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Original Research Article

A Hospital Based Observational Study to Estimate the Clinical Prognosis of Patients with Diagnosis of Acute Kidney Injury

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Abstract

Aim: The aim of the present study was to estimate the clinical prognosis of patients with diagnosis of acute kidney injury.

Methods: The present study was conducted in Upgraded Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India for two years and 200 patients were included in the study.

Results: In the present study, 66% were male and 34% were females. 35% had low PRSIM classification followed by very high 26%. 80% had pre-renal AKI. Patients with a maximum KDIGO stage 3 AKI during PICU stay was associated with higher use and duration of mechanical ventilation in comparison with patients with maximum stages 1 and 2. The mean time of mechanical ventilation was 4.7 days for patients with a maximum KDIGO stage 1 AKI, 5.7 days for a maximum KDIGO stage 2, and 8.5 days for a maximum KDIGO stage 3.

Conclusion: Acute kidney injury, established and classified according to KDIGO as severe and its maximum stage, was associated with worse clinical outcomes; early therapeutic efforts should focus on preventing the progression to severe stages.

Keywords: Acute Kidney Injury, Prognosis, Diagnosis.

Introduction

The kidney is critical in maintaining a stable internal environment by regulating the body fluid volume, maintaining electrolyte balance, and excreting potentially metabolic toxic end products. Glomerular filtration, tubular reabsorption, and tubular secretion are involved in forming urine. Glomerular infiltration involves the ultrafiltration of plasma in the glomerulus, and the filtrates, including water, salts, glucose and urea, are accumulated in the urinary space of Bowman's capsule. Tubular reabsorption involves reabsorption of approximately 99% of the infiltrates into the blood, while tubular secretion involves the transport of substances such as K+, H+, ammonium, creatinine, and urea into the urine. Acute kidney injury (AKI), previously called acute renal failure, is characterized by an abrupt decline in renal function, resulting in an inability to secrete wastes and maintain electrolyte and water balance.[1] AKI has clinical manifestations ranging from a small elevation in serum creatinine (SCr) levels to an uric renal failure.[2] The

severity of AKI is defined by Risk Injury Failure Loss End- Stage (RIFLE) and Acute Kidney Injury Network (AKIN) criteria, which are based on the presence of increased SCr levels and/or a decreased urine output.[1,3]

This serious disorder may aggravate pre-existing kidney disease, thus leading to a rapid loss of renal function. Several studies have shown that AKI is associated with an increased risk of morbidity and mortality.[4-6] The most important factor contributing to mortality after AKI is the underlying cause of AKI.[7,8] To reduce the severity of and improve recovery from AKI, it is important to identify the underlying cause of AKI. The etiologies of AKI are commonly categorized into prerenal, renal or post renal. Prerenal AKI is due to impaired blood flow to the kidneys as a result of decreased blood volume, low circulating volume to the kidneys, and agents that reduce renal blood flow. Renal AKI is due to damage to the renal parenchyma, such as glomeruli, renal tubules and interstitium. Post renal AKI is due to the obstruction of the urinary tract. The most common causes of AKI are frequently associated with infection, renal ischemia, and nephrotoxic drugs.[7,9]

Acute kidney injury (AKI) is a syndrome defined by a rapid increase in serum creatinine, decrease in urine output, or both.[10] It is currently classified by following the Kidney Disease Improving Global Outcomes (KDIGO classification).[11,12] It occurs frequently in hospitalized pediatric patients and in greater numbers in critically ill patients. The disease is associated with morbidity, prolonged hospital stay, and high risk of mortality.[13,14] Incidence and prevalence of AKI in children are widely variable due to multiple factors that influence upon the development and the course of the disease. The AWARE study reported 26% (95% CI, 25.6 to 28.2) incidence of global AKI and 11% (95% CI, 10.7 to 12.5) of severe AKI developed during the first week of hospital stay in pediatric intensive care.[15]

The aim of the present study was to estimate the clinical prognosis of patients with diagnosis of acute kidney injury.

Materials and Methods

The present study was conducted in Upgraded Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India for two years and 200 patients were included in the study.

All data used in this study were collected during the course of routine medical care in the hospital, and patients were not asked to give informed consent at the time of these clinical encounters. Since the study was retrospective and patient data were all identified. We included all patients with AKI except those who had only one SCr measurement. Clinical data such as age, gender, admission and discharge times, days of hospitalization were recorded for all patients.

We also evaluated other clinical information, including the department in charge of hospitalization, primary diagnosis, etiology, treatment, complications, and prognosis. Laboratory tests including SCr, blood urine nitrogen (BUN), Ca2+, K+, Na+, Cl2, carbon dioxide combining power (CO2CP), hemoglobin (HGB), hematocrit (HCT), serum albumin (ALB), urine blood (BLO) and urine protein (Pro) were reviewed. These biological parameters were measured using an automatic biochemistry analyzer. The laboratory data at the first or latest abnormal SCr were used for analysis. BUN and SCr levels at peak and at discharge were also recorded. Kidney size

Statistical Analysis

Analyses were performed using SPSS 17.0 software (SPSS, Chicago, IL, USA). Quantitative data with normal distribution were expressed as means 6 SD and analysed using analysis of variance

(ANOVA). Quantitative data without normal distribution were expressed as median and interquartile range and analyzed using the rank sum test. Categorical data were expressed as frequency and percentage and analyzed using a chi square analysis. Ranked data were expressed as frequency and composition and analyzed using a Wilcoxon rank sum test. Spearman's partial correlation tests were used to analyze the association between AKI causes and the prognosis and treatment after adjusting for age and sex. Multivariate logistic regression was used when more than one independent variable was involved. Any variable having a significant univariate test was selected as a candidate for the multivariate analysis. P,0.05 was considered statistically significant was calculated from radiological imaging after AKI diagnosis was analysed.

Results

Table 1: Baseline characteristics

Variables	Values
Gender	
Male	132 (66)
Female	68 (34)
length of hospital stay (interquartile range)	8 days (3–16 days)
PRISM classification	
Low	70 (35)
Moderate	50 (25)
High	28 (14)
Very high	52 (26)
Potential physiopathological mechanism of AKI	
Pre-renal AKI	160 (80)
Renal AKI	40 (20)

In the present study, 66% were male and 34% were females. 35% had low PRSIM classification followed by very high 26%. 80% had pre-renal AKI.

Table 2: Outcomes in patients with AKI diagnosis stratified by KDIGO stage, mild/moderate AKI and severe AKI on admission

	Total (n = 200)	AKI KDIGO stage 1 Mild/ moderate AKI (n = 100)	AKI KDIGO stage 2 (n = 60)	AKI KDIGO stage 3 (n = 40)	P-value
Renal-replacement therapy	40 (20%)	20 (20%)	12 (20%)	8 (20%)	0.774
Use of vasoactive drugs	140 (70%)	72 (72%)	42 (70%)	28 (70%)	0.863
Use of diuretics	160 (80%)	80 (80%)	48 (80%)	28 (70%)	0.446
Use of mechanical ventilation	140 (70%)	72 (72%)	30(50%)	24 (60%)	0.684
Days of mechanical ventilation	5 (3.4–6.5)	7 (4.3–9.6)	4 (1.7–6.2)	4 (1.7–6.2)	0.322 c
Length of stay at PICU	12 (9.2-14-7)	14 (12.5–15.4)	7 (3.2–10.7)	11 (8.6–13.3)	0.092 c
Mortality	20 (10%)	9 (9%)	6 (10%)	8 (20%)	0.342

Patients with a maximum KDIGO stage 3 AKI during PICU stay was associated with higher use and duration of mechanical ventilation in comparison with patients with maximum stages 1 and 2. The mean time of mechanical ventilation was 4.7 days for patients with a maximum KDIGO stage 1 AKI, 5.7 days for a maximum KDIGO stage 2, and 8.5 days for a maximum KDIGO stage 3.

Discussion

Acute kidney injury (AKI) is a syndrome defined by a rapid increase in serum creatinine, decrease in urine output, or both.[17] It is currently classified by following the Kidney Disease Improving Global Outcomes (KDIGO classification).[18-21] It occurs frequently in hospitalized pediatric patients and in greater numbers in critically ill patients. The disease is associated with morbidity, prolonged hospital stay, and high risk of mortality.[22,23] Pediatric patients with AKI reach their maximum KDIGO stage during the first week after diagnosis.[24,25] In our study, most of the patients included reached their maximum KDIGO stage on day one after admission to PICU and this may be explained by several potential factors: patients included came from rural areas, had varying degrees of malnutrition, and presented insurance-related barriers to health care in agreement with previous recent reports from Latin America.[26]

An increase in the severity of AKI (maximum KDIGO stage during PICU stay) was associated with more use and longer duration of mechanical ventilation, as well as use of RRT in this study. A multi-national study from Asia, Australia, Europe, and North America (AWARE study), showed that an increase in the peak stage of AKI was associated with greater use of RRT and more days of mechanical ventilation.[15] Similar results have been reported by studies in medium-complexity hospitals of developing and developed countries.[27,28]

The cause of AKI was significantly associated with the severity of AKI. Prerenal and renal causes were significantly associated with Stage I and II, while post renal causes were associated with Stage III. Since prerenal causes such as low blood volume and decreased cardiac output can induce compensatory regulation in the body, prerenal AKI can be mild, especially within a short period of time (within 48 h), and thus is categorized as Stage I according to the AKIN criteria. In contrast, post renal obstruction produces a rapid and serious kidney injury within a short period of time without compensatory regulation, and is thus categorized as Stage III. Dialysis is often used in renal AKI caused by nephritis, nephrotoxins and rhabdomyolysis, and are categorized as Stage III. [17] Therefore, renal and post renal causes are the major causes for Stage III AKI patients. In this study, treatment and severity of AKI were significantly associated. Stage I and II patients primarily received conservative treatment, and rarely had surgery. Surgical treatment was significantly increased in Stage III patients.

The term AKI has now been adopted to describe the range of renal impairment from mild alteration, which presumably occurs without actual damage, to complete organ failure. Thus, the spectrum of AKI encompasses mild impairment in kidney function to overt organ failure; however, there exists an inconsistent relationship between ‘injury’ and ‘impairment’ of renal function such that injury may either precede or follow impairment. Furthermore, injury may exist with or without renal impairment.

Conclusion

Acute kidney injury, established and classified according to KDIGO as severe and its maximum stage, was associated with worse clinical outcomes; early therapeutic efforts should focus on preventing the progression to severe stages.

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