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Original Article

The Effect of Acute Kidney Injury on Mortality in Geriatric Patients Followed Up in the Intensive Care Unit

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SUMMARY

Background: The number of geriatric patients in the intensive care unit (ICU) is increasing day by day in line with the increase in the population. The present study evaluated the relationship between the presence of acute kidney injury (AKI) and mortality in geriatric patients, who are increasingly seen in the ICU.
Methods: This retrospective study was conducted in a tertiary-level ICU of a public hospital in Istanbul, Turkey. The data of 2154 patients aged 65 and over, who were followed up in the ICU between January 2013 and January 2020, were collected and digitally analyzed using Structured Query Language.
Results: The patients were divided into two groups as 1286 (59.7%) who developed AKI and 868 (40.3%) who did not develop AKI. Patients with AKI stay in the ICU longer than patients who did not develop AKI (median 5.91 vs. 3.44 days, $p < 0.05$). ICU mortality was 46.2% in patients with AKI and 25.8% in patients without AKI ($p < 0.001$). All stages of AKI were found to increase mortality ($p < 0.05$). The probability of mortality in patients above 85 years of age who developed AKI was 1.7 times higher compared to that of geriatric patients who developed AKI younger than 75 years (OR: 1.749; 95% CI: 1.099–2.785).
While the increase in sequential organ failure assessment score, ventilator workload and lactate level, need for dialysis, and development of pressure sores was associated with increased mortality in geriatric patients with AKI, an increase in body mass index was associated with a decrease in mortality (OR: 0.961; 95% CI: 0.929–0.995).
Conclusion: AKI is associated with ICU mortality in geriatric patients and it increases morbidity.

1. Introduction

Aging is characterized as a loss of functional reserve that leads to an increased risk of disease and death, as well as a significant reduction in adaptive homeostatic ability against endogenous and exogenous stress.[1] The number of people over the age of 65 is expected to double by 2050, from 461 million in 2004 to 2 billion.[2] Patients over 65 years of age account for almost half of all intensive care unit (ICU) admissions and the rate of ICU readmission is higher in this patient population.[3] In the geriatric population, comorbidities that come with aging raise the risk of organ dysfunction.[4] Functional, structural, and molecular changes in different organ systems, including the kidney, are associated with human aging.

Susceptibility to acute kidney injury (AKI) in the elderly may be increased by age-related changes in kidney function, multiple comorbidities, and polypharmacy.[5,6] According to the current diagnosis and staging criteria, it has been determined that the incidence rate of AKI in ICU patients is over 50%, and 10–15% of these patients are administered renal replacement therapy.[7] According to previous research, elderly patients have a higher risk of AKI compared to younger patients.[8] A decrease in the number of nephrons and a decline in the Glomerular filtration rate (GFR) in elderly kidneys is related to increased sensitivity to AKI in the geriatric population.[9] In the geriatric population, AKI causes prolonged stay in the hospital and increased risk of transfer to the ICU.[10]

The geriatric-AKI phenotype is more common in the ICU due to the rapid increase in the number of geriatric patients and the increased incidence of AKI in this patient group. Our research aimed to delve into the growing geriatric-AKI phenotype in the ICU and determine the impact of AKI on ICU outcomes in geriatric patients.

2. Materials and methods

2.1. Datacenter

This retrospective analysis was carried out in the ICU of a third-level training and research hospital in Istanbul, Turkey.

Patients, who experienced a loss of consciousness (Glasgow Coma Scale < 9), an arrhythmia that impaired hemodynamics and respiratory distress requiring advanced respiratory support, patients with respiratory rate > 35/min and mean arterial pressure below 65 mmHg despite sufficient fluid resuscitation (30 mL/kg), patients who required a vasoactive agent to attain a mean blood pressure of > 65 mmHg, and patients, who developed one or multiple acute reversible organ failure due to any reason, were admitted to the ICU.

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Patients admitted to the ICU are undressed, their accessories are removed, their bare weight and height are measured by their nurse, and this information is recorded in the patient file of the clinical decision support system (CDSS). Treatments that may impact the weight, such as intravenous fluids and diuretics administered before admission to the ICU are not considered during this measurement. After the weight and height data are recorded into CDSS, the system calculates the body mass index (BMI) and stores it in the patient file. Hourly urine output is monitored by the nurse and recorded in the CDSS. In addition, laboratory findings requested during ICU follow-up, such as creatinine, are automatically transferred from the hospital electronic information system to the CDSS. The AKI algorithm, which was developed using the Clinical Practice Guideline for Acute Kidney Injury (KDIGO) criteria, measures the creatinine values and hourly urine output of the patient.[11] If the patient meets the AKI criteria, the system determines the stage of AKI and creates a warning. This warning is saved in the patient file, and the user is warned. As a result, AKI is determined quickly and accurately.

In the AKI algorithm in CDSS, if the patient has CRF and is receiving renal replacement therapy (RRT), this information is recorded in the relevant field in CDSS and CDSS does not signal an AKI warning in these patients. Therefore, patients with CRF and RRT are not included among the patients who are warned with AKI. In addition, patients, who have been admitted with the diagnosis of intoxication and have undergone RRT for the elimination of toxic substances (drugs, fungi), are not evaluated as AKI. AKI data are obtained after excluding these patients.

2.2. Data collection

Data from the *EMRall-QlinICUImdSoftMetavision* CDSS used in the ICU were collected and analyzed using Structured Query Language queries for all patients followed up between January 2013–January 2020. The demographic information of the patients, comorbidities, primary ICU admission diagnoses, scores, blood gas and admission biochemical values, interventions and treatments, complications, mechanical ventilation parameters and period of mechanical ventilation, and mortality data were evaluated.

2.3. Sample

A total of 9544 patients were admitted to the ICU during the study period. After the exclusion of 7390 patients from the study according to the exclusion criteria, the remaining 2154 patients constituted the population of the study (Figure 1).

2.3.1. Admission criteria

All patients over 65 years of age, who stayed in the intensive care unit for longer than 24 hours, were included in the study.

2.3.2. Exclusion criteria

Patients under the age of 65 (n: 4864), patients who were trans-

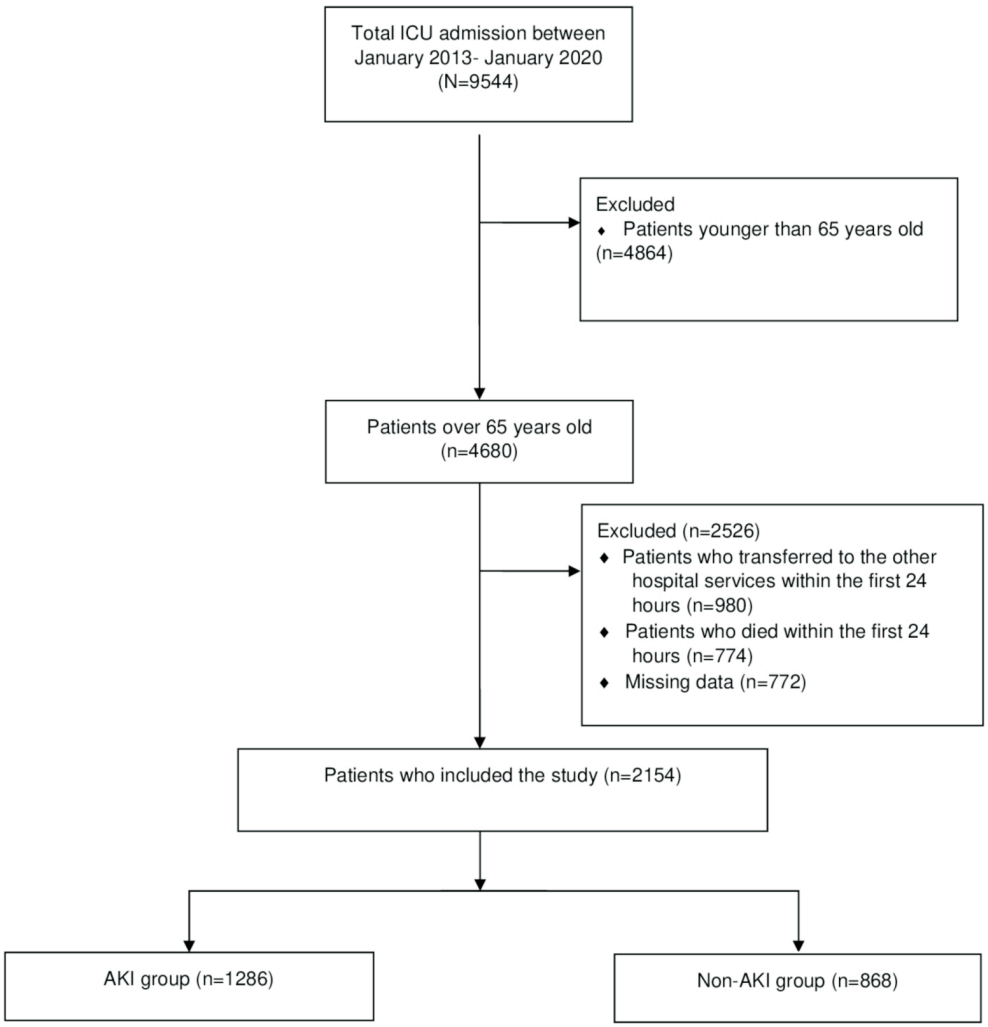

Figure 1. Flow diagram of patients selection. AKI: acute kidney injury; ICU: intensive care unit.

ferred to the clinic within 24 hours of ICU admission (n: 980), patients who died in the first 24 hours in the ICU (n: 774), and patients with missing data (n: 772) were removed from the analysis.

2.4. Ethical issues

Before starting the study, ethics committee approval and institutional permission were obtained from Bakırköy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (Protocol code: 2021/273; Approval number: 2021-09-19; Approval date: 03.05.2021).

2.5. Statistical analysis

The data collected in the analysis were analyzed using the SPSS 22.00 software. Frequency and percentage were used to express categorical variables. Data with a normal distribution were expressed as mean ± standard deviation, whereas data with a non-normal distribution were expressed as median and interquartile range. The independent samples t-test was used for comparison of the numerical data, and the Mann-Whitney U test was used when the assumptions of this test were not met. The Chi-square test was performed to compare categorical variables, and Fisher's exact test was used when the assumptions of the Chi-square test were not met. The parameters associated with mortality risk in geriatric patients with AKI were determined using logistic regression analysis. After analyzing the assumptions of the logistic regression model, variables with a p value less than 0.20, which could affect mortality in geriatric patients with AKI, were included in the multivariate model. Then, the non-significant variables were removed with a stepwise backward method, and the multivariate model was finalized. The p-value of < 0.05 is accepted as the level of significance.

3. Results

Geriatric patients followed in the ICU were classified in 2 groups as patients with and without AKI (non-AKI). The general characteristics of the patients are presented in Table 1. Patients, who developed AKI, were found to be older (77.50 ± 7.92) compared to the patients in the non-AKI group (76.17 ± 7.76) ($p < 0.05$). It was determined that the female gender (460; 53.0%) was more common in patients in the non-AKI group, whereas the male gender (677; 52.6%) was more common in patients with AKI ($p < 0.001$). Hypertension was observed to be the most common comorbid disease in both groups. There was no significant difference between the groups regarding the frequency of the comorbid diseases. When the admission diagnoses of the patients were examined, sepsis was found to be the most common admission diagnosis to the ICU in both categories. When the groups were compared with each other, sepsis was observed to be more common in patients, who developed AKI (388; 30.2%), compared to the patients in the non-AKI group (211; 24.3%) ($p < 0.05$). The most common source of sepsis was intra-abdominal sepsis in both groups. Intra-abdominal sepsis and pneumonia sepsis were more common in patients with AKI, whereas urosepsis was more common in non-AKI patients ($p < 0.05$). Pulmonary disorders (241; 18.7%) were more frequent in AKI patients; however, non-AKI patients had a higher rate of postoperative follow-up (135; 15.6%) and gastrointestinal bleeding (33; 3.8%) ($p < 0.05$) (Table 1).

Table 2 presents the scores of patients measured in the ICU, the interventions, and treatments administered to the patients. Patients with AKI had higher intensive care scores, while their GCS and RASS scores were lower ($p < 0.05$). In patients with AKI, arterial and central venous catheterization were performed more commonly, and the need for dialysis was discovered to be higher ($p < 0.05$). The use of vasoactive medications, antibiotics, and TPN was found to be more common in patients with AKI ($p < 0.05$).

3.1. Mechanical ventilation

Patients who developed AKI during intensive care follow-up needed more frequent mechanical ventilator assistance. While 58.9% (511) of the patients in the non-AKI group required mechanical ventilation support, this rate increased to 77.2% (993) in patients with AKI ($p < 0.05$). When compared to non-AKI patients (3.95 [1.61–8.16]), AKI patients had a longer period of mechanical ventilation (6.12 [2.77–14.12]) ($p > 0.001$). Peak pressure (13 [12–15]) and the Work of Breathing ventilator (WOBv) (1.10 [0.94–1.25]) values were higher, and pulmonary complaints (36 [29–45]) were lower in patients with AKI when mechanical ventilator parameters were examined (Table 3).

3.2. Laboratory parameters

Table 3 presents the laboratory parameters of the patients.

Table 1
Sociodemographic characteristics and admission diagnosis of the patients.

Parameters	Non-AKI n = 868 (40.3%)	AKI n = 1286 (59.7%)	*p*-value
Age (year)	76.17 ± 7.76	77.50 ± 7.92	< 0.001
65–74	397 (45.7)	508 (39.5)	0.004
75–84	321 (37.0)	495 (38.5)	0.479
≥ 85	150 (17.3)	283 (22.0)	0.007
Gender			> 0.001
Female	408 (47.0)	677 (52.6)	0.010
Male	460 (53.0)	609 (47.4)	
Comorbidity	799 (92.1)	1205 (93.7)	0.140
Hypertension	460 (53.0)	709 (55.1)	0.329
Diabetes	252 (29.0)	377 (29.3)	0.887
Cerebrovascular disease	98 (11.3)	157 (12.2)	0.518
CAD	175 (20.2)	267 (20.8)	0.735
COPD	129 (14.9)	208 (16.2)	0.411
Malignancy	103 (11.9)	181 (14.1)	0.137
Hepatic disease	8 (0.9)	24 (1.9)	0.075
Psychiatric disorder	10 (1.2)	9 (0.7)	0.271
Dementia	64 (7.4)	118 (9.2)	0.140
Other	51 (5.9)	104 (8.1)	0.051
Admission diagnosis			
Cerebrovascular disease	113 (13.0)	147 (11.4)	0.267
Cardiac	69 (7.9)	79 (6.1)	0.104
Pulmonary	127 (14.6)	241 (18.7)	0.013
Pneumonia	64 (7.4)	142 (11.0)	0.005
COPD	44 (5.1)	70 (5.4)	0.704
Pulmonary, other	19 (2.2)	29 (2.3)	0.158
Metabolic	60 (6.9)	79 (6.1)	0.476
Hepatic cirrhosis	4 (0.5)	16 (1.2)	0.069[a]
Trauma	22 (2.5)	33 (2.6)	0.964
Sepsis	211 (24.3)	388 (30.2)	0.003
Pneumosepsis	23 (2.6)	93 (7.2)	< 0.001
Intra-abdominal sepsis	103 (11.9)	194 (15.1)	0.034
Urosepsis	38 (4.4)	26 (2.0)	0.002
Sepsis, other	47 (5.4)	75 (5.8)	0.681
Malignancy	66 (7.6)	83 (6.5)	0.302
Postoperative	135 (15.6)	149 (11.6)	0.008
GIB	33 (3.8)	29 (2.3)	0.035
Other	28 (3.2)	42 (3.2)	0.959

AKI: acute kidney injury; CAD: coronary artery disease; COPD: chronic obstructive pulmonary disease; GIB: gastrointestinal bleeding.
[a] Fisher exact test.

Table 2
ICU scores, interventions-treatments, and mortality results of the patients

Parameters	Non-AKI n = 868 (40.3%) n (%)	AKI n = 1286 (59.7%) n (%)	*p*-value
BMI (kg/m^2), mean ± SD	27.02 ± 5.69	27.66 ± 5.38	0.009
APACHE 2	21 (15–28)	24 (18–30)	< 0.001
APACHE 4	79 (58–108)	88 (66–112)	< 0.001
SAPS 3	47 (39–55)	51 (44–60)	< 0.001
SOFA	5 (3–9)	7 (4–10)	< 0.001
TISS	19 (16–23)	22 (18–26)	< 0.001
GCS	10 (7–14)	8 (4–12)	< 0.001
RASS	0 (-3–0)	-2 (-4–0)	< 0.001
Interventions			
Arterial catheter	586 (67.5)	951 (74.0)	< 0.001
Central catheter	366 (42.2)	791 (61.5)	< 0.001
MV	511 (58.9)	993 (77.2)	< 0.001
Tracheostomy	102 (11.8)	289 (22.5)	< 0.001
Dialysis	129 (14.9)	324 (25.2)	< 0.001
Treatments			
Nutrition (kcal/day)	1641 (1440–1882)	1608 (1419–1806)	0.104
TPN	244 (28.1)	514 (40.0)	< 0.001
Antibiotics	744 (85.7)	1177 (91.5)	< 0.001
Vasoactive agents	424 (48.8)	921 (71.6)	< 0.001
Pressure sores	101 (11.6)	122 (9.5)	0.108
MV (day)	3.95 (1.61–8.16)	6.12 (2.77–14.12)	< 0.001
LOS ICU (day)	3.44 (1.54–7.61)	5.91 (2.83–13.34)	< 0.001
28-day mortality	218 (25.1)	575 (44.7)	< 0.001
ICU mortality	224 (25.8)	594 (46.2)	< 0.001

AKI: acute kidney injury; APACHE: acute physiology and chronic health evaluation; BMI: body mass index; GCS: Glasgow coma score; ICU: intensive care unit; IQR: inter quartile range; LOS: length of stay; MV: mechanic ventilation; RASS*:* Richmond Agitation and Sedation Scale; SAPS: simpli?ed acute physiology; SOFA: sequential organ failure assessment; TISS: therapeutic intervention scoring system; TPN: total parenteral nutrition.

When blood gas values were analyzed, it was found that patients with AKI had higher pCO_2, HCO_3, and lactate ($p < 0.05$). PH and PO_2 levels were similar in both groups ($p > 0.05$). According to the biochemical parameters, the levels of glucose, procalcitonin, creatinine, and magnesium serum were found to be higher in patients with AKI. The WBC, INR, and APTT levels were also detected to be higher in patients with AKI ($p < 0.05$).

3.3. Length of stay in the ICU and mortality

ICU stays were longer in patients with AKI (5.91 [2.83–13.34]) compared to the non-AKI patients (3.44 [1.54–7.61]) ($p < 0.05$). The 28-day mortality rate in patients with AKI was 44.7% (575) compared to 25.1% (218) in non-AKI patients ($p < 0.001$). When the stages of patients who developed AKI were examined, it was found that 32.8% (422) were at stage 1, 29.5% (379) were at stage 2, and 37.7% (485) were at stage 3. It was determined that mortality was associated with the stage of AKI, and mortality increased as the stage advanced. While the mortality rate was 13.5% (57) in stage 1 AKI, it increased to 49.9% (189) in stage 2 and 71.8% (348) in stage 3 ($p < 0.001$). ICU mortality was found to be 46.2% (594) in patients with AKI and 25.8% (224) in non-AKI patients ($p < 0.001$). According to the subgroup analyses performed based on diagnoses of patients at the time of admission, the mortality rates of patients diagnosed with metabolic causes, cirrhosis, and gastrointestinal bleeding did not vary between the groups. Patients with AKI had a higher mortality rate compared to the patients with any other diagnosis at the time of admission ($p < 0.05$).

The rise in BMI was correlated with a decrease in mortality rates of patients with AKI, according to the logistic regression model created to determine the factors associated with mortality in patients with AKI (OR: 0.961; 95% CI: 0.929–0.995). It was determined that the probability of mortality in patients who developed AKI was 1.74 times higher at patients ≥ 85 years of age compared to the patients between 65 and 74 years of age who developed AKI (OR: 1.749; 95% CI: 1.099–2.785). Furthermore, it was concluded that the requirement for dialysis increased the probability of mortality by 2.1 folds (OR: 2.108; 95% CI: 1.396–3.182). Increased SOFA score and high lactate were found to be correlated with mortality ($p < 0.05$). Finally, it was discovered that the development of pressure sores in AKI patients increased the risk of death by 1.9 times (OR: 1.917; 95% CI: 1.107–3.319) (Table 4).

4. Discussion

According to the findings of this report, which investigated the impact of AKI on mortality in a geriatric patient population monitored in the ICU, mortality increased with the progression of AKI in all stages and almost all admission diagnoses. In patients with AKI, it was detected that increasing age, SOFA score, and lactate level increased the risk of mortality while increasing BMI decreased the risk of mortality. Furthermore, it was found that the mortality rates of patients with AKI were correlated to the use of vasoactive medications and dialysis. It was determined that AKI developed more frequently in patients with the admission diagnosis of pneumonia and sepsis.

While aging does not cause primary kidney disease, age-related functional and structural changes in the kidney can make the elderly susceptible to kidney disease.[12] According to a study, after the age of 30, approximately 6,000–6,500 nephrons are lost each year as a result of aging.[13] In geriatric patients, structural changes such as vascular sclerosis, decreased weight, and increased sclerosing glomerular amount, as well as functional changes such as increased glomerular capillary pressure, decreased GFR, and decreased ultrafiltration coefficient, increase susceptibility to AKI.[14,15] Structural and functional changes associated with aging change renal sensitivity to vasoactive agents, reduce autoregulation capacity and functional reserve. Furthermore, the rate of cellular apoptosis increases, while the rate of cellular proliferation in response to acute injury decreases with age.[16] In a study of Medicare patients conducted in the United States, it was discovered that the prevalence of AKI grew gradually, from 26.8% in the 66–69 age group to 77.1% in the 80–84 age group.[17] In our study, the detection of AKI in 59.7% of geriatric patients can be explained by the high mean age and the fact that overlooking the diagnosis of AKI was prevented by instant follow-up of CDSS.

The mortality rate of patients with AKI was found to be 46.2% in our study, which was consistent with the literature.[18] Additionally, each AKI category was determined to increase the rate of mortality. Patients who developed AKI were found to be independently correlated with in-hospital mortality in each category in a report, which matched our findings. A high risk of hospital mortality is associated with AKI.[19] Patients with AKI have higher ICU scores and a lower GCS, which supports this theory. According to a previous study, mortality is found to be four times higher in patients with AKI compared to the non-AKI patients.[20]

The large variance in elderly AKI mortality may be attributed to the population studied as well as the etiology of AKI. It was detected in the present study that age and BMI were correlated to mortality in AKI. Furthermore, the concept of AKI and whether CKD was included in the studies may have influenced mortality outcomes. In previous studies, pneumonia and sepsis were found to be the most frequent

Table 3
Mechanical ventilation, blood gas and laboratory parameters of the patients.

Parameters	Non-AKI n = 868 (40.3%) Median (IQR)	AKI n = 1286 (59.7%) Median (IQR)	*p*-value
Mechanical ventilation (mean values)			
FiO_2 (%)	42 (40–47)	43 (40–48)	0.087
PEEP (cmH_2O)	5.4 (5.1–5.9)	5.4 (5.1–5.9)	0.229
P peak (cmH_2O)	12 (11–14)	13 (12–15)	< 0.001
Tidal volume	483 (421–558)	477 (424–538)	0.118
Tidal volume (ml/kg)	6.73 (5.93–7.63)	6.63 (5.90–7.45)	0.564
Respiratory rate (min)	19 (16–22)	19 (16–22)	0.095
Compliance (ml/cmH_2O)	38 (31–48)	36 (29–45)	0.010
WOBv (j/L)	1.06 (0.90–1.21)	1.10 (0.94–1.25)	0.006
Mechanical power (J/min)	9.53 (7.87–12.70)	9.22 (7.70–10.70)	0.061
Blood gas (mean values)			
PH	7.39 (7.32–7.44)	7.39 (7.31–7.44)	0.423
PO_2 (mmHg)	87.0 (62.5–108.8)	86.8 (65.7–108.6)	0.417
PCO_2 (mmHg)	39.8 (35.7–45.4)	42.1 (36.8–48.5)	< 0.001
HCO_3 (mEq/L)	23.5 (20.4–26.8)	24.9 (21.4–28.4)	< 0.001
Lactate (mmol/L)	1.74 (1.30–3.08)	1.86 (1.40–3.20)	0.014
Laboratory (admission values)			
Glucose (mg/dl)	143 (119–178)	148 (126–182)	0.006
Hemoglobin (g/dl)	9.75 (8.71–11.12)	9.57 (8.70–10.80)	0.068
Hematocrit (%)	30.37 (27.09–34.16)	29.95 (27.21–33.89)	0.339
Platelet ($\times10^9$/L)	211 (152–281)	207 (149–276)	0.250
WBC ($\times10^9$/L)	11.97 (9.12–15.90)	12.89 (9.74–16.93)	0.004
CRP (mg/L)	1.84 (0.28–4.99)	2.11 (1.01–5.15)	0.101
Procalcitonin (ug/L)	0.80 (0.37–4.15)	0.90 (0.40–4.21)	0.012
INR	1.17 (1.06–1.39)	1.23 (1.09–1.46)	< 0.001
APTT (sec)	30.9 (26.1–39.4)	33.3 (27.3–42.9)	< 0.001
AST (U/L)	30 (20–54)	32 (21–62)	0.101
ALT (U/L)	18 (12–35)	20 (12–39)	0.283
Creatinine (mg/dl)	0.67 (0.45–1.05)	0.75 (0.50–1.10)	0.006
Albumin (mg/dl)	2.86 (2.34–3.31)	2.80 (2.37–3.30)	0.694
Sodium (mmol/L)	139 (136–142)	139 (136–143)	0.211
Chlorine (mmol/L)	103 (100–107)	103 (99–107)	0.141
Potassium (mmol/L)	4.1 (3.7–4.5)	4.1 (3.7–4.5)	0.340
Magnesium (mg/dl)	1.96 (1.78–2.16)	2.0 (1.81–2.21)	0.009

ALT: alanine aminotransferase; APTT: activated partial thromboplastin time; AST: aspartate aminotransferase; CRP: C-reactive protein; FiO_2: fraction of inspired oxygen; HCO_3: bicarbonate; INR: international normalized ratio; IQR: inter quartile range; PEEP: positive end-expiratory pressure; PH: power of hydrogen; PCO2: partial pressure of carbon dioxide; PO2: partial pressure of oxygen; WOBv: work of breathing ventilator.

Table 4
The parameters associated with mortality in geriatric AKI patients.

Parameters	OR	95% CI	*p*-value
Age, year			
65–74	reference		
75–84	1.110	0.752–1.639	0.600
≥ 85	1.749	1.099–2.785	0.018
BMI	0.961	0.929–0.995	0.025
Dialysis	2.108	1.396–3.182	< 0.001
Pressure sores	1.917	1.107–3.319	0.020
Vasoactive agents	1.628	0.971–2.731	0.065
Lactate	1.138	1.044–1.240	0.003
WOBv	3.067	1.511–6.225	0.002
SOFA	1.473	1.376–1.577	< 0.001

BMI: body mass index; CI: confidence interval; OR: odds ratio; SOFA: sequential organ failure assessment; WOBv: work of breathing ventilator.

reason for mortality in patients with AKI.[21] Geriatric patients comorbidity burdens, age-related changes in organ function, and decreased organ reserves, along with impaired immunity, increase their susceptibility to sepsis and pneumonia, leading to AKI and multiple organ dysfunction. In line with the literature, our findings demonstrated that pneumonia and sepsis diagnoses were more common, and the mortality rate was higher in patients with AKI.[22] Previous studies demonstrated that the mortality rate in AKI due to sepsis was very high, and it could reach 74.5%.[21] SOFA and lactate elevation, both of which were associated with mortality in patients with AKI, as well as the use of vasoactive medications, were found to support the literature in our study. In previous studies, the SOFA scores of patients with AKI patients were correlated to ICU and hospital mortality.[23] Mortality rate of geriatric septic patients with AKI increases due to their susceptibility to multiple organ failure. As a result, it is important to pay more attention to the treatment of sepsis and accompanying diseases in elderly patients with AKI, as well as the prevention of organ dysfunction.

The present study concluded that patients with AKI needed more mechanical ventilation support and higher ventilation pressures, as well as a longer period of mechanical ventilation and ICU stay. Besides, it was detected that patients with AKI had more central catheters placed, and they needed more vasoactive medications and antibiotics. Our findings were in line with the literature. Development of AKI was associated with increased ICU length of stay, morbidity, hospital costs, and poor outcomes in critically ill patients in previous studies.[5,8] Similarly, it was found that the duration of stay in the ICU was longer in geriatric patients with AKI.[24] The deterioration of pulmonary dynamics due to hypervolemia, which is normal in patients with oliguric AKI, may explain increased peak pressure and

WOBv with decreased pulmonary compliance in patients with AKI. Increased respiratory load and impaired pulmonary dynamics can cause mechanical ventilation to be prolonged in the geriatric population, in addition to muscle weakness.

4.1. Limitations

This study has several limitations. Conducting the study in a single center prevents findings from being generalized despite the residential diversity of the patients. Retrospective design may cause confounding factors and risk of bias. The diagnosis and stages of AKI in patients may have been influenced by the lack of records of IV fluids and diuretic medications used before admission to the ICU.

5. Conclusion

AKI increases the mortality rate in the ICU in geriatric patients. At all diagnoses of admission, AKI is correlated to ICU mortality. AKI stage is associated with mortality, and the probability of mortality increases with the advance in the stage. AKI develops more frequently in patients admitted with the diagnosis of pneumonia and sepsis. In geriatric patients, AKI raises the need for and length of mechanical ventilation. The ICU morbidity and length of stay increase in geriatric patients as AKI develops. Age is associated with mortality in patients with AKI. Patients older than 85 years of age who develop AKI are observed to have a higher probability of mortality compared to the geriatric patients under 75 years of age who develop AKI.

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Disclosure statement

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