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Original Article

Estimation of Severity and Outcome of Acute Kidney Injury in Children by Using pRIFLE Criteria

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Abstract

Background: Acute kidney injury (AKI) is rapid decrease of renal function. AKI has been resulted in significant morbidity and mortality. The term RIFLE consist of risk, injury, failure, loss, and end-stage renal disease. A modified version of this criteria pRIFLE is used in pediatric population with AKI, for the severity assessment and its outcome. Therefore early intervention can be made. This study helps to make recommendations based on pRIFLE criteria for severity and outcome.
Objectives: To determine severity and outcome of AKI in pediatric population using pediatric RIFLE criteria.
Study design, settings and duration: It was a descriptive case series carried out in departments of Pediatric ICU and pediatric nephrology unit at National Institute of Child Health (NICH), Karachi from August 2010 to March 2011.
Patients and Methods: Total ninety seven children with acute kidney injury (AKI) were included in this study. Schwartz equation was applied for calculation of estimated glomerular filtration rate (eGFR) and severity of AKI was assessed using pRIFLE criteria at presentation and then on daily basis till discharge. Outcome was labeled as death or alive. Data entered and analyzed by using SPSS version 19.0.
Results: The pediatric RIFLE identified those at risk, injury, and failure in 16 (16.5%), 25 (25.8%), and 56 (57.7%) patients respectively. Outcome in term of mortality was observed in 11.3% cases. There was 6.3% death in those at risk, 17.9% (10/56) in those with failure and no significant in injury.
Conclusion: There are significant number of patients in renal failure due to AKI, this implies lack of early detection of AKI and delayed referral to the pediatric tertiary care hospital so "pRIFLE criteria" can be widely used by all pediatricians for early detection of children with AKI in risk category so that early interventions may halt the progression of AKI to failure.
Key words: Acute kidney injury, RIFLE, pRIFLE.

Introduction

Acute Kidney Injury (AKI) is defined as transient decrease in kidney functions characterize by raise plasma creatinine with nitrogenous waste products leading to failure of fluid and electrolytes management.[1] In pediatric population AKI is the one of the most important cause of morbidity and mortality.[2] AKI may leads to long term problems due to limited residual kidney functions including proteinuria, chronic kidney disease (CKD) and hypertension.[1-3] The incidence of AKI vary, poles part of the world include both developed and developing regions. Incidence of AKI in China is 0.32%, United States of America 0.39%, United Kingdom 0.8/100,000 per year and a hospital based study in India revealed about 25.1%.[4]

"Acute Dialysis Quality Initiative" (ADQI) in 2nd international consensus conference, has been standardized the criteria, to define AKI is RIFLE classification scheme which consist of risk, injury, failure, loss of kidney function and end stage kidney disease.[5] After modifications in adult derived RIFLE criteria, it was validated and applied with the new

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SS & NG conceptualized the project. SS & MR did the data collection. SS & MA performed the literature search. SS & AAM did the statistical analysis. Drafting, revision and writing of manuscript was done by SS.

name of pediatric RIFLE (pRIFLE) criteria.[4] The RIFLE is acronym, R is risk, I is injury, F is failure, L is loss of kidney function and E is end stage renal function. It categorized mild to severe on the basis of estimated glomerular filtration rate and creatinine clearance[6] and management and prevention options are used according to the degree of severity is important of AKI.[7,8]

Early detection of AKI as initial management will lead to scanty long term consequences[9] and consequently identification of patients who are prone to develop AKI, monitor accordingly and then start treatment or intervention at early stages of AKI.

Number of studies available in terms of AKI illness and its consequences but regarding Pakistan, scanty reports are available.[10]

National institute of child health (NICH) is a public tertiary care hospital in which patients received free of cost treatment. It receive number of referrals from all over urban and rural Sindh. It also has the facility of pediatric hemodialysis, as well as peritoneal dialysis. Limited studies are available of developing countries as well of Pakistan. Considering the limited availability of data on pediatric AKI in Pakistan, we have designed this prospective study to assess the severity and outcome of children hospitalized at NICH with AKI.

Patients and Methods

It was a descriptive case series conducted on 97 children of AKI admitted at pediatric Intensive Care Unit (PICU) and Nephrology ward of National Institute of Child Health (NICH), Karachi in the duration of 6 months from August 1, 2010 to March 31, 2011.

All children from 1 month to 14 years of age, who were admitted in PICU or nephrology ward with diagnosis of AKI were included. Children with known chronic kidney disease (CKD) either on conservative treatment or on renal replacement therapy (RRT) and children with severe acute malnutrition (weight for length or height <70%) were excluded.

"pRIFLE criteria" was used for diagnosis of AKI.[3] "Schwartz equation" was used to estimate glomerular filtration rate (eGFR).[11]

For individual case, we filled a proforma which was designed before hands. Height and weight was measured by researcher using standard technique. Grading of AKI based on severity was done by using pRIFLE i.e R, I, F Risk, Injury, and Failure respectively. Sample size was calculated by using proportion found from previous studies as 10% mortality rate in those at risk at 95% Confidence interval and absolute precision 6% using EPI info version 6, sample of 97 patients was calculated.[8]

Using pRIFLE criteria, severity and outcome of AKI was assessed. AKI was defined as Urine output <0.5 ml/kg for more than 8 hours. Severity of AKI was assessed on the basis of pRIFLE criteria. Risk (R) was defined as either decrease in estimated GFR by 25% from base line or urine output <0.5 ml/kg/hour × 8 hours. Injury (I) was defined as presence of either 50% decrease in estimated eGFR from baseline or urine output <0.5 ml/kg/hour × 16 hours. Failure (F) was defined as presence of either 75% decrease in estimated eGFR from baseline or urine output <0.3 ml/kg/hour × 24 hours/ anuric for 24 hrs.[3] Outcome was measured in the term of mortality or alive. Mortality was defined as death within the first 3 months of diagnosis of AKI.

Serum creatinine level was measured at the time of admission and then on daily basis and investigation was sent to the institutional laboratory and "Jaffe's method" was used to check plasma creatinine. Urine output was measured on hourly basis. Using the Schwartz equation, estimated GFR was calculated and severity of AKI was assessed using pRIFLE criteria at presentation and on daily basis till recovery from AKI. Severity of AKI was labeled as Risk, Injury and Failure as per operational definition. Outcome was labeled as death or alive.

Data was entered and analyzed using SPSS version 19.0. Frequency and percentages were calculated for qualitative variables. Mean ± standard deviation were computed for quantitative variable. Chi square test was applied to see the effect of these on outcomes. $p \leq 0.05$ was considered significant.

The permission taken from ethical committee of National Institute of Child Health (NICH), Karachi. Parents were informed about study and written consent was taken.

Results

Ninety seven children with acute kidney injury (AKI) were included in this study. Seventy one children were above 12 months of age as presented in Table-1. The mean age was 43.14±36.62 with the age varying from 2-16 months. Out of 97 children, there were 51 (52.6%) male and 46 (47.4%) female. The mean weight and height of the children was 14.30±6.50 kg and 90±20.82 cm respectively as presented in Table-1.

The patients in Risk category were 16 (16.5%), 25 (25.8%) were in Injury category and 56 (57.7%) were in Failure category, as shown in Table-1.

Table 1: Demography, severity and outcome of children with AKI.

Parameters	*Values*
Age Mean ±SD (range)	43.14±36.62 (2-168) months
2-12 months	26
12.1-60 months	47
More than 60 months	24
Weight Mean ±SD (range)	14.30±6.50 (3-33) kg
Height Mean ±SD (range)	90.36±20.82 (52-161) cm
Gender	N (%)
Male	51 (52.6)
Female	46 (47.4)
Severity	
Risk	16 (16.5)
Injury	25 (25.8)
Failure	56 (57.7)
Outcome Risk	
Alive	15 (93.8)
Death	1(6.3)
Injury	
Alive	25 (100.0)
Death	0 (0.0)
Failure	
Alive	46 (82.1)
Death	10 (17.9)

Outcome in term of mortality was observed in 11.3%, 6.3% (1/16) mortality in those at risk, none in injury, and 17.9% (10/56) in those with failure. There was significant difference in outcome among three groups, (*p* value 0.05).

Severity and outcome of AKI was further analyzed in male and females, No significant difference in outcome in either gender was observed as shown in Table-2.

Children were in different age groups from 2-12months, from 12.1 to 60 months and > 60 months. Most of the children 47 (48.45%) were in age group of 12.1 to 60 months. There was no significant difference in outcome in terms of mortality in either age group (*p* value 0.88) as shown in Table-2.

The children according to weight in different groups from 3-10kg, 11-20kg and >20kg. Most of the children 54 (55.6%) had weight ranging from 11-20kg. However there was no significant difference in outcome (*p* value 0.78) in either weight group as shown in Table-2.

According to height, children were classified into different groups as height <70cm, 71-100cm and >100cm.There was no significant difference in mortality (*p* value 0.87) in either height group as shown in Table-2.

Discussion

This study was conducted in tertiary care hospital of children and has examined that most of the children 47 (48.4%) were between 12.1 to 60 months of age. In comparison with other studies from developing countries where it has shown pediatric AKI is most common in <5yr of age.[4] In contrast to our results, which reported most of the

Table 2: Severity and outcome according to age, gender, weight and height.

	N	Risk N (%)	Injury N (%)	Failure N (%)	Outcome Alive N (%)	Outcome Death N (%)	*p* value
Severity of AKI according to age groups (month)							
2-12	26	5 (19.2)	7 (26.9)	14 (53.8)	24 (92.3)	2 (7.7)	
12.1-60	47	6 (12.8)	13 (27.7)	28 (59.6)	42 (89.4)	5 (10.6)	0.88
>60	24	5 (20.8)	5 (20.8)	14 (58.3)	20 (83.3)	4 (16.7)	
Severity of AKI according to Gender							
Female	46	10 (21.7)	8 (17.4)	28 (60.9)	40 (87.0)	6 (13.0)	0.13
Male	51	6 (11.8)	17 (33.3)	28 (54.9)	46 (90.2)	5 (9.8)	
Severity of AKI according to Weight(kg)							
3-10	31	6 (19.4)	10 (32.3)	15 (48.4)	29 (93.5)	2 (6.5)	
11-20	54	8 (14.8)	12 (22.2)	34 (63.0)	47 (87.0)	7 (13)	0.78
> 20	12	2 (16.7)	3 (25.0)	7 (58.3)	10 (83.3)	2 (16.7)	
Severity of AKI according to Height(cm)							
< 70	19	4 (21.1)	6 (31.6)	9 (47.4)	17 (89.5)	2 (10.5)	
71-100	46	7 (15.2)	12 (26.1)	27 (58.7)	41 (89.1)	5 (10.9)	0.87
> 100	32	5 (15.6)	7 (21.9)	20 (62.5)	28 (87.5)	4 (12.5)	

children with AKI are above 5 years in one year of study duration.[1] Studies from other developed countries have observed AKI in children was most common in >5 years of age group.[9]

Regarding severity according to pRIFLE criteria, 16 patients i.e (16.5%) were risky, 25 (25.8%) injury category and 56 (56.7%) were in failure. This is contradictory to other local and international studies which revealed that most of the children were in risk category.[9,10] In Prodhan et al study, the pediatric RIFLE identified patients at risk (R) in 30 (51%), injury (I) in 10 (17%) and failure (F) in 12 (21%) children.[12] Another study by Gupta et al in India has shown 49.1% in risk category, 29.5% in injury category and 21.3% in failure category.[9] A study by Mehta et al has shown that in AKI maximum number of AKI in stage 1 (65.8%), in stage 2 (17.8%) and in stage 3 (16.4%).[10] Similar results about categorization of AKI (Risk, Injury, Failure) has been reported by Akcan-Arikan et al 48.8% in risk, 26% in injury and 25.2% in failure. Study by Plotz et al reported that 52% in risk, 37% in injury and 11% in failure.[13,14] Naik et al has estimated 37.9% children in risk followed by 35.9% in injury and 26.2% in failure category.[15] Our study reported that children with Failure were due to late detection of AKI and delayed referral to tertiary care hospital.

In this study, overall mortality was 11.3% (11/97) and according to severity it was 6.3% (1/16) in patients at risk, and 17.9% (10/56) in patients with failure. Mortality was significantly higher in failure category (p =0.05) (10/56). In study by Prodhan et al, mortality in risk group was 3 out of 30 patients (10%), in injury group it was 3 out of 10 patients (30%), and in failure it was 4 out of 12 patients (33%).[12] In study by Duzova et al in children series aged more than one month difference in mortality among three groups that is at risk (24.4%), injury (30.2%) and in failure (24.1%) p >0.05 was not significant statistically.[16] Our study emphasizes that AKI with failure is associated with high mortality in hospitalized patients. Similar results have been shown by previous studies in children as well as in adults.[17-19]

Our study revealed 11.3% mortality by AKI in compare to Mehta et al mortality in AKI was 37% and by Krishnamurthy et al in which mortality of AKI was 46.3%.[8,10]

According to our study, children with high severity score with failure, there was significantly high mortality, while there was no significant mortality was observed due to injury indicating proper management in hospital and we didn't follow up after discharge. The reported overall mortality in pediatric population from recent study is from 20 to 41.5% which is much higher than from our study (11.3%).[20] Several factors have effect on mortality like etiology and underlying cause of AKI, co morbid conditions, transportation and availability of dialysis facilities. Many other factors have been associated though not consistently with high mortality like young age, sepsis, multiorgan failure and septic shock.[20] Limitations of our study were that we collected data from single pediatric tertiary care hospital which not truly reflective of severity and outcome of AKI in whole pediatric population of our country, we have not identified predictors of mortality and not follow up our patients to observe long term outcome. Further studies are needed on larger scale using pRIFLE criteria for early identification and early treatment of children with AKI.

Our study revealed number of patients in failure category, this implies lack of early detection of AKI and delayed referral to the pediatric tertiary care hospital so pRIFLE criteria should be implied by all pediatrician nationwide for early detection of children with AKI in Risk category so that early interventions may slow the progression of AKI to Failure.

Conflict of interest: None declared.

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