

Original Research Article

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Study of clinical profile, risk factors of acute kidney injury in children admitted in pediatric intensive care unit at tertiary health care centre

Harsha S., Gonesh N. Mevundi*

Department of Pediatrics, Mahadevappa Rampure Medical College Kalaburgi, Karnataka, India

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***Correspondence:**

Dr. Gonesh N. Mevundi,

E-mail: goneshmevundi04745@gmail.com

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ABSTRACT

Background: Acute kidney injury (AKI) is an important condition in hospitalized patients, associated with adverse short- and long-term outcomes. Objective of this study was to determine the clinical profile of acute kidney injury in pediatric ICU (Basaveshwar Teaching and General Hospital, Sangameshwar Hospital, Kalaburagi).

Methods: This study was conducted in 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 May 2017.

Results: Incidence of AKI was 6.9% in pediatric intensive care unit. The median age of boys and girls were 4.56 ± 3.84 and 4.49 ± 4.01 respectively. Hypotension and need for ventilation were significant risk factors for AKI ($p < 0.001$). The median admission serum creatinine value in AKI patients was 2.91 ± 2.48 mg/dL. In the present study, the median duration of PICU and Hospital stay was 9.98 ± 7.27 in AKI group compared to 7.41 ± 5.62 days in non-AKI group ($p < 0.001$).

Conclusions: It was concluded that Incidence of AKI was 6.9% in pediatric intensive care unit. The mean and SD of age of boys and girls were 4.56 ± 3.84 and 4.49 ± 4.01 respectively. Hypotension and need for ventilation were significant risk factors for AKI.

Keywords: Acute kidney injury, Incidence, Pediatric intensive care unit, Risk factors, Ventilation

INTRODUCTION

Acute kidney injury (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.¹

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 have 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).

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.² The spectrum and burden of AKI in developing countries may be different from that of developed countries.³

Only a few retrospective studies have been conducted to determine the incidence and profile of AKI in critically ill-children from the developing world in recent years.⁴

Detection of the incidence, etiological profile and outcome of AKI is important for commencement of preventive and therapeutic strategies.⁵

The present study is conducted to determine the incidence, identify the risk factors and to determine the short-term clinical outcome in children admitted in PICU (Basaweshwar teaching and general hospital and Sangameshwar hospital Kalaburagi with acute kidney injury).

This study was conducted to determine the clinical profile of acute kidney injury in pediatric ICU (Basaveshwar Teaching and General Hospital, Sangameshwar Hospital, Kalaburagi).

METHODS

This was a prospective, observational study, in which 1000 patients were screened, 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.

The minimum sample size required to study the fact based on data in literature with 5% level of significance.⁴ The sample size taken will be 300. Using simple random sampling method.

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 and children who were diagnosed with chronic kidney disease on first visit.

Methods of collection of data: Following an informed parental consent, clinical history and examination will be done, comorbidities will be noted, and relevant data regarding investigations will be collected for all children admitted to PICU.

Serum levels of creatinine estimated at admission and at daily intervals in PICU patients till discharge from PICU. Urine output measured and recorded as ml/kg/hour.

Diagnosis and staging of AKI will be based on acute kidney injury network (AKIN) definition and classification.

Serum creatinine will be done on all patients admitted to PICU from day of admission till discharge from PICU.

Serum creatinine of patients with AKI will be done at the time of discharge from hospital. If necessary, CBC, urine routine, blood urea, serum electrolytes and USG abdomen will be done.

Statistical analysis

Descriptive statistical characteristics and variables of the patients will be described. The biochemical and other numerical parameters will be compared using t-test, Z test, and chi-square or Fischer exact test and other applicable methods. p-value <0.05 was considered as the level of significance.

RESULTS

Study reveal that, maximum number of cases 380 (38.0%) belongs to the age group of 1-5 years, followed by 5-10 years 267 (26.7%) and minimum number of cases 13 (1.3%) belongs to the age group of 15-18 years. The mean and SD of age of boys and girls were 4.56 ± 3.84 and 4.49 ± 4.01 respectively.

There was no statistically significant difference of age among males and females ($p > 0.05$). There were 584 (58.4%) males and 416 (41.6%) females in the study. The sex ratio of male to female was 1.4:1. Table 1.

Table 1: Age and sex wise distribution of cases.

Age in years	Males		Females		Total	
	No.	%	No.	%	No.	%
1 month - 1 year	124	21.3%	69	16.6%	193	19.3%
1-5	222	38.0%	158	37.9%	380	38.0%
5-10	149	25.5%	118	28.4%	267	26.7%
10-15	81	12.9%	66	15.9%	147	14.7%
15-18	8	1.3%	5	1.2%	13	1.3%
Total	584 (58.4%)	100.0%	416 (41.6%)	100.0%	1000 (100.0%)	100.0%
Mean \pm SD	4.56 ± 3.84		4.49 ± 4.01		4.54 ± 3.91	
Z-value, p-value, sig	Z=0.213 p>0.05, NS					

Table 2: Age wise distribution of AKI cases and non-AKI cases.

Age in years	AKI cases		Non AKI cases		Total	
	No.	%	No.	%	No.	%
1 month - 1 year	18	26.1%	175	18.8%	193	19.3%
1-5	22	31.9%	358	38.4%	380	38.0%
5-10	21	30.4%	246	26.5%	267	26.7%
10-15	8	11.6%	139	14.9%	147	14.7%
15-18	0	0.0%	13	1.4%	13	1.3%
Total	69 (6.9%)	100.0%	931 (93.1%)	100.0%	1000 (100.0%)	100.0%
Mean±SD	4.56±3.84		4.49±4.01		4.54±3.91	
X ² , p-value, sig	X ² = 2.46, p>0.05, Not significant					

Table 3: Duration of hospital stay wise distribution of AKI cases and non-AKI cases.

Duration	Duration in days		Z-test value	p-value and significance		
	Mean±SD					
AKI cases (n=69)	9.98±7.27		Z = 3.22	p>0.01 HS		
Non-AKI cases (n=931)	7.41±5.62					
Total mean±SD	7.63±5.73					

Table 4: Comparison of ventilation and hypovolemia among AKI and non-AKI cases.

Variables	AKI cases (n=69)	Non-AKI cases (n=931)	χ ² -values, p-value and significance
Ventilation	17 (24.6%)	45 (4.8%)	χ ² =43.32, p<0.000, VHS
Hypovolemia	30 (43.5%)	66 (7.1%)	χ ² =98.08, p<0.000, VHS

VHS: very highly significant.

Table 5: Comparison of blood urea and serum creatine among AKI and non-AKI cases.

Variables	AKI cases (n=69)	Non-AKI cases (n=931)	Z-test values, p-value and significance
	Mean±SD	Mean±SD	
Blood urea	103.53±64.81	27.70±16.69	Z=23.88, p<0.000, VHS
Serum creatinine on admission	2.91±2.48	0.71±0.15	Z=25.45, p<0.000, VHS

In the present study the incidence of AKI 6.9%. There was no statistically significant difference of age among AKI and non-AKI groups (p>0.05). But cases are more in the lower age groups Table 2.

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 statistically significant difference of sex among AKI and non-AKI groups (p>0.05).

Statistically very highly significant difference of anuria, gross hematuria and encephalopathy among AKI and non-AKI groups (p<0.001) 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 statistically significant difference of oliguria, fever, seizures, breathlessness and Gl. Hemorrhage among AKI and non-AKI groups (p>0.05).

The mean and SD age of AKI cases of hospital stay was 9.98±7.27 and non-AKI cases was 7.41±5.62 overall mean and SD of all the cases was 7.62±5.73.

Highly statistically significant difference of duration of hospital stay among AKI and Non-AKI groups (p<0.01).

Duration of hospital stay was longer in the AKI cases as compared to non-AKI cases Table 3.

Statistically very highly significant difference of ventilation and hypovolemia among AKI and non-AKI groups (p<0.001). The ventilation and hypovolemia were significantly higher in the AKI cases as compared to non-

AKI cases Table 4. Statistically very highly significant difference of blood urea and serum creatine among AKI and non-AKI groups ($p<0.001$). The mean blood urea and serum creatine were significantly higher in the AKI cases as compared to non-AKI cases Table 5.

DISCUSSION

AKI is a clinical condition that commonly occurs in critically ill patients in the pediatric intensive care unit.

Published data about AKI in Indian children are limited. Most data available are from developed countries.

Very few Indian studies provide incidence of AKI in pediatric ICU. The incidence and risk factors of AKI in developing countries may be different from those of developed countries. The purpose of this study is to understand the incidence of acute kidney injury in children admitted to pediatric intensive care unit of a tertiary care center Table 6.

Table 6: Comparison of incidence between present and previous studies.

Study	Year	Sample size	Criteria	Incidence
Present	2017	1000	AKIN	6.9%
Krishnamurthy et al ⁴	2011	215	AKIN	25.1%
Rama G et al ⁵	2014	30	AKIN	0.44%
Srinivasa et al ³	2015	680	RIFLE	26.1%

Table 7: Common aetiopathogenesis in different studies.

Study	Year	Sample size	Common etiology
Present	2017	1000	Sepsis
Krishnamurthy et al ⁴	2011	215	Sepsis
Naik S et al ⁶	2014	252	Sepsis
Prabhakar TS et al ⁷	2015	200	Sepsis
Gupta S et al ⁸	2016	536	Sepsis

Table 8: Risk factors of AKI among different studies.

Study	Year	Risk factors
Present	2017	Hypovolemia and mechanical ventilation
Krishnamurthy et al ⁴	2011	Mechanical ventilation
Naik S et al ⁶	2014	Sepsis, shock, cardiac disease and mechanical ventilation
Prabhakar TS et al ⁷	2015	Younger age, sepsis and shock, mechanical ventilation
Gupta S et al ⁸	2016	Mechanical ventilation
Mehta et al ⁹	2008	Shock, mechanical ventilation, young age

In the present study, the incidence of AKI in PICU was 6.9%. Compared to other Indian studies by Krishnamurthy et al however the incidence rate is lower.⁴ Heterogeneity of patient population, diverse regional differences, and sample sizes study designs can explain varying incidence of AKI.

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 al⁴ study.

A wide spectrum of etiology for AKI has been found across the world. While sepsis, HUS, ATN predominate in developing countries, these have been replaced by hematologic complications and pulmonary failure as causes of AKI in west. In the present study sepsis

followed by encephalitis was leading cause of AKI. Similar to Krishnamurthy et al study Table 7.⁴

According to Naik S et al presence of infection sepsis were significant predictors of AKI comparable to this study.⁶

In the present study hypovolemia and need for mechanical ventilation were significant risk factors similar to Naik S et al, Table 8.⁶

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, it was 1.1 mg/dL.⁴ Acute kidney injury is common after pediatric cardiac surgery and is associated with prolonged mechanical ventilation and increased hospital stay. Cardiopulmonary

bypass time and age were independently associated with acute kidney injury risk. Cardiopulmonary bypass time may be a marker for case complexity.¹⁰

CONCLUSION

It was concluded that Incidence of AKI was 6.9% in pediatric intensive care unit. The mean and SD of age of boys and girls were 4.56 ± 3.84 and 4.49 ± 4.01 respectively. Hypotension and need for ventilation were significant risk factors for AKI ($p < 0.001$). The median admission serum creatinine value in AKI patients was 2.91 ± 2.48 mg/dL. Median creatinine value in non AKI group was 0.71 ± 0.15 .

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