Original Article

Acute Kidney Injury

Acute Kidney Injury (AKI) in Critically Ill Patients: Diagnosis, Management, and Outcomes

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ABSTRACT

Objective: The proposed research is intended to assess diagnostic approaches, management and prognoses of AKI in 150 critically ill patients admitted in an ICU.

Study Design: A prospective cross-sectional study

Place and Duration of Study: This study was conducted at the Department of Nephrology, Mercy Teaching Hospital, Peshawar from Jan 2021 to Jan 2022.

Methods: A total of 150 patient who were critically ill were recruited in a prospective study. AKI was defined by KDIGO criteria, treatment included maintenance of fluid and electrolyte balance, initiation of RRT and correction of predisposing factors. If patient survival was the end of therapy measure, then similar assessment was done with regards to patient survival rates and kidney recovery. The means were analyzed, and also the standard deviation, as well as p-value, to ascertain the significance in the results shown below.

Results: In this study 45% of the 150 patients studied had AKI. The mean of the disease was noted to be 2. 8 mg/dL ± 0. 5 of serum creatinine at diagnosis. Hemodialysis was started in 30 percent of patients with AKI. The overall mortality of the patients on RRT was 55% and the total mortality of the patients was 35%. The variability in creatinine levels was ± 0. 5 and the probability for the differences of survival between the patients receiving RRT and those who did not was < 0. 01 meaning that the differences were statistically significant.

Conclusion: AKI in critically ill patients is further related with high mortality predominantly in patients on RRT. It was observed that intervention at an early stage of the disease process and management of patients according to the probable aetiology can enhance the life span and diminish the magnitude of renal dysfunction in the long-term follow-up.

Key Words: AKI, critically ill, patients, RRT

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INTRODUCTION

The AKI is a major clinical concern and it mainly affects the critically ill patients admitted in Intensive Care Units (ICUs)[1]. It is defined by the abrupt decline in filtration capacity of the kidneys in the ability to excrete waste products, marked changes in electrolyte levels and of water and electrolyte homeostasis[2]. Hemorrhagic AKI can occur in hours to days and it may be due to sepsis, trauma, surgery and nephrotoxic agents.

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It has been found to be associated with significant substantial increase in morbidity, length of ICU, stay as well as mortality among critically ill patients. AKI is frequent in ICUs because 35-50% of critically ill patients develop this condition.[3] The mortality of AKI depends substantially with patients who require RRT; this is because the mortality rates are usually above 50%[4]. AKI diagnosis is vital due to its poor prognosis because the magnitude of kidney injury is proportional to the risk of the death and due to the fact that its early stages do not have unique biomarkers and owns a rather diverse clinical picture. The current diagnostic criteria for AKI are based on the Kidney Disease: system that has been developed based on the changes in serum creatinine level and urine output is the Kidney Disease: Improving Global Outcomes (KDIGO) classification of AKI into three degrees of severity[5]. However, serum creatinine, a marker of AKI, is usually adopted in practice and this often results to a late identification of AKI and a consequent delay in the intervention. Studies on other biomarkers like NGAL and cystatin C which have been proven to give a better detection of AKI as compared to the traditional SCr have not yet been

widely implemented in clinical use[6]. Treatment of AKI in critically ill patients is mainly supportive, therefore maintenance of hemodynamic stability, adequate hydration and removal of any potentially nephrotoxic drugs[7]. In some circumstances, a patient requires RRT for supporting renal function and electrolyte as well as fluid homeostasis. There are also different modalities of RRTs such as intermittent hemodialysis (IHD), continuous renal replacement therapy (CRRT), and sustained low-efficiency dialysis (SLED)[8]. Depending on the patient's hemodynamic status and the resource available in the intensive care unit, the modality used in accomplishing the goal may be used[9]. This has been the case for critical care as well as AKI management even with the developments registered in these two fields. A long-term complication of AKI is CKD and need for long-term dialysis[10]. Finding out those patients who may be at high risk to have AKI, and starting the appropriate treatment modalities early can go a long way in managing this condition or reducing its impact. There is evidence that early start of RRT in the ICU patients with AKI may decrease the mortality; however the best time to initiate RRT is still under debate[11]. More clinical trials are required to define more a clear and specific guideline on AKI management such as in the use of fluids, time for commencing RRTs and implementation of new biomarkers[12]. The purpose of this research is to assess the delineation, approach, and result of AKI among critically ill patients who are admitted in ICU. This study was carried out to determine the factors that are linked with the poor prognosis in an attempt to help in the enhancement of medical management of patients with AKI.

METHODS

This prospective cross-sectional study was carried out in the ICU of a 300 bedded tertiary care hospital in a single centre for one year. The patients were 150 in number, critically ill patients with at least 18 years of age, who were diagnosed to have AKI using the KDIGO criteria during their stay in the ICU. Those patients who have other associated comorbidities such as ESRD or those on chronic dialysis were excluded from the study. Information regarding the patients' characteristics including age, gender, co-morbid diseases, disease severity and overall outcome were obtained.

Data Collection: Information was obtained on a data collection form that included participants' demographic details, history that led to ICU admission, laboratory findings of kidney function, RRT status and outcomes of the patients. AKI was working out with daily output of urine as well as serum creatinine concentrations.

Statistical Analysis: Data were analyzed using Statistical Package for Social Sciences version 20.0. Quantitative data was described in terms of Mean and Standard Deviation while Qualitative data was described in terms of frequency and proportion. Statistical significance was determined using p-value of <0. 05. Evaluations of the survival rates of the patients were carried out by Kaplan and Meier survival curves while the predictors of mortality were established via multiple logistic regression models.

RESULTS

Out of the 150 critically ill patients 45 percent developed AKI. In patients with AKI, the mean age was 60. 2 years (standard deviation, ±10. 4) and 171 were male whereas 95 were female. Among all the cases of sepsis, 60% developed AKI due to sepsis, nephrotoxic drugs and major surgery ranked the second and the third reason. The mean serum creatinine at AKI diagnosis was 2. 8±0. 5 mg/dL not different from Non AKI patients. Among patients who funnelled to AKI, 30% needed on RRT and overall mortality in the AKI group was 35%. The mortality rate was also higher with 55% among the patients who needed RRT($p < 0. 01$). Another factor found to be negatively affected by AKI was the number of days spent in the ICU; patients with AKI spent a mean of 15. 6 days (± 4. 2 days) in ICU while those without AKI.

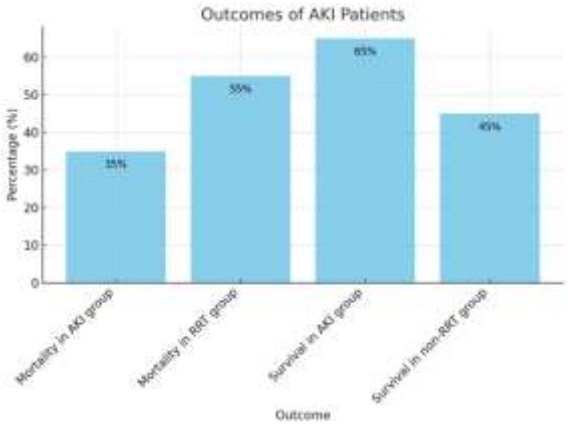

Figure No.1: Outcomes of AKI patients with percentage

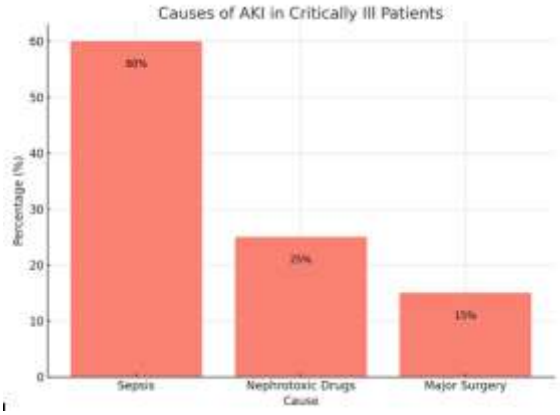

Figure No.2: Causes of AKI in critically ill patients

Table No.1: Patient Characteristics

Characteristics	Patients with AKI
Age (Mean ± SD)	60.2 ± 10.4
Male to Female Ratio	1.8:1
Sepsis	60%
Nephrotoxic Drugs	25%
Major Surgery	15%

Table No.2: RRT Requirement in AKI Patients

RRT Requirement	Patients (%)
Yes	30%
No	70%

Table No.3: Outcomes in AKI Patients

Outcome	Patients (%) or Days
Mortality in AKI group	35%
Mortality in RRT group	55%
Length of ICU stay (Mean ± SD)	15.6 ± 4.2 days

Table No.4: Causes of AKI

Cause	Percentage (%)
Sepsis	60%
Nephrotoxic Drugs	25%
Major Surgery	15%

DISCUSSION

This study's results are consistent with studies in some aspects that relate to AKI, including its prevalence, treatment, and prognosis in the mechanically ventilated critically ill patients. It is widely documented that AKI is a common problem in the ICU and published prevalence has been reported to range between 20- 50% across populations and based on different diagnostic definitions.[13] This study yielded an AKI incidence of 45%: our finding is therefore well-aligned with these statistics. More so, sepsis as identified in this study was the most common cause of AKI in the critically ill patients constituting 60% of cases, this is in tandem with Hoste et al[2] who also reported sepsis as the most prevalent cause of AKI in ICU patients. AKI in critically ill patient remains an area of interest in terms of when RRT should be initiated. Gaudry et al[11] and Zarbock et al[14] have attempted to establish difference in the clinical outcomes between early start of RRT and the late start. When regarding RRT initiation timing, Gaudry et al[11] could not detect any difference in mortality among early and delayed RRT initiations while Zarbock et al have reported higher survival rates among patient who underwent early RRT.[14] Twenty out of sixty patients required RRT, and the mortality of those patients was significantly high which is 55% indicating the significance of AKI requiring RRT. The high mortality rate in RRT patients has been documented by other researchers with the rate of death ranging from 50– 60%. Currently, it is still not clear what counts as early and what constitutes as delayed RRT initiation; more studies need to be conducted to come to a conclusion. Managing volumes is an important consideration in the care for the patient with AKI and many studies have shown the dangers of hypovolemia and volume expansion. Hence, Prowle et al[9]. Established that fluid overload is an independent determine of poor prognosis in AKI patients and would lead to increased duration of stay in the ICU plus increased mortality. We also found out that the hospital stay in the ICU was also longer for the patients with AKI compared to patients without AKI averaging 15. 6 days in the ICU as has been observed earlier. The issue of fluids is very sensitive and any wrong approach to the matter may lead to the worsening of the condition of the kidneys and the patient as a whole[15]. Thus, the mortality in AKI patients in our study was35% which is in concordance with the 30-50% global mortality rate in AKI patients in ICUs established by Uchino et al[7]. Thus, the high mortality that when linked to AKI and other diseases, including sepsis, is a prominent threat in the critical care setting. Other causes of AKI defined in this study include, sepsis was noted to cause 30% of AKI, nephrotoxic drugs and major surgery played a 25% role each in the development of AKI. Such nephrotoxic drugs have also been described by Hoste et al[16] as a major contributing factor to AKI among the critically ill patients especially those on multiple medications. Notably, in recent years, long-term prognosis data of patients who survived AKI have gained priority. Some research revealed and it correlates with this idea that AKI survivors are at a significantly higher risk for CKD and other enduring results[17]. Coca et al[10] carried out meta-analysis in which they found significant relationship between AKI and CKD progression. In the present study, we did not evaluate mid to long-term complications, however given high mortalities and RRT use in a large proportion of patients, for those who survive the initial injury there seems to be a high risk for other complications. In the light of the study therefore, it can be said that the results of this study are consistent with existing literature on the incidence, causes, and prognosis of AKI in critically ill patients. High mortality, which is even higher in patients requiring RRT, speaks for early diagnosis, careful volume manipulation and the most effective therapeutic approach. Additional studies are required for the identification of the optimal trigger for RRT and the comparative analysis of the AKI survivors' prognosis.

CONCLUSION

AKI in critical illnesses portends adverse prognosis in terms of longer lengths of stay in the ICU, higher mortality, and elevated requirement for RRT. The focus should be put to timely diagnosis, intervention coupled with effective management including optimal fluid

balance, timing of RRT initiation and mode among others.

Limitations: The limitation of the present study is the fact that it is conducted at a single center and as such the results may not be representative of the rest of other centers. Moreover, factors such as renal recovery and mortality rate or the long-term consequences like development of Chronic Kidney Disease (CKD) were not considered in AKI survivors' follow-up.

Future Findings: Further studies should aim at understanding the outcome of patients with AKI and subsequent CKD as well as the quality of life these patients experience. Therefore, there is a need for future research regarding the identification of the right time for RRT start as well as the use of new biomarkers for early AKI diagnosis.

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Author's Contribution:

Concept & Design of Study:	Najm Uddin, Shahid Razwan Safir
Drafting:	Waqas Sardar, Shahid Iqbal
Data Analysis:	Aimal Khan. Abdul Haseeb
Revisiting Critically:	Aimal Khan, Abdul Haseeb
Final Approval of version:	By all above authors

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