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Incidence and outcome of Acute Kidney Injury in patients admitted in a level III ICU in Nepal: A retrospective, observational study.

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ABSTRACT

Background and aims: Acute kidney injury (AKI) is associated with increased mortality, morbidity, and hospital stay. AKI is seen in 20-60% of patients admitted to the intensive care unit (ICU), and mortality is as high as 50% if not managed timely. Burden of AKI is more in developing countries as compared to the developed ones. There is a paucity of published literature regarding incidence and outcome of AKI in critically ill patients from lower-middle income countries like Nepal. This study aimed to determine the incidence and outcome of AKI in patients admitted to a level III ICU in Nepal.

Methods: This observational study was conducted in the ICU of Hospital for Advanced Medicine and Surgery (HAMS) Hospital, Kathmandu, Nepal. Data over a period of one year was curated from ICU registry. Eligible patients were screened and the incidence of AKI in ICU admitted patients along with their outcomes (length of ICU stay, need of RRT and ICU mortality) were observed.

Results: Among 881 patients admitted to the ICU, 660 patients were enrolled for analysis. Of them, 14.2% of patients developed AKI during ICU stay, out of which 5.3% received RRT and 19.1% died. The median (IQR) length of ICU stay for those who developed AKI was 4 (3-7) days. The 34.0% patients who developed AKI had sepsis.

Conclusion: Patients admitted to ICU in this study have high incidence of AKI. In patients who developed AKI, sepsis was the leading cause of ICU admission.

Keywords: *Acute Kidney Injury (AKI), incidence, Intensive Care Unit, outcome.*

INTRODUCTION

Acute kidney injury (AKI) is a sudden reduction in kidney function determined on the basis of increased serum creatinine level and decreased urine output.[1] AKI is a major health problem worldwide and is associated with higher rate of mortality, morbidity and risk of developing chronic kidney disease (CKD).[2,3] The incidence and outcome of the patients with AKI differ significantly between developing and developed countries. Cases of AKI from developing countries account for more than 85% of the global burden.[4,5] AKI is a commonly encountered condition in critically ill patients admitted in Intensive Care Unit (ICU) and has been linked with increased rate of mortality, longer ICU stay and use of renal replacement therapy (RRT).[6]

Based on the definition of AKI used, it has been estimated that up to 15% of hospitalized patients and up to 60% of ICU admitted patients develop AKI.[7-9] On an average, over 5% of patients with AKI in ICU need RRT.[8] Similarly, the risk of mortality in patients with AKI has been reported to be as high as 50%.[9,10] Sepsis, pre-existing chronic kidney disease, use of vasopressor, severity of illness, diabetes mellitus and hypovolemia are the major risk factors of developing AKI in ICU admitted patients.[11] Various studies from around the world have shown a high incidence of AKI in ICU admitted patients, with worse outcomes in-terms of mortality, length of ICU stay and need of RRT compared to other critically ill patients who do not develop AKI in ICU.[11-13] However, there are very limited studies and data from low- and middle income countries (LMICs).[4,5,12] There is a great need to define the extent and outcome of AKI in critically ill patients in LMICs like Nepal, a key step for improving outcomes and achieving the proposed goal of zero preventable deaths from AKI by the year 2025 as set by International Society of Nephrology (ISN).[12] To our knowledge, there is little data on the incidence and outcome of AKI in ICU admitted patients in Nepalese hospitals.[12-14] Knowing the burden of AKI in ICU is the initial step in planning measures to address it.

The aim of this study is to estimate the incidence of AKI in patients admitted to this ICU and determine the outcome of such patients in terms of length of ICU stay, need of RRT, and ICU mortality.

METHODS

This was a retrospective, observational study conducted using registry data obtained from Nepal Intensive Care Research Foundation (NICRF). The study was supported by a grant received from NICRF. Patients admitted in the ICU of Hospital for Advanced Medicine and Surgery (HAMS) from 1st January 2022 till 31st December 2022 were screened after obtaining ethical clearance from the Institutional Review Committee of HAMS [Ref: HAMS/IRC No. 02-2024; dated January 5, 2024].

Patients aged 18 years or older who developed AKI during the ICU stay were included in the study. The exclusion criteria were: patients who had been previously diagnosed with CKD, those receiving renal replacement therapy (RRT) on regular basis prior to the study, diagnosed as AKI before ICU admission and/or patients with serum creatinine level >1.5mg/dl at the time of ICU admission, re-admitted patients who were already included in this study during the same hospital stay and those with incomplete data in the registry.

The clinical and demographic data of the patients, including age, gender, co-morbidities, primary diagnosis at ICU admission, use of vasopressors, use of antibiotics, serum creatinine at admission, and AKI stage, were collected. The incidence of AKI in ICU admitted patients and their outcomes (length of ICU stay, need of RRT and ICU mortality) were recorded.

The Kidney Disease Improving Global Outcomes (KDIGO) clinical practice guidelines was used to define and stage the severity of AKI. The diagnosis of AKI was based solely on the rise in serum creatinine level. Due to the retrospective nature of the study and the unavailability of the urine output data, urine output criteria was not included for AKI diagnosis in this study.

The data was entered in Microsoft excel 2013 and then exported to IBM SPSS version 20 for statistical analysis. Categorical variables were expressed as frequency and percentages. Continuous variables were expressed as mean with standard deviation or median with interquartile range.

RESULTS

A total of 881 patients admitted to the ICU during the study period were screened. Out of this, 660 patients were eligible for the study. Among the 660 patients included in the study 94 patients (14.2%) developed AKI during the ICU stay. The mean age of patients who developed AKI during ICU stay was 63.6 ± 17.6 years. Most of the patients, 63.8% (n=60) who developed AKI during ICU stay were 60 years or above. The majority of patients who developed AKI were male (60, 63.8%).

The baseline serum creatinine level (mean ± SD) of the patients who developed AKI post-ICU admission was 0.87 ± 0.25 mg/dl (range [0.4 – 1.4]), while it was 1.63 ± 1.19 mg/dl (range [0.7 – 5.5]) at the time of diagnosis of AKI. According to the severity of grading of AKI, 74.5%, 19.1% and 6.4% of patients had stage 1, stage 2 and stage 3 respectively.

Hypertension (59.6%) was the most common co-morbidity followed by diabetes mellitus (35.1%) and chronic respiratory disease (10.6%) in patients who developed AKI. Similarly, 29.8% of the patients had both hypertension and diabetes mellitus as their co-morbidities (Table 1).

Table 1. Clinical characteristics of the patients who developed AKI (n=94)

Characteristics	Frequency (percentage)
Gender	
Male	60 (63.8)
Female	34 (36.2)
Comorbidities	
Hypertension	56 (59.6)
Diabetes Mellitus	33 (35.1)
Chronic respiratory diseases	10 (10.6)
Hypothyroidism	3 (3.2)
Cardiovascular diseases	2(2.1)
Stage of AKI	
1	70 (74.5)
2	18 (19.1)
3	6 (6.4)
Need of RRT	
Yes	5 (5.3)
No	89 (94.7)
Need of vasopressors for Shock	
Yes	35 (37.2)
No	59 (62.7)

The main reason for ICU admission in patients developing AKI was sepsis (34.0%), respiratory disease (23.4%), neurological disorder (15.9%), cardiovascular disease (14.9%), trauma (3.2%) and others (15.9%) (Figure 2). Among them, 15 patients (15.9%) were already on at least one vasopressor agent before admission to ICU and 35 patients (37.2%) received at least one vasopressor agent during their ICU stay for hypotension.

In this study, out of 94 patients who developed AKI after ICU admission, 80.8% (n=76) were receiving at least one antibiotic and out of them 35.5% (n=27) were receiving at least one nephrotoxic antibiotic such as vancomycin, gentamicin, amikacin, piperacillin/tazobactam and others.

Among 94 patients who developed AKI after ICU admission, 5 patients (5.3%) required RRT. A total of 18 patients (19.1%) who had developed AKI died in ICU, out of which the mortality of patients receiving RRT was 40% (2 out of 5) and that of those not receiving RRT was 18%. The median (IQR) length of ICU stay for those who developed AKI was 4 (3-7) days (Table 2).

Table 2. Outcome of patients who developed AKI after ICU admission.

Outcome	Number (percentage)
Need of RRT [n, (%)]	5 (5.3%)
Length of ICU stay [median (IQR)]	4 (3-7) days
ICU mortality [n, (%)]	18 (19.1%)
ICU mortality in patients receiving RRT [n, (%)]	2 (40%)

DISCUSSION

AKI is a growing problem in patients admitted to ICU and is associated with mortality, morbidity, chronic kidney disease and prolonged hospitalization.[13] However, there is limited data in Nepal regarding the incidence and outcome of patients who develop AKI during ICU stay.

Out of 660 patients eligible for our study, 94 patients (14.2%) developed AKI during ICU stay, which is lower than that seen in Jordan (31.6%) and Sudan (34.8%), which might be attributed to different patient population and variable reasons for ICU admission.[14,15] Our study wasn't only limited to patients with sepsis, but also included patients with cardiovascular, neurological and other diseases requiring ICU admission.

The mean age of patients who developed AKI during ICU stay was 63.6 ± 17.6 years, which is similar to a study done in Indonesia.[13] More than 60% of our patients with AKI were 60 years and above as elderly are prone to develop AKI due to kidney senility (glomerular filtration rate declines by approximately 1ml/min/m^2 per year starting from the third decade of life). In addition, people in the older age group are more likely to have comorbidities like long-standing diabetes, hypertension which can predispose to decreased renal function.[14]

In this study, AKI predominantly developed in male patients who had at least one co-morbidity, mostly hypertension or diabetes mellitus, similar to that reported from Indonesia and Sudan.[13,16]

Most patients had KDIGO stage 1 AKI (74.5%), followed by stage 2 and 3, which is consistent with other studies and

reflects early detection in the ICU.[15] However, studies done in Indonesia and India reported that the majority of patients had stage 2 and stage 3 AKI with stage 1 being the least common which might be due to delay in timely detection of AKI.[13,17]

Only 5.3% of patients with AKI required RRT in our study which is similar to that reported in a study done in Laos.[18] However, India reported a much higher rate (21.8%) of RRT among patients who developed AKI after ICU admission.[19] This may be because majority of the patients in our study had stage 1 AKI whereas in the study done in India majority of patients had stage 2 and stage 3 AKI.

In our study, ICU mortality of the patients who had developed AKI was 19.1% (n=18), which is consistent with a study from China (21.8%), whereas it was reported to be as high as 44.5% in a study conducted in Laos.[15] This difference might be due to the fact that most of the patients in the study done in Laos had stage 3 AKI, while ours had stage 1 AKI. Notably, ICU mortality among patients who had not developed AKI during ICU stay in our study was only 7.2%. The mortality of patients receiving RRT was 40% (2 out of 5) in our study. This high rate of mortality in patients receiving RRT may be because RRT has been reported to be an independent risk factor for mortality in AKI and does not reverse the negative impact of AKI.[17,18] Recent multicenter, randomized controlled trail in septic patients with AKI has shown that a 'watch and wait' approach resulted in lesser RRT use and did not increase mortality.[17]

The length of ICU stay (median with IQR) for those who developed AKI was 4 (3-7) days in our study, which is similar to that reported from Laos (median with IQR) 3 (2-4) days. Study from India reported length of ICU stay (median with IQR) to be 6(3-9) days and that from Sudan was 6.7 ± 3.8 (range 2-17) days. Shorter ICU stay of patients in our study may be because of lesser severity of kidney injury, i.e. stage 1 AKI being more prevalent (74.5%) with lower AKI related complications, while stage 2 and 3 AKI was more commonly seen in India and Sudan.[16,19]

The present study has few limitations. First it was a study done in single ICU setting, which may not represent patients who develop AKI in other ICUs around the country. Second, as we had no data on urine output, only serum creatinine value was taken to diagnose AKI. Had urine output criteria been implemented in the study, the incidence of AKI might have been different in our study. The detection rate of AKI is almost double when urine output criteria is also used compared to when serum creatinine alone is used for AKI diagnosis.[20] Third, these patients represent various stages of AKI and need further follow-up for potential recovery or progression to CKD. So, a longer duration of follow-up would have better represented the actual adverse effects of AKI developed in ICU.

CONCLUSION

The burden of AKI in critically ill patients admitted in our ICU is high. Sepsis was the leading cause of ICU admission in patients who developed AKI.

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