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Acute Kidney Injury In Intensive Care Unit

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Abstract

Objective: To highlight the risk factors, mechanisms and prognosis in acute kidney injury in patients in intensive care unit (ICU).

Background: Acute kidney injury (AKI) is common and carries a high mortality rate. Most epidemiological studies were retrospective and were done in Western populations.

Patients and methods: This study was meted out as a prospective, observational study. This study included 50 critical ill patients admitted to ICU. Patients were recruited from intensive care unit from January 2018 to July 2018. Oral and written consent were taken from every participant when explaining the thought of the analysis. All patients were clinically evaluated and had routine assessment.

Results: The mean age of our studied population was 56.3±6.8 years demonstrated a significant trend toward an increased number of AKI cases with older age, males represented 68.9% of the included patients, 62% of patients suffering from AKI had history of diabetes mellitus. Mortality was evident in 14% of patients with AKI. Acute kidney injury patients with older age, male sex, diabetes mellitus, chronic obstructive pulmonary disease, congestive heart failure, mechanical ventilation and vasopressor were significantly associated with renal replacement therapy.

Conclusion: Acute kidney injury was associated with high mortality rate and. Early identification may cause a dramatic decrease in mortality and morbidity could be expected in these high-risk patients.

Keywords: Acute Kidney Injury, Humans, Intensive Care Units .

Introduction

Acute Kidney Injury (AKI) is a major global public health concern, with an incidence of about 2,100 per million populations. **[1]** AKI development in Intensive Care Unit (ICU) is associated with risk of long-term renal dysfunction and short- and long-term mortality. **[2]**

AKI is characterized by a rapid deterioration of kidney function and accumulation of waste products, electrolytes, fluids, and also less obvious effects, including reduced immunity and dysfunction of non-renal organs (organ cross-talk). [**3]**

The current study aimed to highlight the risk factors, mechanisms and prognosis in acute kidney injury in patients in ICU.

Patients and Methods

Ethical thought approval was obtained by the medical institution commission (27/8/2017), and written knowledgeable affected person consent with a proof concerning the concept of the analysis has been taken to any or all of the registered patients. This study was applied as a prospective, observational study. This study included 50 critical ill patients admitted to ICU. Patients were recruited from intensive care unit from January 2018 to July 2018.

Inclusion criteria included; age more than eighteen years and patients who stayed in the ICU longer than 48 hours. Exclusion criteria included; ICU admission of less than 48

hours, post-elective surgery and ICU readmission. All included patients underwent detailed history taking, they were clinically evaluated, had habitual laboratory investigations.

Statistical analysis

All data were collected, tabulated and statistically analyzed using SPSS 19.0 for windows (SPSS Inc., Chicago, IL, USA. Data were expressed as mean ± SD. ANOVA test was used to assess the difference between the studied parameters in the studied groups. The frequencies were expressed in %. Chi square χ^2 was used to assess the difference between the studied frequencies in the studied groups. Probability (P) was considered significant if less than 0.05 and highly significant if less than 0.001.

Results

Analysis of the baseline data of the study population revealed that the mean age of our study population is 56.3±6.8 years, 68% of them are males, 62% of them are diabetics, 42% are hypertensive, 42% of them had history of cardiovascular diseases, 50% had chronic liver disease, 48% had chronic renal failure and 56% of them had cancer. Mortality was evident in 14% of our study population. **(Table 1)**

Age (Years)	Mean ± SD	56.3±6.8
	25-44	3 (6%)
	45-64	41 (82%)
	≥ 65	6 (12%)
Sex	Male	34 (68%)
	Female	16 (32%)
Diabetes mellitus		31 (62%)
Sepsis		23 (46%)
Congestive heart failure	Hypertension	25 (50%)
	Cardiovascular disease	30 (60%)
Chronic liver disease	Hepatorenal disease	15 (30%)
	Non hepatorenal disease	9 (18%)
Chronic kidney disease		24 (48%)
Cancer		28 (56%)
SOFA		22 ± 3
APACHE II		50 ± 7
GCS		13 ± 2
Mortality	Non survivors	7 (14%)
	Survivors	43 (86%)

**High significant difference (P-value <0.01)

GCS: Galasco coma scale

APACHE-II: Acute Physiology and Chronic health Evaluation II

SOFA: Sequential Organ Failure Assessment

Comparison between AKI with renal replacement therapy (RRT) and AKI patients without RRT regarding different parameters revealed that there was no significant difference regarding Galasco coma scale (GCS). Acute kidney injury patients with RRT were older age than those without RRT. Males, diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), congestive heart failure, mechanical ventilation, vasopressor and Acute Physiology and Chronic health Evaluation II (APACHE-II) and Sequential Organ Failure Assessment (SOFA) score were significantly increased among RRT group (**Table 2**).

		AKI with RRT (N=14)	AKI without RRT (N=36)		P-value
Age (Years)		62.3 ± 7.8	53.4 ± 5.5	t-test=4.6	0.0001
Sex	Male	4 (28.6%)	28 (77.8%)	χ^2 = 10.6	0.0011
	Female	10 (71.4%)	8 (22.2%)		
Diabetes mellitus		13 (92.9%)	18 (50%)	χ^2 = 7.9	0.0051
COPD		12 (85.7%)	4 (11.1%)	χ^2 = 25.8	0.0000
Congestive heart failure		11(78.6%)	3 (8.3%)	χ^2 = 24.7	0.0000
Mechanical ventilation		8 (57.1%)	3 (8.3%)	χ^2 = 14	0.0002
Vasopressors		9 (64.3%)	3 (8.3%)	χ^2 = 17.3	0.0000
SOFA		28.5 ± 1.6	23.1 ± 2.7	t-test= 7	0.0001
APACHE-II		61.7 ± 4.3	43.5 ± 7.5	t-test= 8.5	0.0001
GCS		14.2 ± 4.3	13.6 ± 2.2	t-test=0.7	0.5175

APACHE-II: Acute Physiology and Chronic health Evaluation II

COPD: chronic obstructive pulmonary disease

GCS: Galasco coma scale

SOFA: Sequential Organ Failure Assessment

Discussion

In the present study, 94% of the studied patients aged more than 45 years. Old age is well defined risk factor of occurrence of AKI and related to compromised kidney function due to aging induced physiological and pharmacokinetic changes. Moreover, elderly patients have comorbid conditions for which they are using medications

including nephrotoxic drugs and it make them more susceptible of AKI. [**4**]

In the present study, males represented 68.9% of the included patients. Previously, it was demonstrated that; the rate of AKI development was the same in either sex. [**5**] In accordance with our findings; **Malleshappa and his colleagues [6]** found that male represented 62.3% of ICU patients with AKI. **Doddakula and his colleagues** [**7**] identified that female patients were associated with a higher risk of dialysis requiring AKI.

In the current study, 62% of patients suffering from AKI had history of DM. These finding is in accordance with the findings of **Schmitz and his colleagues [8]** as they noted that; critically-ill patients with diabetes have a higher incidence of developing AKI. This can be explained as; hyperglycemia induce release of free fat acids, the inactivation of nitric oxide (NO), and increased production of reactive oxygen species (ROS), respectively [**9**].

However, **Nisula and his colleagues [10]**, found no significant difference between patients with AKI and those without AKI regarding history of diabetes mellitus as DM was evident in 22% of ICU patients with AKI.

In the current study, 53 %of patients with AKI are suffering from cancer. This can be explained as cancer patients are particularly at risk for AKI secondary to infection and sepsis [**11**], tumor lysis syndrome (TLS) [**12**], kidney damage induced by immunosuppression after hematopoietic stem cell transplantation (HSCT) [**13**], and direct effects from the primary malignancy. [**14**]

However, these findings disagree with the findings of **Mao and Qin [15]**, as they noted no significant difference between patients with AKI and those without AKI regarding history of malignancy as cancer was evident in 25.5% of ICU patients with AKI.

AKI in ICU is multifactorial and true etiology is still needed to be evaluated. [**16**] Primary diagnosis on ICU admission may vary from clinicians to clinicians; therefore suggest studies with well-defined diagnostic criteria are suggested in order to determine the exact cause of AKI. [**15**]

In the present study, congestive heart failure was evident in 60% of patients with AKI. It was reported that heart failure is often regarded as one of the most important risk factors for perioperative AKI. [**17**]

In the present study, chronic liver disease was evident among 30% of the included patients. **Piano and his colleagues [18]** reported that AKI has an estimated prevalence of approximately 20–50% among hospitalized patients with cirrhosis and patients with cirrhosis are more likely to develop renal failure compared to individuals without liver disease.

In the present study mortality was evident in 14% of the studied population. AKI is independently associated with short and long-term mortality. [**2**] Critically ill patients with AKI are approximately 2 to 5 times more likely to die compared with those without AKI, with mortality exceeding 50%. [**19**]

Patients with AKI in ICU are usually managed with conservative treatments or RRT. Conservative treatment includes management of volume, electrolyte and acid-base homeostasis and specific drug management. Renal replacement therapy (RRT) is indicated for management of specific problems such as volume overload, hyperkalemia, acidosis and symptoms of uremia. **[20]**

Because of limited health resources and complications associated with RRT, many critically ill patients with AKI are often managed conservatively with mechanical ventilation, inotropes, diuretics and intravenous fluids; RRT is usually initiated when major complications of fluid overload, acidosis, uraemia or hyperkalaemia develop. Early prediction of the requirement for acute RRT would

be useful in ICU where physicians have excessive workload. [**15**]

Therefore, several risk factors of dialysis treatment were determined in current study. In this context, current study determined risk factors of dialysis treatment among AKI patients. AKI patient with old age were found to be significantly associated with dialysis treatment. Similar findings were reported by **Elsevier and co-workers [20]** that AKI patients requiring RRT were significantly older than those who did not need RRT in ICU. We also identified that female patients were associated with a higher risk of dialysis requiring AKI and similar findings have been reported by **Doddakula and his colleagues [7]**.

In the present study, presence of congestive heart failure and COPD was associated with dialysis. These results are in agreement with other findings evaluating different factors of RRT need among AKI patients. [**7**]

In the current study the dialysis treatment was significantly associated with diabetes mellitus**. Faulke and his colleagues [21]** have also reported association of diabetes mellitus with RRT.In the current study, the percentage of patients who were treated with vasopressor drugs was significantly increased among RRT group. **Myc and his colleagues [22]** found that estimated glomerular filtration rates were also significantly lower in the AVP group.In the present study, the percentage of patients who needed mechanical ventilation was significantly increased among RRT group. **Doddakula and his colleagues [7]** found that ventilator duration and pulmonary complications are significantly associated with RRT risk. Other risk factors of dialysis initiation were mechanical ventilation and high disease severity scores. The severity of disease, as evaluated by recognized prognostic scales in ICU, considerably affects the risk of dialysis treatment. [**23**] The results of current study also showed increased risk of dialysis with high SOFA and APACHE-II results.

These results are also in concordance with the findings of **Czempik and his colleagues [24]** where they found that dialysis increased with each score increase. Need of mechanical ventilation and vasopressors denote seriously ill patients as evidenced by the high GCS, APACHE-II and SOFA scores and these patients had higher risks of dialysis in present study. These findings are consistent with other studies conducted in ICU. [**7**]

Conclusion

AKI was associated with high mortality rate and. Early identifcation may cause a dramatic decrease in mortality and morbidity could be expected in these high-risk patients.

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