Clinical profile of children with acute kidney injury in a tertiary care centre from southern India

Shrikiran Aroor[1], **Kavya Kambham**[1], **Pushpa G Kini**[1], ***Shravan Kanaparthi**[1]

Sri Lanka Journal of Child Health, 2018; **47**(4): 338-341

Abstract

Introduction: Acute kidney injury/impairment (AKI) includes the entire spectrum of the syndrome from minor changes in markers of renal function to the requirement of renal replacement therapy.

Objective: To study the incidence, clinical profile and outcome of AKI in the paediatric intensive care unit (PICU) of a tertiary care centre from South India.

Method: A prospective observational study was conducted in a paediatric tertiary health care centre from South India. All children between 1 month and 18 years of age, admitted to the PICU from October 2015 to April 2016 were included in the study. Children with known pre-existing renal disease, children who underwent renal replacement therapy before admission and children admitted for post-operative care and who were discharged within 48 hours or against medical advice, were excluded from the study.

Results: A total of 310 children was admitted to the PICU during the study period and 262 were considered for the study after excluding 48 cases. Male-female ratio in the study group was 1.12:1. At admission, AKI was present in 8% (21 out of 262), at 48 hours in 7.9% (20 out of 252, 10 children expired before 48hrs). Overall, pRIFLE criteria were observed in 31 (11.8%) out of 262 children during the hospital stay. The overall mortality rate of the study group was 9.2%. The length of PICU and hospital stay was significantly longer in children with AKI when compared to children without AKI (p-values 0.003 and <0.001 respectively). Most common aetiology implicated in the present study was sepsis (64.5%).

Conclusions: The incidence of AKI in the PICU of the tertiary centre from South India was 8%, the mortality rate was 9.2% and the most common aetiology implicated (64.5%) was sepsis.

[1]*Kasturba Medical College, Manipal, Mahe, India*
**Correspondence:* shravan.1354@gmail.com

(Received on 31 January 2018: Accepted after revision on 16 March 2018)

The authors declare that there are no conflicts of interest

Personal funding was used for the project.

DOI: http://dx.doi.org/10.4038/sljch.v47i4.8596

(Keywords: Acute kidney injury, sepsis, hyponatraemia, hyperkalaemia, mechanical ventilation).

Introduction

Acute kidney injury/impairment (AKI) includes the entire spectrum from minor changes in markers of renal function to the requirement of renal replacement therapy. It includes patients with functional impairment relative the physiological demand[1]. It reflects the importance of smaller derangements in kidney function which exert a significant influence on morbidity and mortality[1-4]. Acute Dialysis Quality Initiative (ADQI) proposed the RIFLE (Risk of renal dysfunction, Injury to kidney, Failure of kidney function, Loss of kidney function and End-stage kidney disease) definition and staging system for AKI[4] based on creatinine clearance and urine output which was further modified for the paediatric population (pRIFLE criteria)[2]. Acute Kidney Injury Network (AKIN) proposed a modified classification for AKI based on the increase in serum creatinine levels and urine output[3]. Most recently, the Kidney Disease Improving Global Outcomes (KDIGO) has brought together a definition and staging system that combines the previous definitions and staging systems proposed by ADQI and AKIN[1].

Objectives

To study the incidence, clinical profile and outcome of AKI in the paediatric intensive care unit (PICU) of a tertiary care centre from South India. The primary outcome was to grade AKI in children admitted to PICU using pRIFLE criteria. Secondary outcomes included studying the progression of AKI in PICU using pRIFLE criteria and the clinical profile of AKI in PICU.

Method: A prospective observational study was conducted in a paediatric tertiary health care centre from South India. It was approved by the Institutional Ethics Committee (IEC). All children between 1 month and 18 years of age, admitted to the PICU during the study period (October 2015 to

April 2016) were included in the study. Children with known pre-existing renal disease, children who underwent renal replacement therapy before admission and children admitted for post-operative care and who were discharged within 48 hours or against medical advice, were excluded from the study. A probability of children with AKI in PICU was taken as 15%, and with a 5% margin of error, the sample size was estimated as 196.

Demographic data, the presenting complaints and the diagnosis were noted in a predesigned proforma. Written and informed consent were obtained from the parents. Serum creatinine levels were obtained on admission and after 48 hours for the study population. The estimated creatinine clearance (eCCl) was calculated using the modified Schwartz formula[5]. The baseline eCCl, whenever not available, was considered as 100 ml /min /1.73 square metres[2]. The eCCl was calculated on admission and 48 hours after admission, and the corresponding pRIFLE grade was assigned. The course of hospital stay, including the need for renal replacement therapy, inotropic support and mechanical ventilation, was studied. The durations of PICU and hospital stay were noted along with the diagnosis and outcome of the child.

Statistical analysis was done using SPSS 16.0. Median was used for non-parametric data and analysis was done using Mann Whitney for continuous variables and Chi-square test for categorical variables. Mean was used for non-skewed data. A p value of <0.05 was considered statistically significant.

Results

A total of 310 children were admitted to the PICU during the study period and 262 were considered for the study after excluding 48 cases. The male: female ratio in the study group, was 1.12:1 (140 and 122 cases respectively). At admission, AKI was present in 8% (21 out of 262) and at 48 hours in 7.9% (20 out of 252, 10 children expired before 48 hours). Overall, pRIFLE criteria were observed in 31 out of 262 (11.8%) children during hospital stay (Table.1).

Table 1: ***Grading of AKI as per pRIFLE criteria during the hospital stay***

pRIFLE grade	At admission *(n=262)* Number (%)	At 48 hours *(n=252)** Number (%)	Highest pRIFLE grade during hospital stay *(n=262)* Number (%)
No AKI	241 (92.0)	232 (92.0)	231 (88.1)
Risk	05 (02.0)	07 (02.8)	08 (03.0)
Injury	07 (02.7)	08 (03.2)	11 (04.1)
Failure	09 (03.3)	05 (02.0)	12 (04.8)

**10 children (No risk=8, Failure=2) expired within 48 hours*

Of these 8 (25.8%) reached pRIFLEmax R, 11 (35.4%) reached pRIFLEmax I, and 12 (38.7%) reached pRIFLEmax F. Among children with AKI, 67.8% were aged less than 3 years. Male: female ratio in AKI group was 1.2:1. Overall mortality rate of the study group was 9.2% (24 of 262). Mortality among patients with AKI was 45.2% (14 out of 31). Overall, in children admitted to PICU (n=262), median (95^{th}, 25^{th} centile) PICU stay and hospital stay was 2 (4, 1) and 8 (12, 5.2) days respectively. In children with AKI, median (95^{th}, 25^{th} centile) PICU and hospital stay were 7 (12, 3) and 16 (26, 8.5) days respectively. The length of PICU and hospital stay were significantly longer in children with AKI when compared to children without AKI (p-values 0.003 and <0.001 respectively). Most common aetiology implicated in present study was sepsis in 64.5% (Table 2).

Table 2: ***Aetiology of AKI in the study group where profile was observed (n=31)***

Aetiology	Number (%)
Sepsis	20 (64.5)
Urosepsis	03 (09.7)
Leptospirosis	01 (03.2)
Acute gastroenteritis with severe dehydration	02 (06.5)
Acute tubular necrosis	01 (03.2)
Unknown	04 (12.9)

In children with AKI, hyponatraemia and hyperkalaemia were observed in 25.8% and 22.6% respectively. No significant differences were observed in sodium (p-value: 0.33) and potassium (p-value: 0.72) levels in children with and without AKI. Inotropic support and mechanical ventilation were required in 47.8% and 45% respectively in children with AKI and was significantly higher when compared to children without AKI (p-values:<0.001 for both variables).

Secondary outcome variables in the study group are shown in table 3.

Table 3: ***Secondary outcome variables in the study group (n=262)***

Indicator	AKI (n=31)	No AKI (n=231)	p value
Shock	15 (47.8%)	16 (06.9%)	<0.001
Mechanical ventilation	14 (45.1%)	13 (05.6%)	<0.001
Median duration of ICU stay (days) (75, 25 IQ)	07 (12, 03)	02 (04, 01)	<0.001
Median duration of hospital stay (days) (75, 25 IQ)	16 (26, 08.5)	08 (11, 05)	0.003
Mortality	14 (45.1%)	10 (04.3%)	<0.001

Discussion

A total of 262 children were included in the study group with an almost similar number of children from each age group and sex. Mean patient age was 8.5±6.4 years and the male: female ratio was 2:1 in a study by Hui *et al*[6]. Mean patient age was 6.4±6.4 in a study by Akcan *et al.* In a study by Duzova *et al*[7] 56.3% of the patients were infants. Male to female ratio was 1.27:1 in a study by Duzova *et al*[7]. In a study by Hui et al, 46% of children at admission had AKI and the overall prevalence of AKI during hospital stay was 56%[6]. 42.3% and 63% of children had AKI at admission in studies by Akcan *et al* and Duzova *et al* respectively[2,7]. The incidence of AKI in the current study was less (8% at admission and 11.8% overall) when compared to other studies.

Sepsis (64.5%) was the most common cause in the present study. Intrinsic followed by pre-renal were the common causes of renal failure in children with the frequency of pre-renal causes increasing with age[7]. Hypovolaemia (secondary to acute gastroenteritis and inadequate fluid intake combined) is the most common (25%) aetiology followed by hypoxic-ischaemic injury, sepsis, glomerular diseases (haemolytic uraemic syndrome, acute post-streptococcal glomerulonephritis, membrano-proliferative glomerulonephritis) and drug-induced / exogenous toxins in children aged >1month[7]. In the newborn, hypoxic-ischaemic injury, sepsis and hypovolaemia were the common causes[7]. Glomerular causes of AKI were seen in 15% of children in a study by Duzova, *et al.* Pre-existing medical conditions before the onset of AKI were observed in 67.5% and 54.4% of newborn and children aged more than 1month, respectively[7]. Aetiology differs in developed and developing countries. Cardiac surgery, malignancy, ischaemia and drugs are the common causes in developed countries whereas acute gastroenteritis and acute glomerulonephritis are the common causes in developing countries. Over the years, AKI due to acute gastroenteritis and acute glomerulonephritis decreased whereas AKI secondary to malignancy and cardiac surgery increased.

There was no significant differences in serum sodium and potassium levels in children with and without AKI. In children with AKI, hyponatremia and hyperkalaemia were the two common abnormalities observed (25.8 and 22.6% respectively). Similar results were observed in a study by Duzova et al[7]. Inotropic support and mechanical ventilation were required in 47.8% and 45% respectively in the study group. Inotropic support and mechanical ventilation were required in 29% and 59% of children with AKI in a study by Hui *et al*[6]. In a study by Akcan, *et al* inotropic support and mechanical ventilation were observed in 53% and 100% respectively[2]. 47.1% of children needed mechanical ventilation in a study by Duzova *et al*[7]. Dialysis rates in a study by Duzova *et al*. were higher in children with pRIFLE I and F when compared to pRIFLE R. However, differences between mortality rates were not significant[7].

Median PICU and hospital length of stay were significantly different (p-values 0.003 and <0.001 respectively) in the present study. Similar results were observed in study by Akcan *et al*[2]. PICU and hospital length of stay were longer in children with AKI compared to children without AKI (p-values 0.06 and 0.004 respectively)[2]. Overall mortality in the group was 9.2% which was similar to that reported in Hui *et al*[6]. Mortality rates among children with and without AKI were significantly different (45% vs 4.3%, p-value <0.001). In a study by Hui *et al.* percentage mortality in children with AKI and without AKI was 21% and 2% respectively[6]. In a study by Akcan *et al*[2] mortality rate was 14.6%, and there was no significant difference in overall mortality rates between children with (14.6%) and without AKI (11.1%). Authors of this study concluded that AKI alone did not increase the risk of mortality[2]. In a study by Duzova *et al* mortality was 27.9%. Chronic heart disease, malignancy, hypoxia, septic shock, hypotension, heart failure, pulmonary oedema, hypervolaemia, dialysis and intrinsic renal failure confer a higher risk for mortality[7]. Mechanical ventilation (in children aged >1month, RR8.73, 95%CI 3.95-19.28) and fluid overload (RR12.90; 95%CI 1.97-84.37) were associated with higher mortality[7].

AKI was associated with a significant mortality and morbidity in children. Infants constituted the dominant age group. Ionotropic support and mechanical ventilation were required in a higher percentage of patients with AKI. Early identification would help in initiating appropriate intervention and thereby improving the quality of life of children.

There were some limitations in the study. As none of the AKI patients were biopsied it was difficult to conclude whether the injury was pre-renal of intrinsic. At what point renal replacement therapy is instituted will decide the outcome of AKI. This was not addressed in the study.

Conclusions

The incidence of AKI in the PICU of the tertiary centre from South India was 8%, the mortality rate was 9.2% and the most common aetiology implicated (64.5%) was sepsis.

References

1. Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, Goldstein SL, *et al.* KDIGO Clinical Practice Guideline for acute kidney injury. *Kidney International Supplements* 2012; **2**(1):1-138.

2. Akcan-Arikan A, Zappitelli M, Loftis LL, Washburn KK, Jefferson LS, Goldstein SL. Modified RIFLE criteria in critically ill children with acute kidney injury. *Kidney International* 2007; **71**(10):1028–35. https://doi.org/10.1038/sj.ki.5002231 PMid: 17396113

3. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG, *et al.* Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. *Critical Care* 2007; **11**(2): R31. https://doi.org/10.1186/cc5713 PMid: 17331245 PMCid: PMC2206446

4. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P. Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. *Critical Care* 2004; **8**(4): R204-12. https://doi.org/10.1186/cc2872 PMid: 15312219 PMCid: PMC522841

5. Schwartz GJ, Brion LP, Spitzer A. The use of plasma creatinine concentration for estimating glomerular filtration rate in infants, children, and adolescents. *Pediatric Clinics of North America* 1987; **34**(3):571–90. https://doi.org/10.1016/S00313955(16)36251-4

6. Hui WF, Chan WKY, Miu TY. Acute kidney injury in the paediatric intensive care unit: identification by modified RIFLE criteria. *Hong Kong Medical Journal* 2013; **19**(1):13–9. PMid: 23378349

7. Duzova A, Bakkaloglu A, Kalyoncu M, Poyrazoglu H, Delibas A, Ozkaya O, *et al.* Etiology and outcome of acute kidney injury in children. *Pediatric Nephrology* 2010; **25**(8):1453–61. https://doi.org/10.1007/s00467-010-1541-y PMid: 20512652