed through a semi-permeable membrane using strong hydrostatic pressure (5). CRRT can also be done by the diffusion cleaning method, i.e., continuous veno-venous hemodialysis (CVVHD). It is a technology similar to blood dialysis but with a lower blood flow rate and lower dialysis flow (5).

Various studies with different results have been conducted in other countries to investigate CRRT effects (6-10). In a study conducted from 1978 to 1998 by Kellum et al., a comparison was made between the mortality of patients who underwent CRRT and those who underwent IRRT. A better condition was observed in patients who have undergone CRRT (6).

Schefold et al. in a prospective randomized controlled trial showed that the survival rate in RRT patients was 39.5% while in CRRT patients was 45%. Finally, it was recommended to perform CRRT in critically ill patients (7).

It has been found that a large percentage of patients who underwent cardiac surgery and suffered from AKI, have undergone CRRT, and it is recommended to prevent the death of patients after heart surgery by preventing complications (8).

In Iran, less research has been done in this field. At Masih Deneshvari Hospital, there is luckily access to CRRT due to major heart and lung transplant surgeries and numerous patients with lung problems who often require hospitalization in the ICU. The main goal of this study was to determine the mortality rate in patients with acute kidney injury (AKI) requiring CRRT treatment in medical and surgical patients and also identify factors affecting it from 2018 to 2021 at Masih Daneshvari Hospital.

MATERIALS AND METHODS

This was an observational study conducted as an analytical-cross-sectional investigation. The target population was all hospitalized patients over the age of 18 who suffered from AKI and underwent CRRT treatment. Exclusion criteria were patients who had ESRD and underwent chronic dialysis and CRRT for some reason. Based on the patient files in the archives of Masih Daneshvari Hospital, demographic data such as sex, age, creatinine level, urine output, arterial blood pH, history of kidney failure, history of diabetes mellitus, blood pressure, type of surgery (in case of previous surgery), and the cause of the medical problem was collected in a questionnaire. This study aimed to determine the mortality rate in patients with AKI under CRRT treatment and in patients with acute kidney injury (AKI) requiring CRRT treatment in medical and surgical patients comparing possible effective factors between two groups: dead and survived subjects.

Statistical Analysis

The data of this research were analyzed using SPSS version 24 software. Quantitative variables were summarized using mean and standard deviation (Mean±SD) and qualitative variables were summarized by frequency and percentage. Kolmogorov-Smirnov test was used to check the assumption of normality of quantitative variables. An Independent T-test was applied to compare the mean of quantitative variables between the two groups. The Chi-square test and Fisher's exact test were used to examine the relationship between categorical variables. The significance level of all tests was considered equal to 0.05.

RESULTS

One hundred AKI patients treated with CRRT were included in this study. Among them, 85 patients (85%)

died including 68 medical and 17 surgical patients. The mortality rate difference between the two groups of medical and surgical patients was 86.1 and 81.0, respectively, which is not statistically significant (P=0.512). Basic and demographic variables and other possible factors affecting mortality were compared between the two groups of patients who died and those who survived. Table 1 shows the result of comparing the demographic variables between the two groups.

Based on the results, Table 1, there are no statistically significant differences between two groups with and without mortality in terms of basic and demographic variables. The proportion of men in dead and surviving groups is 61.2 and 46.7%, respectively. Also, the average age of patients who died and those who did not were 16.9±54.9 and 15.8±60.3, respectively, which is not significantly different (P=0.250). The distribution of patients in terms of underlying diseases is also the same in both groups, and no statistically significant difference was observed. Table 2 compares possible factors related to mortality in two groups of dead and survived subjects.

There is no statistically significant difference in most factors affecting mortality between the two groups. However, the following factors were significantly different: primary calcium (P=0.001), primary leukocyte count (P=0.037), bicarbonate levels at admission (P=0.025), bicarbonate levels during acute kidney injury (AKI) (P=0.028), magnesium levels at admission (P=0.038), and magnesium levels at the end of CRRT (P=0.019) (Table 2).

Table1. Demographic and underlying variables comparison between dead and survived patients.

Item		Died n=85	Survived n=15	P-value
Age (Year)		54.9±16.9	60.3±15.8	0.250
Gender	Male	52(61.2)	7(46.7)	0.292
	Female	28(38.8)	8(53.3)	
CRRT Duration (Hrs)		15.4±6.4	15.4±5.5	0.992
Ultrafiltration(ml)		2424.1±1357.4	2686.7±906.0	0.473
CRRT Times		1.75±1.0	2.2±1.5	0.290
CRRT Mode	CVVH	32(37.6)	6(40.0)	0.539
	CVVHD	53(62.4)	9(60.0)	
AKI Etiology	Medical	68(80.0)	11(73.3)	0.388
	Surgical	17(20.0)	4(26.7)	
Underlying Diseases	Infection	7(8.2)	1(6.7)	0.714
	Cardiovascular	35(41.2)	9(60.0)	
	Pulmonary	26(30.6)	3(20.0)	
	Malignancy	12(14.1)	1(6.7)	
	Other	5(5.9)	1(6.7)	
Hemodialysis		32(37.6)	6(40.0)	0.863
Intubation		82(96.4)	14(93.3)	0.484
Diuretic		22(25.9)	3(21.4)	0.451
Blood Use		13(15.3)	3(20.0)	0.445

Table 2. Factor comparison between died and survived groups

Items	Group	Time			
		Admission	During AKI	CRRT Initiation	CRRT Termination
SBP	Died	120.7±13.7	89.3±8.3	86.5±7.5	91.0±7.7
	Survived	124.3±15.0	90.0±8.0	86.9±9.4	91.1±6.9
DBP	Died	73.9±9.7	74.4±9.6	51.6±7.8	55.7±6.8
	Survived	77.8±10.0	75.3±10.1	54.1±8.8	56.1±7.0
U/O(cc/hr)	Died	12.9±4.8	13.1±4.3	16.2±2.2	16.0±2.0
	Survived	13.3±3.1	13.5±3.8	12.0±2.5	15.0±2.0
Urea	Died	86.1±53.7	118.4±56.4	151.9±68.1	121.7±61.4
	Survived	82.1±43.0	121.7±51.8	162.7±69.1	121.0±86.1
Cr	Died	2.0±1.4	2.8±1.4	3.8±1.6	3.0±1.3
	Survived	1.6±0.9	2.4±0.8	3.5±1.1	3.0±1.1
Na	Died	136.3±5.9	137.6±6.0	138.5±6.0	137.6±4.5
	Survived	137.4±6.7	138.1±6.0	136.8±5.6	138.6±5.1
K	Died	4.1±0.5	4.4±0.4	4.9±0.5	4.3±0.4
	Survived	4.3±0.4	4.5±0.4	4.8±0.3	4.2±0.3
Ca	Died	8.5±0.7*	8.1±0.7	8.2±0.8*	8.1±0.5
	Survived	8.7±0.7*	8.6±0.8	8.8±0.2*	8.3±0.5
P	Died	3.8±1.1	4.6±1.5	5.2±1.9	4.7±1.2
	Survived	3.5±1.1	4.1±1.1	4.1±1.7	4.1±1.2
Alb	Died	3.2±0.6	3.0±0.4	3.0±0.3	3.0±0.4
	Survived	3.2±0.7	3.0±0.5	3.0±0.4	3.1±0.2
Uric Acid	Died	7.0±2.8	7.6±2.6	6.9±2.4	7.4±5.7
	Survived	7.4±2.7	7.1±5.2	7.0±3.0	6.7±2.3
WBC	Died	12000.0±5458.4*	13098.1±5080.5	14249.9±6799.2	15054.7±5728.2
	Survived	8800.0±5138.1*	12308.0±7393.1	12720.0±7055.2	14277.8±4958.5
Hb	Died	11.9±2.8	11.3±2.5	10.9±2.1	10.8±1.8
	Survived	12.5±3.2	11.5±3.1	11.1±3.1	11.3±1.6
Platelet	Died	222152.9±102172.9	192148.1±94211.5	154755.3±95079.8	130509.1±80846.9
	Survived	210600.0±97205.8	195733.3±89324.8	154428.6±63155.1	150666.7±65172.8
pH	Died	7.4±0.1	7.3±0.1	7.2±0.1	7.3±0.1
	Survived	7.4±0.1	7.3±0.1	7.3±0.1	7.3±0.1
Bicarbonate	Died	26.6±7.6*	23.7±5.0*	22.1±6.2	23.9±5.4
	Survived	31.5±8.6*	27.0±6.2*	22.9±4.3	25.5±5.7
Mg	Died	1.9±0.3*	2.0±0.2	2.0±0.1	1.9±0.1*
	Survived	1.8±0.2*	2.1±0.2	1.9±0.1	2.2±0.1*

*: Significant at 0.05 level in mentioned time; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; U/O: Urine Output

DISCUSSION

Since it is possible At Masih Deneshvari Hospital to access CRRT, this study was conducted to investigate the condition and general outcome of patients who were treated with this technique in the ICU. The investigation of effective factors on mortality will control all different types of comorbidities, improve the quality of these patients, and also reduce mortality. Based on the several studies, quick and timely decision to perform CRRT is important in improving the condition of these patients (9-12). This analytical cross-sectional research was conducted to estimate the mortality rate and also determine possible effective factors on mortality.

The difference in the mortality rate in the two groups of medical and surgical patients was not statistically significant (considering almost compatible clinical conditions).

The calcium, leukocyte, bicarbonate, and magnesium at admission plus bicarbonate during AKI and magnesium at the end of CRRT were significantly different between two dead and survived patients in the current study; therefore, it can be applied to improve the final prognosis of patients.

In a study conducted from 1978 to 1998 by Kellum and colleagues, a comparison was made between the mortality of patients who underwent CRRT and those who underwent IRRT which showed a better condition in patients who underwent CRRT (6).

An observational study in patients undergoing CRRT in the ICU showed that the overall mortality was 84.1%. Fluid overload as an indication of CRRT was associated with improved 15-day survival, while higher APACHE II scores and use of mechanical ventilation were associated with 15-day decreased survival (13).

Another study that systematically reviewed multiple modifiable predictors showed that older age, lower BMI, higher APACHE II and SOFA scores, lower systolic BP and diastolic BP, lower serum creatinine level, and higher serum sodium level, increased the risk of in-hospital mortality among critically ill patients who required CRRT (14).

A retrospective cohort study explained that CRRT is valuable for surgical patients with an acute and correctable indication; however, survival decreases significantly with increasing duration of CRRT. Duration of CRRT does not correlate with survival among patients awaiting liver transplants (15).

Another observational study conducted from 2017 to 2018 in Seoul has shown that the presence of fluid overload signifies an increased risk of mortality independent of other factors, including the severity of acute illness (16).

SOFA and vasoactive-inotropic score 24 hours after CRRT, as well as the incidence of postoperative complicated bleeding, are independent risk factors for in-hospital mortality in cardiac surgery-AKI patients who underwent CRRT. It is expected that timely treatment to maintain stable hemodynamics and active prevention and treatment of bleeding complications will reduce hospital mortality and improve the prognosis of these patients (17).

Our findings, which align with those in other studies, highlight the clinical significance of several factors during CRRT for critically ill patients with AKI. Key factors include primary calcium, leukocytes, magnesium, and bicarbonate levels. These elements are crucial for managing these patients, determining their prognosis, and influencing mortality rates.

CONCLUSION

In ICU patients requiring CRRT, patients with AKI have a higher mortality and some factors measured at admission can be used and followed as predictors.

Conflict of Interest

There is no conflict of interest.

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