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PEDIATRIC AKI - A COMPARISON OF pRIFLE, AKIN, AND KDIGO DEFINITIONS

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ABSRACT

Background and Objectives: Acute Kidney Injury is synonymous with morbidity and mortality in critically ill children. Lack of standardization of existing definitions has led to the masking of true incidence of AKI. This study was done to compare the incidence of AKI in PICU and non ICU patients by pRIFLE, AKIN and KDIGO criteria. **Material and Methods:** A prospective observational study of 280 children, aged between 3 months and 18 years, admitted in ICU and general ward of Department of Pediatrics, Rajendra Institute of Medical Sciences, Jharkhand from January to August 2019 was undertaken. Incidence of AKI and staging were defined by pRIFLE, AKIN, and KDIGO definitions. Outcome and duration of stay at each AKI stage between the three definitions were compared by Fisher Exact tests. **Results:** AKI incidences according to pRIFLE, AKIN, and KDIGO were 37.8%, 27.8%, and 30% respectively. Mortality was alike across all definitions (pRIFLE, 2.3%; AKIN, 2.7%; KDIGO, 2.5%). Significantly longer hospital stay was noted, mean duration of ICU and non-ICU stay being 9 and 15 days respectively. Inter-stage incidence was similar between AKIN and KDIGO criteria. **Conclusion:** Since the three definitions led to differences in AKI incidence and staging, these results underscore the need to adopt an universal AKI definition.

KEYWORDS: Staging, AKI, definitions.

INTRODUCTION

AKI, defined as an abrupt decline in renal function due to multiple etiologies[2,3], is an important cause of morbidity and mortality in children in both ICU and NON-ICU settings.[1] Over the years, pRIFLE and AKIN criteria were put in practice and debated over their pros and cons.[4,5,6] The latest KDIGO definition utilized both previous definitions to create a better version for unifying all AKI criteria.[7] Multiple definitions have led to erratic diagnosis and staging of AKI causing further dilemma in treatment options and outcome of patients.

This study compares incidence and staging of AKI by all the three definitions in pediatric population., focussing on inter-stage and inter definition agreement for the ultimate unanimity of consensus for further research work.

AIMS AND OBJECTIVES

The aim of this study was to compare the incidence of AKI in PICU and non ICU patients by pRIFLE, AKIN and KDIGO criteria. The stage wise incidence of AKI, Outcome of patients, Length of stay and Inter-stage agreement between these definitions were also studied.

MATERIAL AND METHODS

A prospective observational study of 280 children admitted in ICU and general ward of Department of Pediatrics, Rajendra Institute of Medical Sciences, Jharkhand between January and August 2019 was undertaken. Incidence of AKI and staging were defined by pRIFLE, AKIN, and KDIGO definitions using creatinine and urine output criteria. Outcome and duration of stay at each AKI stage between the three definitions were compared by Fisher Exact tests.

INCLUSION CRITERIA

All children within the age group of 3 month to 18 years who were critically ill admitted in both ICU and general ward were included in the study after getting consent from parents.

EXCLUSION CRITERIA

1. Maintenance hemodialysis or peritoneal dialysis.
2. Chronic kidney disease with a baseline estimated glomerular filtration rate (eGFR) of < 15 ml/min/1.73 m2.
3. Kidney transplant within 90 days of PICU admission.
4. Neonates have a different spectrum of disease and physiology, hence were excluded from the study.

AKI was defined using three sets of criteria: pRIFLE, AKIN, and KDIGO. AKI was considered positive if either of the creatinine criteria or urine output criteria were positive. For convenience, Loss and ESRD in pRIFLE was considered under Stage 3.

STATISTICS

All data were entered in Excel 2007 and analyzed using IBM‑SPSS (IBM SPSS Statistics for Windows, version 22.0, released 2011; IBM Corp., Armonk, NY, USA). P value was calculated using Chi Square test. P≤ 0.05 was considered statistically significant. Outcome and duration of stay between each AKI stage in the three definitions were compared by Fisher Exact tests.

RESULTS

The mean age among non AKI and AKI positive cases was 8 years and 6.9 years respectively. The maximum distribution was noted in the age group of 1 to 5 years.

Table 1: Variables and Parameters.

VARIABLE	MEAN	SD	SE OF MEAN
AGE	6.88	4.686855	0.641
WEIGHT	20.19	11.7	1.624
HEIGHT	114	27.26	3.74
CREATININE PRIFLE	1.04	0.90	0.13
CREATININE AKIN	1.07	0.62	0.08
CREATININE KDIGO	0.9	0.522	0.07
EGFR PRIFLE	79.15	30.88	4.15
EGFR AKIN	77.88	23.83	3.12
EGFR KDIGO	83.85	33.53	4.53

Of the 280 critically ill patients, 224 were admitted in ICU(median age, 6.97 years) and 56 were classified as non-ICU (median age, 6.71 years). Overall incidence of AKI was labelled using KDIGO staging. AKI incidences according to PRIFLE, AKIN, KDIGO WERE 37.8%, 27.8% AND 30% respectively. (p<0.001), as given in table 2.

Table 2: Aki Incidence by Different Criteria and Respective Staging.

STAGES	PRIFLE(N=106)37.8%	AKIN(N=78)27.8%	KDIGO(84)30%
1	72(25.7%)	52(18.5%)	64(22.8%)
2	27(9.6%)	18(6.4%)	14(5%)
3	7(2.5%)	8(2.8%)	6(2.13%)

The incidences of AKI in the ICU and non-ICU populations as shown in table 3 across all the three definitions is as follows: PRIFLE: 40.6% for ICU and 33.9% for non-ICU; AKIN: 27.2% for ICU and 25% for non-ICU; KDIGO: 30.3% ICU and 28.5% for non-ICU.

Table 3: Incidence of Aki Stage Wise in Icu and Non-Icu Patients.

STAGES	PRIFLE(n=106)		AKIN(n=78)		KDIGO(n=84)	
	ICU	NON-ICU	ICU	NON-ICU	ICU	NON-ICU
STAGE1	61(27.2%)	11(19.6%)	41(18.3%)	11(19.6%)	52(23.2%)	12(21.4%)
STAGE2	23(10.2%)	4(7%)	15(6%)	3(5.3%)	10(4.5%)	4(10%)
STAGE3	7(3.1%)	0	8(3%)	0	6(2.6%)	0
TOTAL	91	15	64	14	68	16

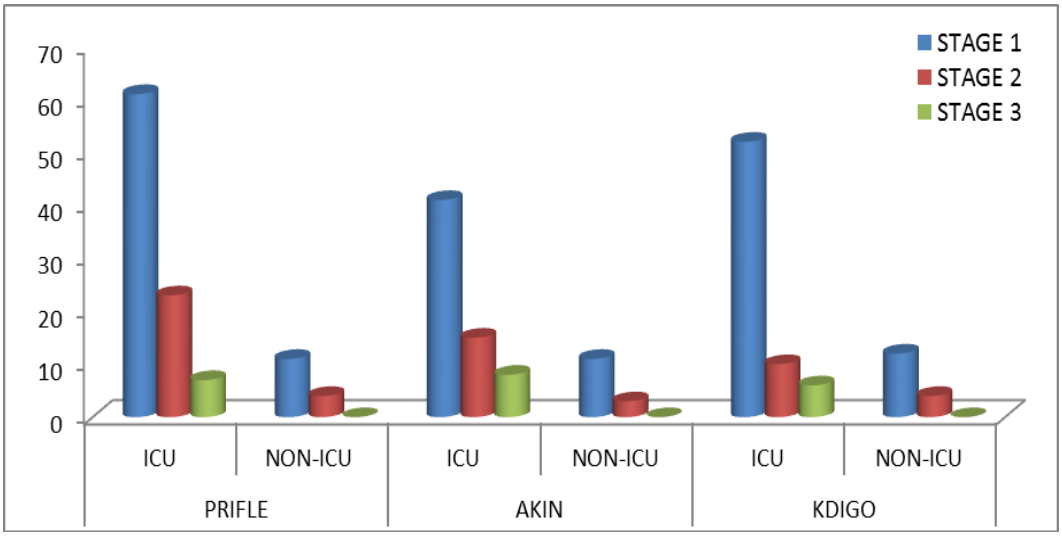

Fig. 1: **Incidence of Aki Stage Wise in Icu and Non-Icu Patients.**

ETIOLOGY

Different disease process, was associated with AKI in critically ill children. Our study revealed that CNS etiology (22.2%) was the major underlying disease process, followed by Renal (16%), Gastrointestinal Sytem(11%) and CVS(7%). Other causes of PICU admission such as poisoning and snake bite contributed to around 20% cases.

AKI STAGE AND LOS (LENGTH OF STAY)

According to pRIFLE, median LOS was 8 days (IQR, 4–12 days) for stage 1,11 days (IQR, 4–25 days) for stage 2, and 13 days (IQR, 5–27 days) for stage 3 (P<0.001 versus no-AKI and versus preceding stage). LOS was highest when the KDIGO criteria was used: stage 1,6 days [IQR, 4–13 days]; stage 2,12 days [IQR, 7–18 days]; stage 3, 18 days [IQR, 10–24 days]. LOS when using AKIN Criteria was in stage 1, 10 days [IQR, 4–14 days]; stage 2, 12 days [IQR, 7–20 days]; stage 3,15 days [IQR, 7–22 days] (P<0.001), tabulated in table 4.

Table 4: Aki and Length of Stay.

CRITERIA	STAGE I	STAGE II	STAGE III	MEAN
PRIFLE	8	11	13	12
AKIN	10	12	15	13
KDIGO	6	12	18	16
MEAN	12	12	15	13

In terms of ICU and non-ICU hospitalizations, higher AKI stage was associated with longer LOS in both settings across all three definitions (P<0.001).

Median LOS was higher among ICU hospitalizations with AKI, than non-ICU across all definitions, pRIFLE: 10 versus 12 days; AKIN: 8 versus 11 days; KDIGO: 13 versus 16 days; (P<0.001).

RENAL REPLACEMENT THERAPY

Renal replacement therapy, either in the form of peritoneal or hemodialysis was done only in 4 patients with stage 2 AKI and 100% of the patients with stage 3 AKI.

AKI STAGE AND MORTALITY

All-cause, in-hospital mortality was 2.5%. In ICU setting, mortality was higher among hospitalizations with AKI than those without across all definitions pRIFLE, 2.3% versus 1.3%; AKIN, 2.7% versus 1.3%; KDIGO, 2.5% versus 1.3%., depicted by fig 2. Mortality was recorded only in Stage 3.

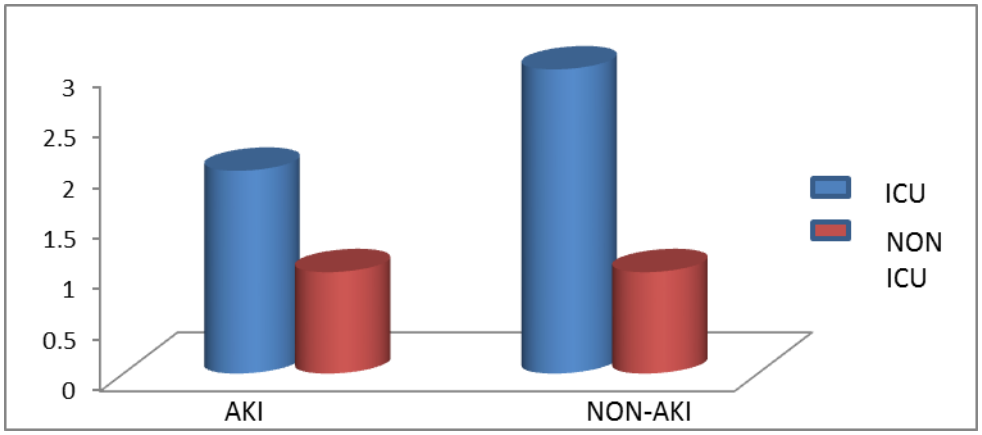

Fig 2: Aki Stage and Mortality.

INTERDEFINITION AGREEMENT

Regarding the diagnosis of AKI, AKIN agreed with pRIFLE 70% of the time. KDIGO agreed with pRIFLE 87% of the time. AKIN agreed with KDIGO 94% (κ=0.94) of the time.

DISCUSSION

The mean age of children in non AKI was 8 years and in AKI group was 6.9 years. The maximum number of children were in age group of 1-5 years. Etiology wise, CNS (22.2%) accounted for maximum underlying disease process, followed by Renal (16%), Gastrointestinal Sytem(11%) and CVS(7%), Poisoning and snake bite (20%).

Out of the 280 critically ill children, 224 were admitted in ICU and 56 were non-ICU cases. The median age in ICU was 6.97 years and in non-ICU cases was 6.71 years. Overall incidence of AKI was 30% using KDIGO criteria, 68(30.3%) in ICU cases and 16(28.5%) in non-ICU cases had AKI. This is lesser than the previous reports of 37-51% of at risk hospitalizations based on creatinine change.[10,11,12]

AKI incidences according to pRIFLE, AKIN, and KDIGO were 37.8%, 27.8%, and 30%, respectively ($p<0.001$). Stage-wise incidence of AKI, we found pRIFLE created the largest(25.7%) stage 1 cohort. There were staging discrepancies, particularly in Stage 2, pRIFLE identifying most (9.6%) of the cases while least(5%) by KDIGO. Zappitelli et al, compared pRIFLE and AKIN and found pRIFLE more sensitive to identify large cohort of stage 1 AKI.[12] We also found that pRIFLE, AKIN and KDIGO resulted in similarly sized stage 3 cohorts. Our study differs from Xeng et al, who found KDIGO to be most sensitive in their study done in Boston.[13] Bastin et al, found in their retrospective study that incidence was similar by all three criterias.[14] We found that pRIFLE had cohorted 40.6% and AKIN least at 27.2% as AKI cases in ICU category.

The staging discrepancies were highlighted in study when AKIN and KDIGO agreed on staging 94% of the time, agreement between AKIN and pRIFLE was only 70%. This difference in incidence and staging by three definitions is troublesome for unanimity of AKI.

Within the ICU, all three definitions demonstrated mortality only in stage 3. AKI cases had a higher mortality rate than non AKI cases. Outside the ICU, both AKI and non AKI cases were associated with similar mortality. This is interpreted as infrequent deaths, rather than difference in definitions. This was supported by longer LOS in cases of higher stages of AKI. Both ICU and non-ICU cases had higher LOS when associated with AKI across all three definitions.

Mean LOS in ICU and non- ICU among AKI cases was 9 and 15 days respectively, which is suggestive of different entities in AKI in ICU and non-ICU patients. Probably the non-ICU AKI cases had different risks and change in outcome when compared to ICU cases with AKI. Our findings are similar to the study of Sunder et al, who demonstrated that ICU AKI had higher mortality(32.8% verses 9.4%) and longer LOS(29 days verses 6 days) than in non-ICU AKI cases.[15] LOS was higher when KDIGO criteria was used.

PRIFLE was sensitive in identifying greater number of cases in stage 1 AKI. Benefit of AKIN is it does not require height and baseline creatinine values. KDIGO has an advantage of being used in pediatric and adult population and a less restrictive timeframe than AKIN.

RRT was done in 4 cases in stage 2 AKI and in all cases in stage 3. Urine output did not correlate with creatinine values and outcomes. We had no baseline creatinine values of all patients which might affect the cohorting and outcome of the study.

LIMITATIONS

Our findings should be interpreted in the context of their limitations. Our study is from a single, pediatric institution; the findings cannot be generalized to other centers or adult populations.

CONCLUSION

In summary, our findings demonstrate that pRIFLE, AKIN, and KDIGO result in different incidences and substantial disparities in staging. Greater AKI severity is associated with higher mortality and longer LOS in the ICU; it is associated with longer LOS in not so ill children. Regardless, our findings highlight the necessity of a unified AKI definition.

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