Original Research Article

Prevalence and Clinical Course of Acute Kidney Injury (AKI) in Critically Ill Patients Admitted in Pediatric Intensive Care Unit- A Prospective Observational Study

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Abstract
Aims: *To study the prevalence of acute kidney injury (AKI) in critically ill patients and to assess the outcome of critically ill patients with AKI.*
Settings and Design: *Single center prospective observational study was conducted over one year at Tertiary care Pediatric Intensive Care Unit (PICU) in Western Rajasthan, India.*
Methods and Materials: *1467 patients fulfilled admission criteria, out of them 149 patients suffered with AKI on admission or later. AKI was categorized by AKIN staging. Associated comorbidities were identified and clinical course followed till discharge/expiry.*
Statistical Analysis: *Analysis of data was done by using SPSS version 15. Differences in distribution of categorical variables were assessed by chi square test.*
Result: *AKI found in 10.16% of total PICU admissions. These patients required higher percentage of inotropic (47.65%) and mechanical ventilatory support (40.27%) with longer PICU stay (6.96±4.18 days) and increase mortality in compare to patients without AKI. Septicemia (53.02%), shock (47.65%), perinatal asphyxia (14.09%) and gastroenteritis (11.41%) were leading comorbidities associated with AKI.*
Conclusion: *AKI is common in PICU patients and associated with a grave prognosis. So we need to early diagnosis and management of AKI in critically ill patients.*
Keywords: *AKI, PICU, mechanical ventilation, vaso-pressor.*

Introduction

AKI is defined as rapid decline in the glomerular filtration rate (GFR) resulting in retention of nitrogenous waste products such as blood urea nitrogen (BUN), and creatinine. [1, 2]

Criteria to define AKI includes presence of any of the following. [3]

- Increase in serum creatinine by ≥ 0.3 mg/dl (≥ 26.5 µmol/l) within 48 hours; or

- Increase in serum creatinine to ≥1.5 times of baseline, which is known or presumed to have occurred within the prior 7 days; or
- Urine volume ≤0.5 ml/kg/h for 6 hours.

The patients with AKI have been classified as nonoliguric, oliguric (urinary output <0.5 ml/kg/hr) or anuric (urinary output <0.3 ml/kg/hr).[2] Depending on the site of lesion AKI may be pre-renal, renal and post renal.

AKI is associated with a markedly increased risk of death in hospitalized individuals, particularly in those admitted to the ICU where in-hospital mortality rate may exceed 50%.[4] The previous studies in the field of AKI were mostly retrospective and were done on adult patients. Moreover there is a lack of studies regarding occurrence and outcome of AKI in Pediatric Intensive Care Unit (PICU) in Western Rajasthan. Thus the present study was planned to assess prevalence and outcome of AKI in PICU at a tertiary care hospital.

Material and Methods

It was a prospective observational study conducted in Pediatric ICU (PICU) of Umaid Hospital, Dr. S N Medical College, Jodhpur over a period of 1year.

Inclusion criteria- All children less than 18 years of age (including out born neonates) admitted in PICU of this hospital for at least 24 hrs or more in duration and developed AKI (ref) on admission or later, were included in this study. For patients admitted with AKI, age matched serum creatinine levels, and for children who developed AKI during hospital course, serum creatinine levels at admission were taken as baseline for AKIN staging. Acute Kidney Injury Network (AKIN) staging was used for the diagnosis of AKI. [5, 6]

Exclusion criteria- Patients with chronic kidney disease, end stage renal disease (ESRD) or previously diagnosed as having kidney disease were excluded.

Procedure of the study- Ethical committee of the Institute approved the study. Informed written consent was taken from parents of all patients. Demographic and clinical details were recorded. All participants were subjected to liver function tests, renal function tests, hemogram, arterial blood gas analysis, serum electrolytes, urine microscopy and urine culture. Renal ultrasound was also done in all. Similar number of age and sex matched patients admitted in PICU but without AKI were taken as control. [7](Table 1)

Our primary outcome measure was final outcome; death or survival. Survived babies were further classified as; not recovered, partial recovered, and completely recovered on the basis of discharge serum creatinine levels more than 150%, 121-150% and ≤120% from baseline respectively. Duration of hospital stay among survived babies was our secondary outcome measure.

Statistical analysis: Analysis of data was done by using SPSS version 15. Differences in distribution of categorical variables were assessed by chi square test.P value <0.05 was considered significant.

Results

In one year study duration, total 2252 patients were admitted in PICU. Out of these, 1467 qualified to be included in the study group. Total 149/1467 (10.69%) children suffered from AKI, out of these 112 (74.2%) had AKI at admission and remaining 37(28.8%) developed it during course of hospital stay.Males were affected more than females with sex ratio of 1.2:1 which is statistically insignificant. Incidence of AKI among rural dwellers was higher than urban (12.16% vs. 5.59% respectively). Majority had AKI stage 3 (41.61%) followed by stage 2 and 1.Sepsis (53.02%) was the most common co-morbidiy followed by shock (47.65%), perinatal asphyxia (14.09%), gastroenteritis (11.41%), encephalitis (8.05%), pyomeningitis (6.04%), malaria (5.37%), DIC (5.37%) and acute nephritis (4.70%). (Table 2)

Inotropic support was required in 47.65% of AKI patients against 28.86% in the control group (p <0.001). Inotropes were required mostly in stage 3

(72.58%) than stage 1 and 2 (19.4% and 37.2% respectively p <0.001). Among AKI cases, 40.27% patients required ventilator support while 28.19% of control group patient's required ventilator support(p <0.05).Ventilator support was required in 61.29% patients of AKI stage 3 while 33.33% of stage 2 and 13.89% of stage 1 patients. Mortality was higher in AKI group (33.56%) in comparison to control group (22%) (p<0.05). Mortality in stage 1, 2 and 3 was 8.33%, 25.49%

and 54.84% respectively. Complete recovery was attained by majority (60.40%). A small chunk (4.03%) showed partial recovery (fig 1). Remaining (35.57%) either did not recover or expired. PICU stay in patients with AKI was 6.96 $\pm$ 4.18 days while in control group it was 3.70 $\pm$ 2.51 days (p<0.001).PICU stay was maximum in patients with AKI stage 3 (8.10 $\pm$ 4.26 days) while it was 6.61 $\pm$ 4.12 days and 5.5 $\pm$ 3.67 days respectively in stage 2 and 1.(Table 3, fig 2)

Table 1: Demographic distribution of study and control group

Characteristics	AKI group	Control group	P value
Mean age (yrs)	6.9	6.6	>0.05
Mean weight (kg)	6.86	7.12	>0.05
Sex ratio(M/F)	107/42= 2.54	108/41= 2.63	0.89
Rural/urban ratio	109/40= 2.72	119/30= 3.96	0.17

Table 2: Distribution of AKI cases according to associated co-morbidities

Co-morbidity	No. of cases	Co-morbidity	No. of cases
Septicemia	79 (53.02%)	MAS	4 (2.68%)
Shock	71 (47.65%)	NEC	4 (2.68%)
Perinatal asphyxia	21 (14.09%)	Snake bite	3 (2.01%)
Diarrhea vomiting	17 (11.41%)	RDS	3 (2.01%)
Encephalitis	12 (8.05%)	HPS	1 (0.67%)
Pyomeningitis	9 (6.04%)	PUV	1 (0.67%)
Malaria	8 (5.37%)	Renal calculi	1 (0.67%)
DIC	8 (5.37%)	DKA	1 (0.67%)
Acute nephritis	7 (4.70%)	GBS	1 (0.67%)
CHD	7 (4.70%)	SJS	1 (0.67%)

Table 3. Comparison of outcome in AKI cases v/s controls in PICU

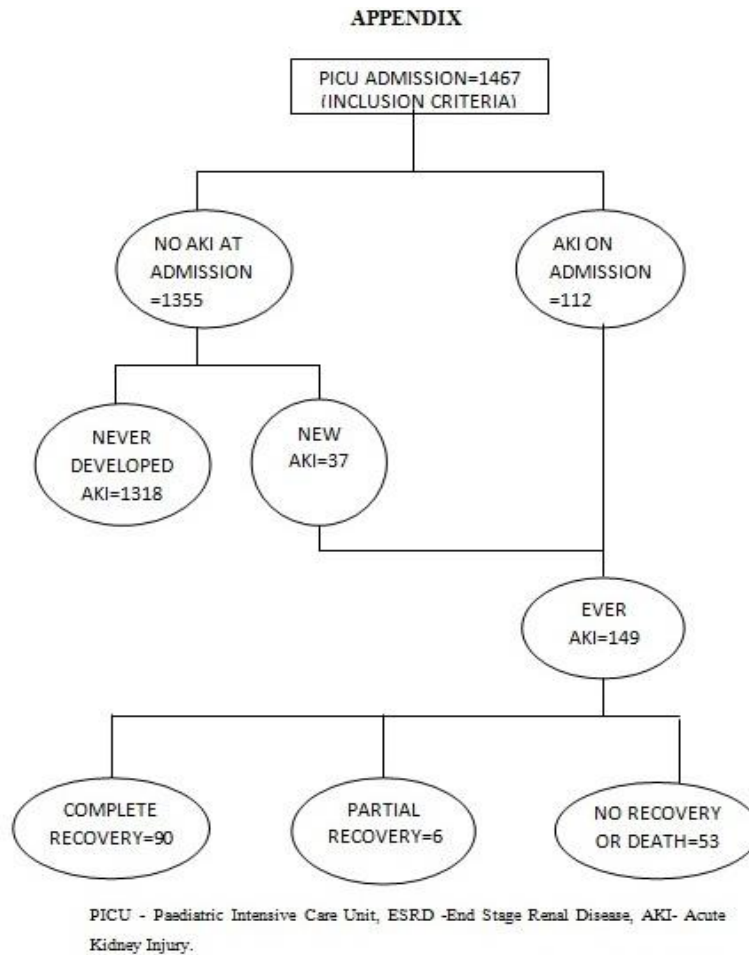| AKI stage	No. (%)	ionotropes required (%)	Mechanical ventilation (%)	Expiry (%)	PICU stay in days (Mean+SD)
Stage 1	36 (24.16)	7 (19.44)	5 (13.89)	3 (8.33)	5.5 + 3.67
Stage2	51 (34.23)	19 (37.25)	17 (33.33)	13 (25.49)	6.61 + 4.12
Stage 3	62 (41.61)	45 (72.58)	38 (61.29)	34 (54.84)	8.10 + 4.26
Total AKI pts	149	71 (47.65)	60 (40.27)	50 (33.56)	6.96 + 4.18
Control pts	149	43 (28.86)	42 (28.19)	33 (22.15)	3.70 + 2.51

Fig.1: PICU statistics- 149 pts (10.16%) suffered from AKI on admission or later. Only 90 pts showed complete recovery while 53 pts expired. (33.56% mortality)
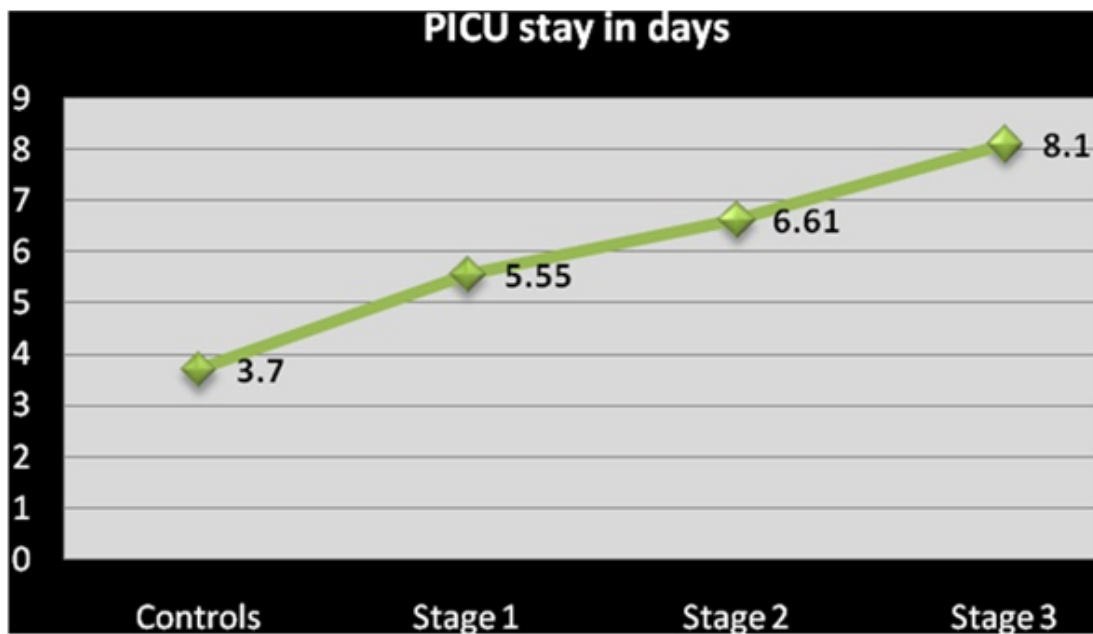

Fig.2: Showing days PICU stay in different groups

Discussion

AKI is a common complication in critically ill patients and is associated with substantial increases in morbidity and mortality. The cause of AKI in the ICU is commonly multi factorial; it frequently develops from a combination of hypovolemia, sepsis, medications and hemodynamic perturbations.

AKI is one of the common condition associated with critically ill children. Prospective studies from our country suggest that upto 40% patients in PICU suffered from AKI [8, 9] while in our study we found prevalence of AKI in critically ill children was10.16 % which was similar to study done by Schneider et al[10]in their PICUbut bailey et al [11] reported lesser prevalence (4.5%). This higher incidence of AKI among sick children of rural areas might be due to poor socio-economic, educational status of their parents with delay in recognition of risk factors due to lack of expert medical care and appropriate facilities.

In the current study, septicemia (53.02%), shock (47.65%), perinatal asphyxia (14.09%) and gastroenteritis (11.41%) were the main co-morbidities associated with AKI. Sean m bagshaw*et*al [12] found in their study that 42.1% AKI children had associated septicemia. Similarly, Jaishreeet al[13] from their study of AKI observed that mortality was 50% in septicemic neonates who had AKI as compared to 25% among those who had normal renal function. They concluded that AKI may additionally increase the mortality in sick neonates.

In this study inotropic support (dopamine, dobutamine and adrenaline) required in 47.65% of cases of AKI patients (maximum in AKI stage 3) which was significantly higher than control group (28.86%), similar finding reported byDaheret al[14] his study.

In this study, among AKI cases 40.27% patients' required mechanical ventilation while 28.19% of control group patients required mechanical ventilation. Alkandari et al[15]observed that 60% of AKI patients required mechanical ventilation in compare to 43.2% non AKI patients. Overall mortality among patients with AKI was significantly higher than control group similar results found by Daheret al [14] and Alkandari et al. [15]

In present study outcomes of AKI cases were categorized as per recovery. Complete recovery (Discharge SCr $\leq$ 120% of bSCr) and partial recovery (Discharge SCr $-$ 121-150% of bSCr) was seen in 60.40% and 4.03% of AKI cases respectively while death or no recovery (Discharge SCr>150% of bSCr) was seen in 35.57% of AKI cases. Daher *et* al [14]from their study observed complete recovery in 59.4% patients, partial recovery in 13.5% patients and no recovery or death in 27.2% patients.

Overall mean duration of PICU stay in study group was 6.96 + 4.18 days while in control group it was 3.70 + 2.51 days (p <0.001). Alkandari et al[15*]* observed average PICU stay of 9.7 days in AKI patients and 4.6 days in non AKI patients in their ICU while Daheret al[14]observed average PICU stay of 7 days in AKI patients and 3 days in non AKI patients in their ICU.

Conclusion: Kidneys are very sensitive to subtle changes in homeostasis which, if lasts longer may result in AKI. As stage of AKI increases chances of survival decreases, so timely recognition of morbidity and appropriate management can improve prognosis.

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