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Spectrum of Acute Kidney Injury and its Clinical Profile and Outcome in Children Admitted to PICU

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Abstract

Objective: To determine incidence, risk factors, and outcome of acute kidney injury (AKI) in Pediatric Intensive Care Unit (PICU). *Materials and Methods:* This prospective observational study was conducted over period of 1½ years. All patients within the age group of 1 month to 18 years admitted in the PICU (Pediatric Intensive Care Unit) at Basaveshwar teaching and general hospital and Sangameshwar hospital attached to Mahadevappa Rampure Medical College during a period from December 2015 to August 2017. *Results*: Out of 1007 patient screened 7 patient were excluded, out of which 2 where congenital dysplastic kidney, 2 were known case of nephrotic syndrome, 3 where known case of chronic kidney disease. Out of 1000 patients 69 children had AKI, giving incidence of 6.9%. The median age of boys and girls were 4.56±3.84 and 4.49±4.01 respectively. 58% of the patients were boys. The median admission serum creatinine value in AKI patients was 2.91±2.48 mg/dL. In the present study, pre-renal causes accounted for (54) 78.3% of AKI. AKI Stage 1, 2, 3 was diagnosed in 11 (15.9%), 14 (20.3%) and 44 (63.8%) respectively. *Conclusions:* AKI continues to be associated with adverse outcomes, including high mortality , morbidity and prolonged hospital stay. Mechanical ventilation & Hypovolemia were independent risk factors. Higher the stage of AKI mortality increases. Early diagnosis of AKI using new defined criteria (AKIN, RIFLE, pRIFLE) [4,5,6] along with early and appropriate management of risk factors will prevent the progression of AKI and decrease the mortality and morbidity of AKI patients.

Keywords: Acute Kidney Injury; Critically Ill Children; Pediatric Intensive Care Unit; pRIFLE.

Background

Acute kidney injury (AKI) is an important condition in hospitalized patients, associated with adverse short- and long term outcomes. Mortality rates in critically ill children with AKI are high, ranging between 9% and 67% and increase if complicated by multiorgan failure, organ transplantation and acute respiratory distress syndrome. Most cases of incident AKI represent acute tubular necrosis (ATN) that is secondary to hypovolemia, sepsis or the use of nephrotoxic agents.

AKI is defined as rapid deterioration of renal function resulting in retention of nitrogenous wastes and inability of kidney to regulate fluid and electrolyte homeostasis. In the past, a lack of objective diagnostic criteria has resulted in wide variability of definitions that have been used for this condition.

Recent reviews emphasize disparities in the definition of AKI have resulted in large variations in reported incidence and outcomes.

The definition and staging of AKI has been recently standardized using the RIFLE classification proposed by the Acute Dialysis Quality Initiative Group, and the one suggested by the Acute Kidney Injury Network (AKIN) [4,5,6].

These classifications have been examined in hospitalized adults and children, and found useful in characterizing AKI.

Most pediatric studies on the incidence of AKI are limited to the developed countries and are based on retrospective analysis of records.

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The Spectrum and burden of AKI in developing countries may be different from that of developed countries. Only a few retrospective studies have been conducted to determine the incidence and proûle of AKI in critically ill-children from the developing world in recent years.

Detection of the incidence, etiological profile and outcome of AKI is important for commencement of preventive and therapeutic strategies.

Objective

To determine the clinical profile of acute kidney injury in pediatric ICU.

To determine the outcome of patients with acute kidney injury in pediatric ICU.

Materials and Methods

This prospective observational study was conducted over period of 1½ years. All patients within the age group of 1 month to 18 years admitted in the PICU (Pediatric Intensive Care Unit) at Basaveshwar teaching and general hospital and Sangameshwar hospital attached to Mahadevappa Rampure medical college during a period from December 2015 to August 2017.

Informed parental consent was obtained from the parents prior to the study.

Serum levels of creatinine was estimated at admission and at daily intervals in PICU patients till discharge from PICU. Urine output measured and recorded as ml/kg/hour [4,5,6].

Diagnosis and staging of AKI was based on Acute Kidney Injury Network (AKIN) definition & classification [4,5,6].

Inclusion Criteria

Patients aged 1 month to 18 years, admitted to pediatric intensive care unit (PICU) (Basaveshwar Teaching and General Hospital and Sangameshwar Hospital, Kalaburagi)

Exclusion Criteria

Patients with known kidney disease such as congenital polycystic kidney disease.

Children who were diagnosed with chronic kidney disease on first visit.

Based on the AKI criteria, AKI was defined as abrupt (within 48h) reduction in kidney function with an increase in creatinine level. The illness was categorized as stage 1 (increase of creatinine by 1.5-1.99 times baseline), stage 2 (increase to 2-2.99 times baseline) and stage 3 (increase to ≥ 3 times baseline).

Shock was defined in presence of tachycardia, feeble pulses, cool peripheries, hypotension (blood pressure <-2 SD for age and sex) or capillary filling time > 3 seconds. Sepsis was the presence of systemic inflammatory response syndrome with suspected or proven infection.

Statistical Method

The biochemical and other numerical parameters was compared using t test, Z test, and chi-square or Fischer exact test and other applicable methods.

Data analysis was done using statistical software SPSS.

Results

Out of 1007 patient screened 7 patient were excluded, out of which 2 where congenital dysplastic kidney, 2 were known case of nephrotic syndrome, 3 where known case of chronic kidney disease. Out of 1000 patients 69 children had AKI, giving incidence of 6.9%. The median age of boys and girls were 4.56±3.84 and 4.49±4.01 respectively. 58% of the patients were boys. The median admission serum creatinine value in AKI patients was 2.91±2.48 mg/dL. In the present study, pre-renal causes accounted for (54) 78.3% of AKI. AKI Stage 1, 2, 3 was diagnosed in 11 (15.9%), 14 (20.3%) and 44 (63.8%) respectively.

Table 1: Sex wise distribution of AKI cases and non-AKI cases

Age in years	AKI cases		Non AKI cases		Total	
	No.	%	No.	%	No.	%
Males	40	58.0	544	58.4	584	58.4
Females	29	42.0	387	41.6	416	41.6
Total %	69 (6.9%)	100.0	931 (93.1%)	100.0	1000 (100.0%)	100.0
X^2-test value & P-Value, sig			X^2= 0.0053 P>0.05, Not significant			

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

There were 40 (58.0%) male AKI cases and 29 (42.0%) female AKI cases in the study.

The sex ratio of total study cases of Male to Female was 1.4:1

The sex ratio of AKI cases of Male to Female was 1.38:1 this is almost same of the total cases

There was no statistical significant difference of sex among AKI and Non-AKI groups (p>0.05) (Table 1).

Statistically very highly significant difference of Anuria, Gross hematuria and Encephalopathy among AKI and Non-AKI groups (p<0.001) was observed and there were statistically significant differences of Vomiting, Loose motion among AKI and Non-AKI groups (p<0.05). The symptoms of Anuria, Gross hematuria, Encephalopathy, Vomiting and Loose motion were significantly less in the non-AKI cases as compared to AKI cases.

There were no statistical significant difference of Oliguria, Fever, Seizures, Breathlessness and Gl. Hemorrhage among AKI and Non-AKI groups (P>0.05).

In the present study, the most common condition associated with AKI was sepsis, encephalitis. Other causes were dengue, pneumonia, DKA, Acute gastro enteritis, acute post-streptococcal glomerulonephritis, hemolytic uremic syndrome and congestive cardiac failure.

AKI was associated with increased mortality. Mortality rate was 34.8% compared to non AKI. In the present study, mortality was 9.1% in Stage 1, 28.5% in Stage 2 and 43.3% in stage 3. Mortality was high in stage 3.

Table 2: Comparison of Staging and outcome in the AKI cases

Staging	No of cases	Outcome		χ^2-test values P-value & significance
		Improved	Died	
1st Stage	11	10(90.9%)	1(9.1%)	χ^2= 4.12
2nd Stage	14	10(71.5%)	4(28.5%)	P<0.05
3rd Stage	44	25(56.8%)	19(43.3%)	S
Total	69	45(65.2%)	24(34.8%)	--

Table 3: Comparison of symptoms among AKI and Non-AKI cases

Symptoms	AKI cases (n= 69)	Non-AKI cases (n=931)	χ^2-test values P-value & significance
Oliguria	3 (4.3%)	39 (4.2%)	χ^2=0.0072 P>0.05, NS
Fever	53 (76.8%)	737 (79.2%)	χ^2=0.051 P>0.05, NS
Vomiting	35 (50.7%)	344 (36.9%)	χ^2=5.09 P<0.05, S
Loose motion	16 (23.2%)	154 (16.5%)	χ^2=5.31 P<0.05, S
Anuria	5 (7.2%)	0 (0.0%)	χ^2=37.8 P<0.001, VHS
Seizures	12 (17.4%)	176 (18.9%)	χ^2=0.73 P>0.05, S
Breathlessness	28 (40.6%)	298 (32.0%)	χ^2=1.87, P>0.05, NS
Gross hematuria	5 (7.2%)	1 (0.1%)	χ^2=31.82, P<0.001, VHS
Gl. Hemorrhage	1 (1.4%)	0 (0.0%)	χ^2=0.431, P>0.05, NS
Encephalopathy	8 (11.6%)	5 (0.5%)	χ^2=33.74, P>0.05, VHS

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

Table 4: Comparison of outcome among AKI and Non-AKI cases

Groups	No of cases	Outcome		χ^2-test values
		Improved	Died	P-value & significance
AKI cases	69	45(65.2%)	24(34.8%)	χ^2= 230.19
Non-AKI cases	931	922(99.0%)	9(1.0%)	P<0.000 VHS
Total	1000	967(96.7%)	33(3.3%)	--

VHS=very highly significant

There was statistically very highly significant difference of outcome in AKI and Non-AKI cases (p<0.001).

The case fatality rate of Non-AKI was 1.0%. whereas the case fatality rate of AKI was 34.8%.

Overall death rate was 3.3%.

Hypovolemia and Need for Ventilation were significant risk factors for AKI (p < 0.001). In the present study, the median duration of PICU and Hospital stay was 9.98±7.27 in AKI group compared to7.41±5.62 days in Non AKI group (p < 0.001)

Discussion

AKI is a clinical condition that commonly occurs in critically ill patients in the pediatric intensive care unit .studies has shown AKI is independently associated with poor outcome. Published data about AKI in Indian children are limited.

In the present study, the incidence of AKI in PICU was 6.9%. Compared to other Indian studies by Krishnamurthy et al. [2] and Mehta et al. [1]; however the incidence rate is lower.

In the present study, median age was 4.56% among boys and girls constituted 4.49%, 58% were boys among AKI patients which is comparable to Krishnamurthy et al study [2].

According to shweta naik et al. [3] presence of infection sepsis were significant predictors of AKI comparable to our study

In the present study hypovolemia and need for mechanical ventilation were significant risk factors similar to Shweta Naik et al. [3].

In the present study, the mean and standard deviation of Serum Creatinine value in AKI patients was 2.29 mg/dL, while in Krishnamurthy et al. study [2], it was 1.1 mg/dL.

In the present study, pre-renal causes accounted for (54) 78.3%of AKI. This is different from other previous studies such as Krishnamurthy et al. [2] and Mehta et al. [1] Garuda rama et al. [7] study prerenal cases were more followed by renal and post renal .which is comparable to our study. In our study renal cases accounted for (13) 18.8%, post renal (2) 2.9%

The mortality in present study, mortality was 34.8%, which is comparable to Mehta et al study [1].

Conclusion

AKI continues to be associated with adverse outcomes, including high mortality , morbidity and prolonged hospital stay. Mechanical ventilation & Hypovolemia were independent risk factors. Higher the stage of AKI mortality increases. Early diagnosis of AKI using new defined criteria (AKIN, RIFLE, pRIFLE) along with early and appropriate management of risk factors will prevent the progression of AKI and decrease the mortality and morbidity of AKI patients.

Reference

1. Incidence of Acute Kidney Injury in Hospitalized Children: Poonam Mehta, Aditi Sinha, Abdus Sami, Mani Kalaivani, Ashima Gulati, Madhulika Kabra, Sushil K Kabra, Rakesh Lodha and Arvind Bagga, Indian Pediatrics; Volume 49 july 16, 2012.
2. Sriram Krishnamurthy, Parameswaran Narayanan, Sivaprakasam Prabha, Nivedita Mondal, Subramanian Mahadevan, Niranjan Biswal, and Sadagopan Srinivasan. Clinical profile of Acute Kidney Injury in a pediatric intensive care unit from southern India: A prospective observational study. Indian J Crit Care Med. 2013 Jul-Aug; 17(4): 207–213.
3. Shwetha Naik, Juoti Sharma, Rameshor Yengkom, Vijay Kalrao, Atul Mulay. Acute Kidney Injury in critically ill children: Risk factors and outcomes. Indian journal of critical care medicine. 2014 March;18(3): 129-33
4. Sean M. Bagshaw, Carol George, Rinaldo Bellomo. A comparison of the RIFLE and AKIN criteria for acute kidney injury in critically ill patients. Nephrol Dial Transplant 2008;23:1569–74.

5. Sharon Phillips Andreolli. Acute kidney injury in children Pediatr Nephrol. 2009 Feb;24(2):253-263.
6. Schrier RW, Wang W, Poole B, Mitra A. Acute renal failure: definations. Diagnosis, pathogenesis, and therapy. J Clin Invest. 2004 Jul;114(1):5-14.
7. Garuda Rama. Study of Acute Kidney Injury in children: Its Aetiology, Clinical profile and Outcome. Journal of Evidence based Medicine and Healtheare; 2015 March 16;2(11): 1577-85.