International Journal of Contemporary Pediatrics
Saritha PJ et al. Int J Contemp Pediatr. 2019 Mar;6(2):853-856
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20190742

Original Research Article

Acute kidney injury in paediatric intensive care: need for extended vigil

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Received: 09 October 2018
Accepted: 10 December 2018

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ABSTRACT

Background: Acute kidney injury (AKI) is an important contributor towards morbidity and mortality among critically ill children. The objective of this study was to ascertain the etiological factors, categorize the severity and determine the immediate outcome of AKI among children admitted to the pediatric intensive care unit (PICU) of a tertiary referral hospital in south India.
Methods: A prospective study was conducted from January to December 2012 in the PICU, Government medical college, kozhikode, a major referral hospital in north Kerala. The institutional ethics committee approved the study. Children in the age group of 1 month to 12 years admitted to the PICU for at least 48 hours were included if they had no previous renal disease/AKI at the time of admission. Serum creatinine levels of the children were measured at the time of admission, at 48 hours, and one month later. Outcome measures included normalization of serum creatinine or persistence of impaired renal function. Mortality was assessed both immediately and after one month.
Results: A total of 1716 children were included in the study, of which 107 children developed AKI (6.2%). Among the 107 children, 56 children (52.3%) were boys. Majority of children were infants 75(70.1%). Infection was the commonest underlying condition associated with AKI. Most of the children with acute kidney injury were in the earliest phase (Stage 1). Twenty-six children (24.29%) died. Among the survivors, 10% were found to have impaired renal function when followed up a month later.
Conclusions: There is a high incidence of AKI in critically ill infants admitted in PICU. Residual renal impairment can persist even after discharge from hospital and these children need follow up for a longer time.

Keywords: Acute kidney injury, Morbidity, Mortality, Paediatric intensive care unit

INTRODUCTION

Acute kidney injury (AKI) is defined as a rapid decline in renal function characterized by elevation in serum creatinine and inability of the kidneys to regulate the fluid and electrolyte homeostasis of the body. Recent data has revealed increasing incidence of AKI in hospitalized children related to multifactorial causes.[1] AKI has been established to be an independent risk factor for prolonged ICU stay, longer duration of mechanical ventilation and increased mortality.[2-4] The use of standard definitions and approach to diagnosis in recent years has helped improve the outcome of AKI in children in developed countries. Persistent abnormalities in renal function in critically ill children with AKI have been reported at the time of discharge from hospital as well as long term follow up.[5] Early recognition of AKI as well as its persistence during follow up are important in planning preventive strategies to avoid further renal damage. Follow up studies in children with AKI discharged from PICU are scarce in Indian literature. The present study was undertaken to out-line the clinical and epidemiological profile of

children with AKI and follow up of renal function of these children at 1 month after PICU admission.

METHODS

A prospective cohort study was conducted from January 2012 to December 2012 in the Pediatric intensive care unit of Government Medical College, Kozhikode. Informed consent was obtained from parents of all children. Institutional ethics committee approved the study.

Inclusion criteria

- All children in the age group of 29 days to 12years admitted in PICU were included.

Exclusion criteria

- Children with previous renal disease/AKI at the time of admission and who stayed less than 48 hours were excluded.

Children included in the study were followed during their stay in the PICU, and data were collected according to the approved protocol. Standard demographic, clinical and laboratory data were collected. Demographic information included age, gender and address.

Clinical data encompassed primary diagnosis, presence of co-morbidities, protein energy malnutrition, pulse rate, blood pressure, drugs, need for mechanical ventilation, renal replacement therapy, period of ICU stay and complications.

Laboratory data included complete blood count, blood urea, serum creatinine, serum electrolyte, urine microscopy and albumin. Serum creatinine (SCR) of the children was measured at the time of admission, at 48 hours, and after one month.

Baseline value is taken as the upper limit of the normal for the age or SCR at the time of admission if it is below the upper limit value. Estimation of serum creatinine was done by autoanalyzer-Jaffe reaction.

The children were categorized according to acute kidney injury network (AKIN) criteria. Outcomes were defined in terms of normalization of S.CR, persistence of impaired renal function or mortality at one month.

Stastical analysis

The data collected were statistically analyzed using software SPSS version 18.

Acute kidney injury was diagnosed based on the acute kidney injury network (AKIN) criteria (Table 1).[6]

Table 1: AKIN staging.

Stages	Description
Stage 1	Increase in S.Cr ≥0.3 or 1.5 to 2-fold rise in S.Cr
Stage 2	>2 to 3-fold rise in S.Cr
Stage 3	> 3-Fold rise in S.Cr or renal replacement therapy

S.Cr-serum creatinine

RESULTS

During the study period, 1806 children were admitted to the PICU. Among them, 1716 children were included in the study. Out of these, 107(6.2%) children developed AKI. The age of the youngest child was 29 days and the eldest was 12 years.

Table 2: Demographic and clinical data.

	No. (%)
Gender	
Male	56 (52.3)
Female	51 (47.7)
Age	
<1 year	75 (70.1)
1-5 years	16 (14.9)
6-10 years	1 2(11.3)
>10 years	4 (3.7)
Duration of hospital stay	
≤7 days	74 (69.2)
8-14 days	13 (12.2)
15-21 days	10 (9.4)
22-30 days	4 (3.7)
>30 days	6 (5.6)
AKIN staging	
Stage 1	80 (74.8)
Stage 2	22 (20.6)
Stage 3	5 (4.7)
Renal recovery	
Within 2 weeks	21 (25)
2-4 weeks	46 (54.8)
Persistently elevated Cr	8 (7.5)
Renal replacement	3 (2.8)
Mechanical ventilation	15 (14)
Mortality	26 (21)

Mean age was 2.1 years and median were 6 months. Males and females were almost equal in number, with 56 children (52.3%) being males. Infants constituted the majority of children with AKI (75,70.1%) and this finding was statistically significant (p value 0.001). Respiratory infections (which included bronchopneumonia and bronchiolitis) constituted the majority of cases associated with AKI (34,31.7%). This was followed by septic shock, which occurred in 25 (23.3%) children. More than half of the children (68, 63.55%) with AKI had under nutrition.

Duration of hospital stay ranged from 2days to 42 days. Majority of the children 74(69.16%) stayed ≤7 days. Eighty children (74.77%) had stage 1 AKI, 22 (20.56%) had stage 2, and 5 (4.67%) had Stage 3 AKI. Average duration of hospital stay of stage 2 AKI was more when compared to stage 1. Average duration of hospital stays of children with stage1, stage 2 and stage 3 were 7.8,11.8 and 6.4 days respectively.

Mortality in stage 1, stage 2 and stage 3 AKI were 21.2%, 23% and 40% respectively. Renal replacement was required in 3 children (2.8%). Fifteen children (14.02%) with AKI under-went mechanical ventilation compared to 7.29% children without AKI. During the hospital stay 26 children died (24.29%). The overall mortality of children admitted in the PICU during the study period was 6.8%. Those with AKI had a mortality of 24.29%, while those without AKI had a mortality of 5.71%.

On follow up, out of the 107 children, 23 children died within one month, in 21 children (25%) creatinine normalized within 2 weeks, in 46 children (54.76%) creatinine normalized in 2-4 weeks. Among the survivors, who could be followed up 67children (89.3%) had complete renal recovery at one month. At the end of 1 month,6 children were lost to follow up. In 8 children AKI persisted at one month. Among them three children died later.

Table 3: Clinical conditions, staging and mortality associated with AKI.

System	No. (%)	Stage 1	Stage 2	Stage 3	Mortality (No.)
Pneumonia/bronchiolitis	34 (31.7)	25	8	1	8
Septic shock	25 (23.3)	19	5	1	7
Primary cardiac illness	14 (13.08)	11	3		3
Primary CNS illness	13 (12.1)	9	3	1	3
Acute diarrhea	5 (4.6)	4	1		-
Primary renal disease	2 (1.8)	1		1	-
Poisoning	3 (2.8)	3			-
Others	11 (10.2)	8	2	1	5

DISCUSSION

The incidence of AKI in present study (6.2%) is low, compared to studies conducted in other parts of India. Incidence of AKI varies in various studies between 4% and 43%.[7,8] The wide variability in the incidence is likely to be related to various factors like age group of children studied, geographic location, disease conditions associated, and the criteria used for making the diagnosis of AKI. Authors used the acute kidney injury network criteria (AKIN) for diagnosis of AKI in children in the age group of 1 month to 12 years.

In a recently published study from North India, Gupta et al, reported a relatively high incidence of 43% of AKI among children admitted in the PICU.[7] This study included children up to the age of 16 years, with p rifle criteria used for making the diagnosis. Ashraf M et al, in their study found only 4% incidence of AKI among PICU patients in the age group of 1 month to 18 years.[7] They used AKIN criteria for diagnosing AKI. Naik S et al, found a prevalence of 40.9% of PICU admissions, using p rifle criteria whereas Krishnamurthy et al, using AKIN criteria had incidence of 25% in a similar population.[9,10]

In present study, infants constituted the majority of children with AKI with a median age of 6 months and this was statistically significant. Among these, infants less than 6 months (53%) constituted the majority. Thirty (40%) of these babies were in the age group 3 months or less. High incidence of AKI in infants has also been reported in many earlier studies.[3] The relative immaturity of the kidneys of the young infant is the possible contributing factor as illustrated by very high incidence of AKI in critically ill newborns.[11,12]

Infections were the most common underlying condition in children with AKI in this study. Majority of children had lower respiratory infections (bronchiolitis/ pneumonia), followed by septic shock. Krishnamurthy et al in their study from South India reported similar findings, with majority of cases of AKI associated with infections.[1] Primary renal disease contributed to the etiology only in 1.8% of our cases where as this was associated with 37% of cases in a study conducted in Jammu and Kashmir, which included cases from general pediatric wards in addition to PICU. In this study, majority of AKI resulting from primary renal diseases had acute glomerulonephritis as the underlying cause (16.9%).[8]

One fifth of our children with AKI died. Mortality associated with AKI has been reported to vary widely between 5.2% and 55.5%.[3,13] The mortality of 21.5% in present study is comparable to two recently conducted studies from North India.[7,14] Mortality varies with the criteria used for diagnosing AKI and the setting in which the study was conducted. Thus, the underlying illness that

is predominant in one particular setting may be a determining factor for mortality.

Among survivors who could be followed up for 1 month, 10% had persistent abnormality in renal function. Krishnamurthy S et al, reported only partial renal recovery at the time of discharge from hospital (with a mean duration of hospital stay of 10.1 days) in 20.7% of patients with AKI in the PICU.[10] Authors followed up the children for 1 month. Persistence of abnormal renal function in 10% of our children indicates the need for further follow up.

Limitations: In the present study, only the short-term outcome of children with AKI was measured. The study was conducted in a tertiary hospital; the clinical profile of children could have been affected by a referral bias.

CONCLUSION

There is a high incidence of AKI in infants admitted to Paediatric ICU. Abnormal renal function persists in 10% of children with AKI at 1 month follow up. This underlines the importance of long term follow up of these children.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Saritha PJ, Jayakrishnan MP, Ashraf TP, Geeta MG. Acute kidney injury in paediatric intensive care: need for extended vigil. Int J Contemp Pediatr 2019;6:853-6.