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Research Article

Study on Related Factors of Acute Kidney Injury in Patients under Intensive Care

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[Abstract] ***Objectives:*** To study the related factors of acute kidney injury (AKI) in intensive care unit (ICU) patients. ***Methods:*** The clinical data of 879 patients in the intensive care unit were retrospectively analyzed. AKI patients were selected according to the AKI clinical diagnostic criteria, the causal analysis was performed, the indicators of AKI patients were tested, and the urine volume and the time of admission to the ICU were recorded. Finally, logistic regression analysis was used to analyze the risk factors that affect the prognosis. ***Results:*** Among the 879 patients in the intensive care unit, 96 patients (10.9%) met the KDIGO-AKI diagnostic criteria, of which 29 (30.31%) died and 49 (51.04%) required renal replacement therapy. As the age and stage of AKI patients increase, the mortality rate also increases. The pathology constituted 46 septic patients (47.92%) and 50 non-septic patients (52.08%). Patients with septic AKI have longer ICU and hospital stay than patients with non-septic AKI (t=2.291, 0.023; t=2.082, 0.041), and the rate of renal replacement therapy is higher($\chi 2$=4.091, P=0.042). Logistic regression analysis shows that old age, low urine volume, shock, acidosis, stage 3 of AKI, intake of blood pressure drugs, infections, and the need for renal replacement therapy are relevant factors that affect AKI. ***Conclusions:*** In the intensive care unit, the incidence and mortality of AKI are very high; the treatment of AKI is related to many factors; early detection and treatment is very crucial to reduce the mortality of AKI.

Key words: Intensive Care Unit Patients; Acute Kidney Injury; Related Factors

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1 Introduction

Acute kidney injury (AKI) is a relatively common clinical syndrome. Currently, there are many definitions of AKI, and its diagnosis and classification criteria remain controversial. This study retrospectively analyzed the incidence of AKI among patients in the intensive care unit (ICU) of our hospital in recent years. The report is as follows.

2 Materials and Methods

2.1 General Information

From January 2015 to December 2018, a total of 879 patients were treated in the ICU of this hospital. Among these indicators, laboratory indicators of AKI patients, urine volume, underlying kidney disease damage, gender, age, period of stay in the ICU, renal replacement therapy, treatment status, prognosis and death factors were tested or observed. Those who have previously had chronic kidney disease were excluded.

2.2 Diagnostic Criteria

KDIGO-AKI is defined as a person who meets one of the following conditions, whose serum creatinine (SCr) increases ≥ 0.3 mg/dL (26.5 μmol/L) within 48 hours; SCr increases to 1.5 times higher than the baseline within 7 days; or urine volume within 6 hours < 0.5mL/(kg•h). Judgment criteria for AKI in sepsis: First, it must meet the diagnostic criteria for AKI; then, it must meet the criteria for acute inflammatory response syndrome: (1) Body temperature < 36 degrees Celsius or > 38 degrees Celsius; (2) Heart rate exceeding 90 beats per minute; (3) Respiration frequency exceeds 20 times per minute or arterial blood $PaCO_2$ < 32Hg; (4) White blood cells > 12×109/L or naive cells > 10%. Any two SIRS and evidence of infection can be diagnosed as septic AKI.

2.3 Treatment Methods

To identify the main cause(s) or aggravating factors, maintain a stable internal environment, and treat the symptoms accordingly.

2.4 Prognostic Assessment Criteria

Cured: Without renal replacement therapy, symptoms and signs disappeared, renal function returned to normal, urine volume > 30 mL/h. Improved: Symptoms and signs improved, and kidney function indicators have not fully recovered or dropped to the level before AKI. Treatment ineffective: the patient's condition has not changed before and after treatment, and the condition has deteriorated and died.

2.5 Statistical Processing

SPSS software was used for statistical processing. The data are expressed as`x±s and the t-test is used for comparison between groups. The data is expressed as a rate, and the comparison between groups is tested by $\chi 2$ test. Logistic regression was used to analyze the related factors affecting AKI. $P < 0.05$ was considered statistically significant.

3 Results

3.1 Basic Information of Patients

Of the 879 ICU patients, 96 (10.92%) met the KDIGO-AKI criteria (including 62 males and 34 females), ranging in age from 18 to 88 years old, with an average age of (52.31±18.92) years old and 28 cases under 40 years old, 35 cases 41-65 years old, 31 cases over 65 years old; KDIGO-AKI staging: 47 cases of AKI stage 1, 21 cases of AKI stage 2, 28 cases of stage 3, SCr value (276.74±147.51) μmol/L; average ICU duration was (13.79±11.4) days, and the average hospitalization time was (24.32±17.69) days. Of the 96 patients, 29 (30.31%) died, and 50 (52.08%) required renal replacement therapy.

3.2 The Etiological Stage and Pathology are shown in Table 1.

Table 1. Pathology of 96 AKI Patients

Pathology	n	AKI Stage 1	AKI Stage 2	AKI Stage 3	Number of Deaths
Infection	45	25(55.56%)	13(28.89%)	7(15.56%)	14(31.11%)
Hypovolemia	16	4(25.00%)	5(31.25%)	7(43.75%)	8(50.00%)
Rhabdomyolysis	8	3(37.50%)	2(25.00%)	3(37.50%)	2(25.00%)
Postrenal	7	5(71.43%)	2(28.57%)	0	1(14.29%)
Psychogenic	5	2(40.00%)	1(20.00%)	2(40.00%)	3(60%)
Hepatorenal syndrome	1	0	0	1	1
Drug	1	0	0	1	1

Table 2. Comparisons between Septic AKI and Non-Septic AKI Patients

Item	Septic	Non-Septic	$\chi 2$	P value
Number of Cases/n	46	50		
Age/y.o.	54.91±18.03	48.49±21.05	1.267	0.207
Creatinine/(μmol/L)	256.73±136.52	297.95±161.55	1.368	0.176
Renal Replacement Therapy/(n，%)	29,(63.04%)	31,(62.00%)	4.091	0.042
ICU Duration/d	15.68±14.07	11.23±8.54	2.291	0.023
Hospitalization Time/d	27.93±18.84	20.65±15.66	2.082	0.041
Deaths/(n，%)	15(32.61%)	19,(38.00%)	0.494	0.482

3.3 Comparisons between Septic AKI and non-Septic AKI Patients

Compared with non-septic AKI patients, patients with septic AKI have longer ICU and hospital stay, and a higher rate of renal replacement therapy (see Table 2).

3.4 Prognosis

The patients' discharge status is categorized into survival (including recovery and becoming chronic); death

and self-discharge accordingly. Among them, 64 cases survived and 29 died. The fatality rate was 30.31%. Patients are also categorized based on age as young people (18-40 years old), middle-aged people (41-65 years old) and old people (over 65 years old). Among them, there are 28 cases of young AKI with mortality rate of 14.29%, 35 cases of middle-aged AKI with mortality rate of 22.86%, and 31 cases of elderly AKI with mortality rate of 54.84%. According to the KDIGO staging, the mortality rates of stage 1, stage 2 and stage 3 were 12.77%, 38.10% and 53.57%, respectively. The more advanced the AKI stage, the higher the mortality rate ($\chi 2$ = 11.12, P = 0.04). Logistic regression analysis found that old age, low urine volume, shock, acidosis, the third stage of AKI, blood pressure drugs, infection and the need for renal replacement therapy are all related factors that affect the prognosis. See Table 3.

mortality rate of 14.29%, 22.86% and 54.84%. It can be considered that the mortality rate increases linearly with age. This is related to the poor health of the elderly, with low immunity leading to susceptibility to infection.

There are many factors related to the prognosis of AKI in ICU patients. Through regression analysis, it can be concluded that old age, low urine volume, shock, acidosis, the third stage of AKI, blood pressure drugs, infection and the need for renal replacement therapy are all influencing factors. The OR value of AKI2 and ICU mortality was 2.1 (P = 0.175), and the OR value of AKI3 was 5.89 (P = 0.001). The results indicate that the more advanced the AKI stage, the higher the risk of death, which is consistent with the results reported by Fonseca et al.

In conclusion, there are many factors affecting AKI in ICU patients, among which sepsis and hypovolemia

Table 3. Logistic Regression Analysis on Related Factors Affecting AKI Prognosis

Factors	OR	95%CI	P Value
Old Age(> 65 y.o.)	5.53	1.72-18.51	0.004
Low Urine Volume	3.67	1.49-9.07	0.003
AKI Stage	5.89	1.96-17.58	0.001
Acidosis	2.59	1.07-6.45	0.031
Renal Replacement Therapy	3.17	1.29-7.56	0.008
Shock	2.94	1.68-6.67	0.019
Blood Pressure Drugs	2.71	1.13-6.49	0.022
Infections	3.67	1.51-9.07	0.003

4 Discussions

Understanding the etiology and prognosis of AKI is of great importance to its clinical treatment. Sepsis is the main cause of AKI in ICU, and the incidence of septic AKI is between 28% and 47%, which is similar to the results of this study[1]. In this study, the main sites of infection in septic AKI patients were abdominal cavity, lung and blood.

According to the study by Ostermann et al., in the RIFLE stratification, the mortality rate of AKI patients with risk, injury and failure was 21.2%, 45.7% and 56.9%, respectively[2]. The results of this study show that the mortality rate of AKI is 30.21%, similar to the study of Fonseca Ruiz et al[3]. In this study, according to the KDIGO-AKI staging criteria, the mortality rates of stage 1, stage 2 and stage 3 were 12.77%, 38.10% and 53.57%, respectively, indicating that the more severe the kidney damage, the higher the mortality rate. Adolescents, middle-aged and elderly people have a

are the main prominent factors. The occurrence of AKI in ICU patients will increase their risk of death. It is necessary to strengthen the monitoring of risk factors and renal function. Early diagnosis and intervention of AKI is very crucial to reduce the mortality rate of ICU patients and improve the prognosis.

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