SPECTRUM OF ACUTE KIDNEY INJURY IN CRITICALLY ILL PATIENTS IN MEDICAL ICU: A SINGLE CENTER HOSPITAL-BASED STUDY FROM NORTH-EASTERN INDIA

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ABSTRACT

BACKGROUND

Acute Kidney Injury (AKI) is a rapid and usually reversible decline in glomerular filtration rate (GFR) that may occur in the setting of either preexisting normal kidney functions or pre-existing damaged kidney. AKI in the ICU is associated with mortality as high as 45–50%, with dialysis dependence, with reduced quality of life, and with excess utilization of health resources. The aim of this study was to analyse the incidence, prognostic factors, and outcome of AKI in critically ill patients in the setting of a medical ICU.

MATERIALS AND METHODS

A single centered prospective observational study was carried out at Silchar Medical College and Hospital, Silchar, Assam for a period of 2 years 2015- 2017. A total of 200 patients with AKI, defined by RIFLE criteria, during this period, who met our study requirements were evaluated.

RESULTS

AKI was predominantly encountered in older males. Diabetes, hypertension, coronary artery disease were the most commonly prevalent comorbidities. Sepsis was the most common cause of AKI, accounting for 38.6% of patients. RRT was required by 34.5% patients. In the hospital, mortality was 32.5%.

CONCLUSION

AKI has a tremendous effect on prognosis. Septic AKI exerts an important and independent increase in the risk for hospital death. A meticulous approach is needed for the better outcome in ICU settings.

KEYWORDS

AKI, Sepsis, ICU, Mortality, Comorbidities.

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BACKGROUND

Acute kidney injury (AKI) is a rapid and usually reversible decline in glomerular filtration rate (GFR) that may occur in the setting of either preexisting normal kidney functions or pre-existing damaged kidney. In the ancient Greek period, the diagnosis was made only by observing a reduction in urine volume. In the modern era, however, the developments seen in fields of biochemistry and pathology have enabled us for clinicopathologic correlation and early diagnosis of AKI.[1] Two trials, namely program to improve care in acute renal disease (PICARD) and beginning and ending supportive therapy (BEST) for the kidney, confirmed that AKI is a significant contributor toward mortality, morbidity among Intensive Care Unit (ICU) patients.[2,3,4]

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In critical care settings, patients with acute kidney injury (AKI) constitute an important subgroup, in that they have higher short and long-term mortality, prolonged hospital length of stay, and more resource consumption.[5,6] Incidence of AKI in ICU patients ranges between 20-70% according to settings and among these, patients who undergo renal replacement therapy (RRT) portend even worse outcome.[7] AKI in the ICU is associated with mortality as high as 45–50%, with dialysis dependence, with reduced quality of life, and with excess utilization of health resources.[8] On the basis of referrals to the centre of dialysis in different tropical countries, it is postulated that acute kidney injury is a clinical entity which is seen more common in the tropical countries of the globe even though the exact statistical figures are not readily available.[9] There is a paucity of data regarding the incidence and spectrum of AKI in critically ill patients from the Indian subcontinent especially North-Eastern India. In view of this, we have conducted a prospective, observational study of patients who has been admitted to the medical ICU in a tertiary care center in North-Eastern India.

Aims and Objectives

The aim of this study was to analyse the incidence, prognostic factors, and outcome of AKI in critically ill patients in the setting of a medical ICU in a tertiary care hospital in the region using the RIFLE criteria.

MATERIALS AND METHODS

The present study was a prospective, observational study conducted in the Department of Medicine, Silchar Medical College & Hospital, a tertiary level referral center in North-eastern India, for a period of 2 years from November 2015 to October 2017. 1080 patients were admitted to the ICU during this period. A total of 781 patients who met our study requirements were evaluated. AKI was defined as patients whose serum creatinine and/or urine output fulfilled the RIFLE criteria. Oliguria was defined as urine output below 500 ml/day.

Class	Urine output	GFR
R	<0.5 mL/kg/h for 6 h	Serum creatinine 1.5 mg/dL
I	<0.5 mL/kg/h for 12 h	Serum creatinine 2.0 mg/dL
F	<0.3 mL/kg/h for 24 h or anuria for 12 h	Serum creatinine 3.0 mg/dL or creatinine 4.0 with acute rise >0.5 mg/dL
L		Complete loss of kidney Function >4 weeks
E		ESRD >3 months

ESRD: End-stage renal disease; GFR: Glomerular filtration rate; RIFLE: Risk, Injury, failure, loss, end

Inclusion and Exclusion Criteria

All patients aged above 18 years admitted to ICU with AKI and those who developed AKI after admission to ICU, during the study period, were included in our study. Patients with preexisting renal disease and those who received renal transplantation or were on other forms of RRT before admission were excluded from the study.

In addition to the demographic factors like age, sex, date of admission to ICU, and preexisting co morbidities were recorded. The presence of sepsis and septic shock, requirement of vasopressors was recorded. Sepsis was diagnosed if the patient had a possible infection and fulfilled at least two systemic inflammatory response syndrome criteria. Details regarding renal replacement therapy (RRT) were collected. Haemodialysis (HD) is the only method used for support of patients with loss of renal function in our center. The patients were followed up till discharge from admission. Outcomes looked at were in hospital mortality and requirement of HD in AKI.

Statistical analysis was done using SPSS 22.0. Continuous variables were presented as mean (±standard deviation). Univariate statistical analysis was performed by Chi-square test for comparing proportions and ANOVA for comparing means. The value $P < 0.05$ was considered to be statistically significant.

RESULTS

Total admissions in our medical ICU between during the study period were 1080 patients. After excluding patients with ESRD and patients under 18 years of age, we collected data of 781 patients. Out of these 781 patients, 200 had AKI. The crude incidence of AKI was 25.6%.

Epidemiology

Majority of patients with AKI belonged to the age group of 61-70 years accounting for 26.5% (n = 53) of total patients. The median age of the patients was 55.5±8.6 years, lying in the age group of 51-60 years. AKI was more commonly associated with male sex, 68.5% (n= 137) of the patients were males. Type 2 diabetes mellitus was the most common comorbidity followed by hypertension and coronary artery disease. Chronic liver disease, chronic obstructive pulmonary disease, cerebrovascular accidents, malignancy were the other common comorbidities. About 51.5% (n= 103) of patients with AKI did not have any comorbidities.

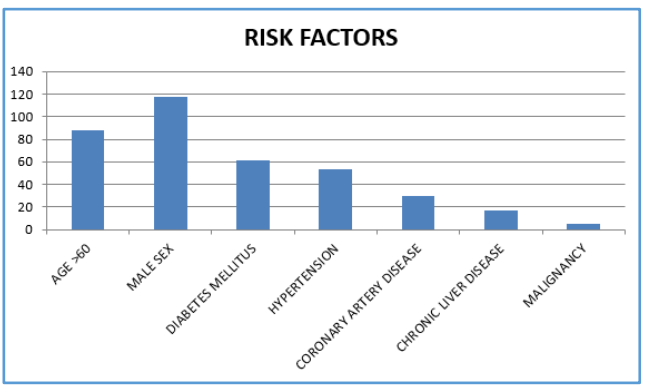

Figure 1. Risk Factors for AKI in present study

Risk factors	No. of Patients
1) Age >60 years	88 (44%)
2) Male Sex	117 (68.5%)
3) Diabetes Mellitus	61 (30.5%)
4) Hypertension	53 (26.5%)
5) Coronary Artery Disease	30 (15%)
6) Chronic Liver Disease	17 (8.5%)
7) Malignancy	5 (2.5%)

Table 1. Risk Factors for AKI in present study

Aetiology

Among the patients (n = 200) enrolled in our study, most common cause of AKI was sepsis. Urinary tract infections were the most common source of sepsis, followed by respiratory infections. Gastroenteritis was the second most common cause of AKI in our study. Malaria, dengue, leptospirosis, Drug induced AKI, snake bite were the other causes of AKI, although less common. Organophosphates accounted for two cases. The observations regarding the aetiology of AKI in our study are summarized in Table 1.

Aetiology	No. of Patients
1) Sepsis	85(42.5%)
2) Acute Gastroenteritis	27(13.5%)
3) Cardiac Causes	13(6.5%)
4) Hepatic Causes	16 (8%)
5) Malaria, Dengue, Leptospira	14 (7%)
6) Poisoning	5 (2.5%)
7) Snake Bite	4 (2%)
8) Drug Induced	11 (5.5%)
9) Others	25 (12.5%)
Total	**200 (100%)**

Table 2. Aetiology of AKI in present study

Clinical Characteristics

Hypotension was the most commonly associated clinical finding, prevalent in 57% (n = 114) of the patients. 73% (n = 146) of the patients were oliguric and 27% of the patients non-oliguric. Non-oliguric patients had faster renal recovery. Fever, tachycardia, hypovolemia, oedema were seen in 46.0% (n = 92), 31.0% (n = 62), 23.0% (n = 46) and 16.0% (n = 32) of the patients respectively. The other commonly associated findings were pallor (32.0%, n = 64), icterus (9.0%, n = 18), cyanosis (11.0%, n = 22).

Baseline Characteristics	Survived (N=135)	Expired (N=65)	P value
Male:	87 (64.44%)	50 (76.92%)	0.023
S. Creatinine Level on Admission:	1.53 ± 0.82	2.21 ± 0.62	0.001
Apache ii Score:	15.6 ± 7.1	23.3 ± 4.6	0.004
Rrt Requirement:	28 (20.74%)	41 (63.07%)	0.001
Use of Vasopressors:	72 (53.33%)	49 (75.38%)	0.001
Outcome			

Average duration of ICU stay was 8.1 days. 31.5% (n =63) of patients in the study group required RRT during their stay in ICU. Majority of the patients, who required RRT, received intermittent haemodialysis. The median duration of dialysis requirement was 8 days. This varied with aetiology. Acute gastroenteritis (GE), drug induced AKI required shorter duration of dialysis, median 3 days. Sepsis, acute pancreatitis required longer duration of dialysis, median 8.7 days. 60.5% (n = 121) of the patients required inotropic support. Among them, 22 patients required 3 or more inotropic drugs. 20 out of these 22 patients expired. 57.5% (n = 117) of the patients recovered with complete renal function restored. The crude mortality rate was 32.5% (n = 63).

DISCUSSION

AKI is a frequently observed clinical syndrome in intensive care unit (ICU), with overall incidence of 20-50%, associated with the mortality rate over 50%.[10] Paudel et al., in a prospective observational study of 100 critically ill patients in New Delhi, India showed that the incidence of AKI is 17.3 cases per 100 person years.[11] Joannidis et al. in their study involving 16,784 ICU patients, found that the prevalence of AKI in ICU was 28.5% using the AKIN criteria and 35.5% using the RIFLE criteria.[12] A study by Bagshaw et al. in Australia, involving 120,123 patients found the prevalence of AKI to be 36.1%[13] whereas the present study noted the incidence of 25.6% in the ICU patients. This highlights the significant risk AKI poses to critically ill patients.

Risk Factors

AKI was predominantly encountered in elderly age (>60 years) and male sex in the present study. Two large studies have shown the median age of AKI in critically ill patients to be 63 and 67 years respectively[12,14] Although gender, race have not been shown to alter AKI susceptibility in previous studies, age has been consistently shown to be a risk factor.[15] In accordance with previous literature, our study highlights the potential risk of AKI in critically ill, elderly patients especially above the age of 60 years. Majority of patients with AKI had preexisting comorbidities, type 2 diabetes, hypertension, coronary artery disease being the three most common. Liver, lung and neurological diseases, although less common were the other significant comorbidities seen in the patient population. These findings are in agreement with a review study by Rodrigo et al., which demonstrated a significantly increased risk of AKI in critically ill patients with older age, diabetes, hypertension, higher baseline creatinine, heart failure, sepsis, use of nephrotoxic drugs, higher severity of disease scores, use of inotropes, high risk surgery and emergency surgery[15]

Aetiology

Sepsis was the most common cause of AKI in our study accounting for more than one third of the cases. The role of sepsis in AKI has been well documented in western literature, causing nearly 50% of the AKI cases in few studies.[16] Jha et al., and Prakash et al., which evaluated AKI irrespective of ICU setting had shown that nephrotoxic drugs were the most common cause of AKI.[17,18] Kaul et al., in their study have reported acute diarrhoea as the most common cause.[19] In our study drug induced AKI accounted for only 5.6% of the cases, which is lower than the previous studies. This might suggest that increasing knowledge of precautions regarding nephrotoxic drugs have helped to reduce the incidence of drug induced AKI. The most common source of sepsis in our study was urogenital. This is in contrast to a multicenter, multinational study by Bagshaw et al., found that the predominant sources of sepsis were chest and abdominal (54.3%) with urogenital sepsis accounting for only 4.1% of septic AKI.[13] The higher number might be attributed to the fact that our institution is a tertiary care center, managing patients referred after developing renal complications. Malaria, dengue, leptospirosis and snake bite accounted for 9.0% (n = 18) of the cases of AKI. These represent a unique aetiology spectrum of AKI in our country in comparison with the western literature.

RRT was required in 34.5% (n = 69) of the patients in our study. Previous Indian studies by Prakash et al., and Singh et al. reported that 34% (n = 28) and 20.58% (n = 7) of the cases respectively, required RRT[20] However, these studies did not specifically evaluate AKI patients in ICU but studied them irrespective of the hospital setting. Intermittent haemodialysis was the most commonly used modalities of RRT in our hospital. These modes are associated with lower cost, lesser adverse effects when compared to the other RRT modes. In our study, although the mortality rate was higher among patients receiving RRT which is in agreement with other western studies like Paudel MS et al[11] however it was not statistically significant (P = 0.12).

Outcomes

The total mortality rate in our study was 32.5% (n = 65). Several large scale studies conducted world-wide have

established that AKI identified by RIFLE criteria in critically ill patients is associated with statistically significant increase in mortality.[6,18] Joaniddis et al., in their study of ICU patients showed that the mortality rate among patients classified to have AKI by RIFLE criteria was 36.5%.[12] In the study by Ali et al. involving 474 patients with AKI, the in hospital mortality was found to be 32.7%.[16] Complete renal recovery is less commonly reported in the literature, however few studies have previously shown that the majority of patients recover sufficient renal function with one study even showing 68.0% of patients recovered completely. The excellent recovery seen in our study, might be due to the exclusion of patients with preexisting renal disease and prompt recognition and early institution of appropriate treatment regimen including RRT where deemed necessary.

A study by Bagshaw et al,[13] which included 120, 123 critically ill patients, found that 36.1% of the patients had AKI according to RIFLE criteria, with 16.2% in the risk class, 13.6% in the injury class and 6.3% in the failure class. They also reported that the mortality rates were 17.9% in the risk group, 27.7% in injury group and 33.2% in failure group. Interestingly in present study, the higher number of patient belonged to injury class (38.7%), followed by failure (21.2%) and risk classes (19.8%). This might be due to the fact that our hospital is a tertiary referral center where most of the referred patients presented in more severe stages of renal injury. The observed mortality rates in our study were highest in the failure class, followed by injury and risk classes, but the difference did not reach statistical significance. This might be attributed to the fact that primary diagnosis and underlying aetiology of renal injury and extent of renal parenchymal damage are equally important predictors of mortality in addition to RIFLE class. However, our study did not include critical illness scoring systems to further stratify patients, which limits our observation.

CONCLUSION

A quarter of the critically ill patients attending intensive care units present with or develop AKI in the course of their illness which significantly determines the eventual outcome. Sepsis was the most common cause of AKI in the critically ill patients in our study. Age>60, male gender was prevalent in the majority of AKI patients. More than 60% of the patients had associated comorbidities, with type 2 diabetes, hypertension and coronary artery disease being the three most common. Majority of the patients did not require RRT and were treated conservatively. Crude mortality rate among patients with AKI in our study group was 32.5%. In view of AKI's tremendous effect on prognosis, we propose using the AKI classification as a risk assessment tool for clinicians. Larger prospective randomized controlled trials are needed in order to ascertain whether the application of treatment measurements targeting the AKI play a role to improve patient prognosis.

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