BANGLADESH J CHILD HEALTH 2014; VOL 38 (3) :120-123

Original Articles

Incidence And Outcome of Acute Kidney Injury in Critically ill Children at Dr. Soetomo Hospital Surabaya

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Abstract

Background: *The development of acute kidney injury (AKI) in critically ill patients, or AKI children worsened to be critically ill, is associated with increased morbidity and mortality. Early detection on AKI improves its poor outcome in those children. To study the incidence and correlate the outcome of critically ill children with AKI in children admitted to Pediatric Intensive Care Unit (PICU) at Dr. Soetomo Hospital Surabaya.*

Methodology: *We prospectively studied children admitted to PICU during 15 January to 14 April 2014. Demographic data including age and sex, PICU indications, and AKI staging were recorded. All data were analyzed by descriptive statistics and chi-square test (P<0.05).*

Results: *A total of 119 children were admitted to PICU during study period. Among those, 63 children were excluded for being <3 months old, had end-stage kidney disease or complex cardiac problem, and children underwent cardiac catheterization. The remaining 56 (47.1%) were studied further, mean age was 49.7 (SD 46.2) months, male-to-female ratio was 1.2:1. Indication for PICU admission was dominated by shock (35.7%), followed by central nervous system (CNS) dysfunction in 13 (23.2%) and respiratory failure in 12 (21.4%) children. AKI was noted in 15 (26.8%) children, mostly (10.7%) in Injury stage with 5 (8.9%) in Risk and 4 (7.1%) in Failure stages. Twelve (21.4%) children died, 7 (58.3%) had AKI with 3 (25.0%) each in Risk and Failure stages while 1 (8.3%) in Injury (P<0.05).*

Conclusion: *The incidence of AKI was moderate in critically ill children but significantly associated with mortality rate.*

Keywords: *Acute kidney injury, Critically ill children, Incidence, PICU.*

Introduction:

Background: Acute kidney injury (AKI), previously termed acute renal failure, is a serious condition that is commonly encountered among critically ill patients.[1] AKI has been associated with prolonged hospital stay, progression to chronic kidney disease, and a significantly higher relative risk of in-hospital death.[2] The development of AKI, particularly in critically ill patients is associated with increased morbidity and mortality.[3,4]

AKI reflects a broad spectrum of clinical presentations ranging from mild injury to severe injury that may result in permanent and complete loss of renal function. The range of severity and variety of causes of AKI has resulted in multiple classification systems complicating diagnosis and subsequent management. The lack of consensus has resulted in a broad range

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of estimated prevalence in the intensive care unit (ICU) ranging from 1% to 70% depending on the criteria used.[5] ICUs have seen an increase in admissions involving AKI ranging from 13% up to 78%. Metnitz (2002) study revealed that the primary endpoint defined as the need for renal replacement therapy (RRT) was noted in 4.9% of all ICU admissions (5.6% of medical ICU admissions and 4.5% of surgical ICU admissions). The most common reasons for admission that resulted in RRT were respiratory disease, sepsis, abdominal surgery, cardiovascular surgery, and surgery not otherwise specified.[6] As for children, pediatric AKI literature lacks comprehensive multicenter studies. To date, the largest study about AKI in children admitted to Pediatric Intensive Care Unit (PICU) was carried by Schneider et al (2010) on 3396 children that revealed 10% AKI prevalence. Despite the large population size, that was a single-center study and did not use the pediatric RIFLE (pRIFLE) criteria.[2] The new pRIFLE criteria uses either urine production or estimated creatinine clearance (eCCl). With reference to the new definition by RIFLE criteria, AKI incidence in the critically ill pediatric population was reported to range from 10% among patients admitted to PICU to 82% among those receiving ventilatory support.[2,7-9] The objectives of this study was to describe the incidence and outcome of AKI in children admitted to Pediatric Intensive Care Unit (PICU) at Dr. Soetomo Hospital Surabaya.

Methodology:

We prospectively studied children aged 3 months to 18 years admitted to PICU at Dr. Soetomo Hospital Surabaya during 15 January to 14 April 2014. Inclusion criteria was all children aged >3 months. Exclusion criteria were children who had end-stage kidney disease (ESKD), complex cardiac problem as underlying diseases noted beforehand, and children underwent cardiac catheterization. ESKD was defined as patients with chronic kidney diseases stage 4 and above with estimated glomerular filtration rate (eGFR) less than 30 ml/minute/1.73 m^2, or patients on maintenance hemodialysis or peritoneal dialysis. Complex cardiac problems was defined as patients with uncorrected congenital heart disease, unless they only had isolated uncorrected cardiac problem such as ventricular septal defect, atrial septal defect, patent ductus arteriosus and patent foramen ovale.

Demographic data including age and sex, PICU indications, AKI staging (based on pRIFLE criteria, either urine production or eCCl) and PICU scores (PELOD, PIM 2, PRISM 3) were recorded. All data were analyzed by descriptive statistics.

Results

A total of 119 children were admitted to PICU during study period. Among those, 63 children were excluded for being <3 months old, had prerenal insufficiency and complex cardiac cases. The remaining 56 (47.1%) were studied further, mean age was 49.7 (SD 46.2) months, comprised of boys (53.6%) in almost similar number as girls (46.4%) and male-to-female ratio was 1.2:1 (figure 1). The clinical characteristics of subjects are shown in table I.

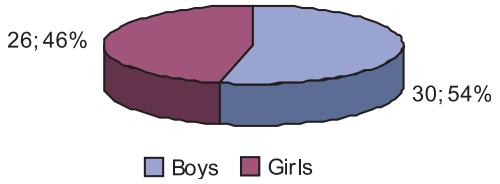

Fig.-1: *Gender distribution of subjects*

Table-I

Clinical characteristics of subjects

Age at admission (months) (mean ± SD)	49.6 ± 46.2
Body weight (kg) (mean ± SD)	18.18 ± 9.6
Body height (cm) (mean ± SD)	97.2 ± 28.3
Sex:	
-Boys, n (%)	30 (53.6)
-Girls, n (%)	26 (46.4)
eGFR at admission (ml/minute/1.73 m^2) (mean ± SD)	192.6± 126.4
Urine production (ml/kg/hour) (mean ± SD)	5 ± 0
AKI:	
-Risk, n (%)	5 (8.9)
-Injury, n (%)	6 (10.7)
-Failure, n (%)	4 (7.1)
Outcome:	
-Alive, n (%)	44 (78.6)
-Died, n (%)	12 (21.4)

Indication for PICU admission was dominated by shock in 20 (35.7%) children, followed by central nervous system (CNS) dysfunction in 13 (23.2%), respiratory

failure in 12 (21.4%), cardiac problem in 6 (10.7%), post surgical in 2 (3.6%), combination of respiratory failure and CNS dysfunction in 2 (3.6%), and combination of respiratory failure and cardiac problem in 1 (1.8%) children (figure 2).

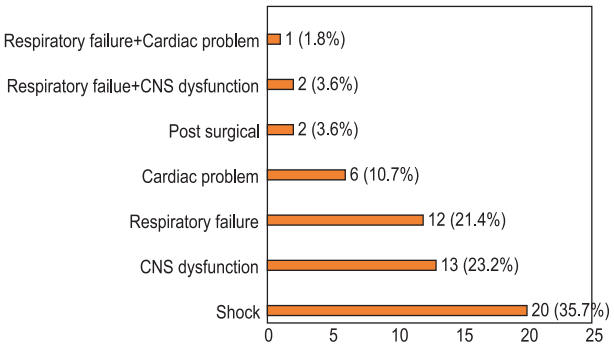

Fig.-2: *Indication for PICU admission*

AKI was noted in 15 (26.8%) children, comprised of 5 (8.9%) children on Risk stage, 6 (10.7%) children on Injury and 4 (7.1%) on Failure stages (figure 3).

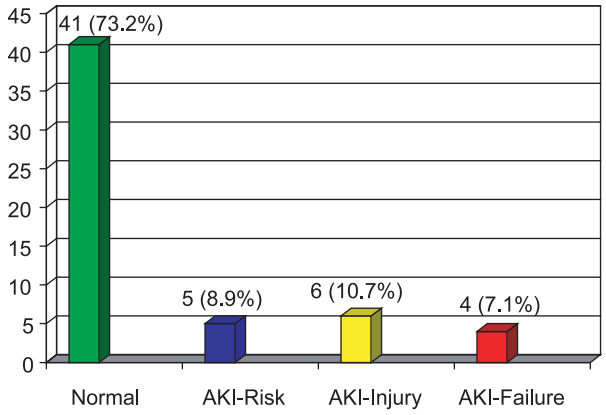

Fig.-3: *Distribution of renal function on subjects*

Death occurred in 12 (21.4%) children, 7 (58.3%) of them had AKI with 3 (25.0%) children each on Risk and Failure stages, and 1 (8.3%) on Injury stage (figure 4). The mortality rate among AKI patients was 46.7% (7 out of 15 patients).

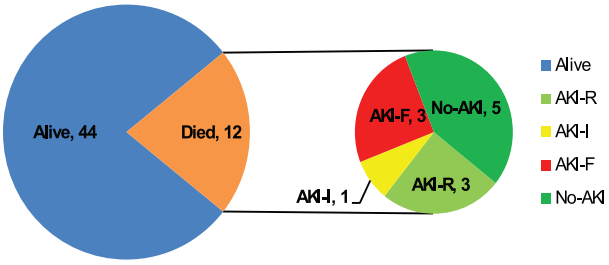

Fig.-4: *Outcome of critically ill children*

Discussion

AKI is a common problem that significantly increases morbidity and mortality in PICUs. The term AKI was introduced by The Acute Dialysis Quality Initiative (ADQI) in 2004 and proposed to cover the entire spectrum based on RIFLE criteria (Risk of renal dysfunction, Injury to the kidney, Failure of kidney function, Loss of kidney funcstion, End-stage kidney disease), from subtle changes in renal function to the end-stage disease that requires renal replacement therapy (RRT).[4] A modified version of RIFLE for pediatric patients, namely pRIFLE, was developed in 2007. This criteria is based on the reduction in estimated creatinine clearance (eCCl) while considering urine output based on body weight.[7]

The incidence of AKI at PICU admission in this study was 26.8% based on the pRIFLE criteria (using either urine production or eCCl criteria). Mostly they were on Injury stage, although not so far different in numbers with Risk and Failure stages. This number is relevant to other studies on the incidence of AKI in PICUs that ranged from 10% to 82%.[2,7-9] Another study by Hui et al (2013) in Hong Kong showed the incidence of AKI at admission was as high as 46% and even increased to 55% during the PICU stay.[1] Our number was lower than the reported figure of 82% in the original article on pRIFLE.[7] However, in that cohort all the patients had respiratory failure and were dependent on mechanical ventilation, whereas our study subjects comprised patients with and without respiratory failure.[7] Schneider et al (2010) reported the lowest prevalence of 10% in which they used only the change in serum creatinine to define AKI and not the change in eCCl.[2]

Our subjects showed that the distribution of patients in the 3 stages of AKI (Risk, Injury, Failure) were almost equal in numbers when they were admitted to PICU. Hui (2013) found that the distribution of AKI patients at admission was not equal with most patients were on Risk (30, 50.9%) and Injury (20, 33.9%) stages, only 9 (15.3%) was in Failure stage.[1]

Death occurred in 21.4% patients in this study, and 58.3% of them had AKI, mostly in Risk and Failure stages. The mortality rate of AKI patients was 46.7%. These numbers were higher than the study by Hui (2013) who reported the overall mortality rate as 12%, and the AKI mortality rate was 21%.[1]

In this study, one of the limitations included the lack of laboratory data of the patients during PICU stay that made AKI progress evaluation impossible. The

patients were all covered by the government insurance which could not allow daily laboratory examinations to be done. Another limitation was the non-compliance nature of the patients, so that the final outcome was not known for patients who asked to be discharged against medical advice.

Conclusion

The incidence of AKI was moderate in critically ill children but significantly associated with mortality rate.

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