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Prediction of Acute Kidney Injury using Renal Angina Index in Pediatric Intensive Care Unit

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Abstract

Prediction of AKI or risk stratification of patients in danger of kidney damage is crucial for initiating preventive measures for AKI. Thus, an appropriate risk assessment for AKI is required in every patient admitted to the intensive care unit (ICU). the renal angina index (RAI), which is determined based on changes in renal function, was proposed to risk stratify critically ill children at high risk of AKI.Determine the capacity of renal angina list on foresee intense kidney harm in kids On pediatric seriousness What's more comparing its abilility with that about serum creatinine. This study will be An prospective obsevational examine might have been conveyed for 162 Youngsters admitted over pediatric emergency unit unit, all examined patients bring been subjected with full historical backdrop taking, finish clinical examination and estimation from claiming finish blood count, serum creatinine, liver work tests (ALT, AST, PT, PTT, INR) and electrolytes. Count 0f renal angina list Also identification of patients produced AKI at D3 as stated by KDIGO criteria. This contemplate incorporated 162 Youngsters. 54% of the examined patients were guys and 46% were females, their intend agdistis might have been 6. 3 years, seventy percent of the examined example needed AKI, there were no statistically critical contrasts the middle of patients with and without AKI in regards to sex, age, or weight, roc bend investigation demonstrated that RAI, and creatinine (each alone) might altogether foresee AKI toward the indicated cutoff qualities. RAI may be a greater amount touchy What's more particular (79. 6% & 64. 8% respectively) over creatinine (59. 4% & 61. 2%).

Keywords: Acute Kidney Injury, Renal Angina Index, PICU.

1. Introduction

Intense kidney harm (AKI), previously known as intense renal disappointment (ARF) means a sudden demise Furthermore regularly reversible decrease in the kidney function, as measured Eventually Tom's perusing glomerular filtration rate (GFR) [1].

There may be no reasonable meaning for AKI. A few distinctive criteria bring been utilized within examination investigations for example, such that RIFLE, associated (Acute kidney harm Network) or KDIGO (Kidney Disease: enhancing worldwide Outcomes) criteria. However, KDIGO is the mossycup oak later Also the vast majority regularly utilized. As stated by KDIGO, AKI will be those vicinity about whatever of the following:. • expansion On serum creatinine Eventually Tom's perusing 0. 3 mg/dL alternately that's only the tip of the iceberg (26. 5 micromoles/L or more) inside 48 hours.

• increment Previously, serum creatinine on 1. 5 times alternately that's only the tip of the iceberg baseline, inside the former 7 times.

• pee volume under 0. 5 mL/kg/h for toward least6 hours [2].

AKI may be a as a relatable point condition particularly "around hospitalized patients. It might be seento dependent upon 7% of doctor's facility admissions and 30% frigid admissions [3]. AKI will be frequently all the a paramount component that contributes will choice will hospitalize to other conditions, though not constantly the sole purpose behind hospitalization. A large portion pills or methods that utilization difference keeping networking might require with delay because of co-existent AKI. Practically of the pills need aid renally excreted, What's more dosages may have with be balanced will represent the lessened renal capacity [4]. Prediction from claiming AKI alternately danger stratification about patients done risk of kidney harm may be significant for initiating preventive measures for AKI. Thus, an fitting danger appraisal for AKI will be required On each tolerant admitted of the seriousness (ICU). In spite of those kidney sickness moving forward worldwide conclusions (KDIGO) guideline characterizes AKI as stated by serum creatinine Also pee output, serum creatinine is an blemished marker for identifying extreme AKI, and novel AKI biomarkers would developing. AKI biomarkers, for example, Mobile cycle capture markers (tissue inhibitor from claiming metalloproteinases 2 and insulin-like Growth component tying protein 7), 3,5 neutrophil gelatinase-associated lipocalin, and L-type greasy acid–binding protein (L-FABP) were accounted for to anticipate AKI. However, it will be essential that these biomarkers be utilized within a suitable setting, a result they might be influenced Eventually Tom's perusing co_morbidities, What's more their execution might decline clinched alongside an alternate setting [5]. Recently, those renal angina list (RAI), which may be dictated In view of progressions for renal function, might have been recommended to danger stratify critically sick know youngsters during high hazard for AKI. The idea for renal angina need come into utilization on highlight those aspects of renal damage Similarly as a relationship of the idea of angina pectoris, which is used to build those suspicion of intense coronary syndrome clinched alongside cardiology. Those RAI may be accepted will serve Likewise An possibility device for identifying initial indications about persistency AKI [6]. Those point from claiming this contemplate might have been will focus the capacity of renal angina list will foresee intense kidney harm in Youngsters done pediatric seriousness and comparing its abilility for that about serum creatinine.

2. Patients and methods

This study is a prospective obsevational study was carried on 162 children admitted in pediatric intensive care unit at Benha University Hospitals from October 2019 to March 2020 .This study was approved by the ethical committee of the Faculty of Medicine, Benha University. Informed written consents were taken from parents of the included patients.

Inclusion criteria

All enrolled patients were:

All children, 1 month to 12 years, admitted in pediatric intensive care unit, for at least 8 hours and remaining for more than 3 days and having documented body-weight and intake-output records over this duration.

Exclusion criteria

- Known cases of chronic kidney disease.
- Children already on dialysis.

There were 387 hospitalizations during the recruitment period and, of these 121 patients were eligible for the study. Parental consent was not granted in sixteen cases and two children died before the start of the examination. Of the 103 cases who had RAI done and creatinine measured , three children were excluded after they discharged from PICU before 3 days of stay . 162 children aged from 1 month to 12 years with mean age (6.3±5,4 year). They were 88male (54%) and 74 females (46%).

All studied patients have been subjected tofull history taking, complete clinical examination and Measurement of Complete blood count, Serum creatinine. (On day of entry (D0), 24h (D1), 48h (D2)and 72h (D3)), Liver function tests (ALT, AST, PT, PTT, INR) and electrolytes.

Calculation 0f renal angina index;[7]**.** Detection of patients developed AKI at D3 according to KDIGO criteria [2]**.**

2.1 Statistical analysis

The collected data were tabulated and analyzed using SPSS version 16 software (SpssInc, Chicago, ILL Company). Categorical data were presented as number and percentages, Chi Square (χ^2) was used to analyze them. Quantitative data were tested for normality using Shapiro-Wilks test assuming normality at P>0.05. Normally distributed variables were expressed as mean ±standard deviation, median and inter-quartile range (IQR) were added when non-parametric, and analyzed by Mann Whitney U test (ZMWU) for 2 independent groups. ROC curves were constructed to assess validity and predictivity of the studied variables in prediction of AKI.

3. Results

This study included 162 children. 54% of the studied patients were males and 46% were females, their mean age was 6.3 years, the median is 5 years ranging from 2 months to 12 years. The weight of the studied sample ranged between 3 to 59 kg with mean and median values of 19.1 and 15.5 kg Table (1).

Table (1) Basic characters of the studied sample.

Variable		No. (N=162)	% (100%)
Sex	Male	88	54.0
	Female	74	46.0
	Mean ±SD	Median	Range
Age (years)	6.3±5.4	5.0	2 months- 12 ys
Weight (kg)	19.1±14.0	15.5	3-59

Seventy percent of the studied sample had AKI, there were no statistically significant differences between patients with and without AKI regarding sex, age, or weight (P>0.05 for all) Table (2).

Table (2) Comparing patients with and without AKI according to basic characters.

Variable		AKI (n=113)		No AKI (n=49)		X^2	P
		No.	%	No.	%		
Sex	**Male**	71	62.9	23	46.7	2.26	0.13 (NS)
	Female	42	37.1	26	53.3		
Age (ys)	**Mean±SD**	5.7±4.4		4.4±4.6		Z_{MWU}=	0.13
	Median (Range)	5 (2m-12 ys)		1 (2m-12 ys)		1.52	(NS)
Weight	**Mean±SD**	16 (20.2±14.5)		10 (16.3±12.6)		Z_{MWU}=	0.17 (NS)
(kg)	**Median (Range)**	3-59		4-45		1.35	

Z_{MWU}=Z value of Mann Whitney U test.

Table (3) shows that 79.1% of patients with positive RAI suffered from AKI compared to 21% of those with negative RAI. This difference was statistically highly significant (P<0.001).

Table (3) Comparing patients with and without AKI according to RAI.

			AKI at D3		X^2	P
			Positive	**Negative**		
RAI	**Positive**	Count	89	16	31.8	<0.001
		% within RAI	79%	31%		(HS)
	Negative	Count	24	33		
		% within RAI	21%	68%		
Total		Count	113	49		
		% within RAI	67.0%	33.0%		

Table (4) Shows that 79.6% of patients with positive creatinine suffered from AKI compared to 58.7% of those with negative creatinine. This difference was statistically significant (P<0.05).

Table (4) Comparing patients with and without AKI according to serum creatinine.

Serum creat		AKI at D3		X^2	P
		Positive	**Negative**		
Positive	Count	77	15	5.18	
	% within Setum creatinine	68.7%	31.3%		
Negative	Count	36	34		0.023 (S)
	% within Setum creatinine	52.8 %	47.2%		
Total	Count	113	49		
	% within Setum creatinine	67.0%	33.0%		

The mean values of risk , injury , and RAI scores were significantly higher among patients with AKI (5.04, 4.78, and 22.7 respectively) than those without (3.93, 3.16, and 12.47 respectively). All P values are <0.05 Table (5).

Table (5) Comparing patients with and without AKI according to the studied scores.

Variable	**AKI (n=70)**			**No AKI (n=30)**			Z_{MWU}	**P**
	Mean	**± SD**	**Range**	**Mean**	**± SD**	**Range**		
Risk score	5.04	1.95	1-6	3.93	2.44	1-6	2.51	0.012 (S)
Injury score	4.78	2.44	1-8	3.16	2.05	1-8	3.14	0.002 (S)
RAI score D0	22.7	15.4	2-48	12.33	12.47	2-48	3.48	=0.001 (HS)

ROC curve analysis showed that RAI, and creatinine (each alone) can significantly predict AKI at the shown cutoff values. RAI is more sensitive and specific (79.6% & 64.8% respectively) than creatinine (59.4% & 61.2%) Fig (1, 2).

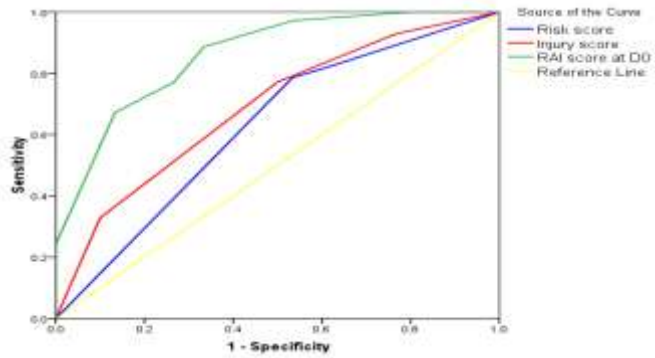

Fig (1) ROC curve for the performance of RAI in early diagnosis (prediction) of AKI

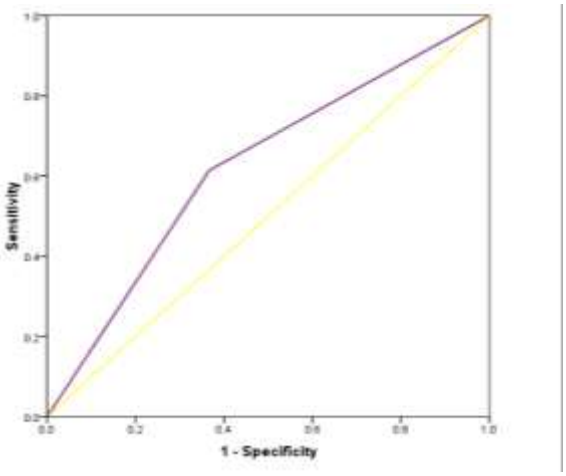

Fig (2) ROC curve of creatinine

4. Discussion

This study included 162 children, 54% male and 46% females. Those patients mean period might have been 6. 3±5. 4 A long time (2 months: 12 years) What's more their intend weight might have been 19. 1±14. 0 quite some time (3-59 kg).

Those predominanace from claiming male sex (54%) might have been comparative on past investigations [8], of the 433 patients admitted to PICU, 237 (54. 73%) were male. Furthermore On another ponder [9], "around those 688 patients selected in the study, 55. 6% were male. Also done [10] study, starting with 400 patients, F:M proportion might have been 1:1. 2. Moreover, [11] have recognized male sex Likewise a danger element to PICU confirmation.

In this study, those intend hazard score might have been 4. 8±2. 06, the imply harm score might have been 4. 2±2. 5, RAI might have been computed starting with result of the renal hazard What's more renal damage score. Renal angina positivity might have been characterized Similarly as RAI ≥ 8. Those RAI score might have been certain to 74%Also negative Previously, 26% What's more its mean quality In day 0 might have been 20±14. 7. Same time serum creatinine might have been certain to main 48% for situations and negative over 52%. AKI during day 3 might have been certain for 69,7% and negative done 30,3% for cases.

This might have been for concur with [12]–[15], who news person that RAI performed superior to benchmark serum creatinine Furthermore rate fall in eCr/Cl starting with benchmark to foreseeing AKI. As Previously, [15] study, thirty-eight kids required RAI > 8 In confirmation (37. 2%). Thirty-three kids required AKI ahead day 3 of confirmation (32. 3%).

Different investigations about AKI in the PICU have news person frequency extending broadly between studies; Menta et al. [16] news person An 36. 1% frequency of AKI in the critically sick kids incorporated to their examine. Naik et al. [17] news person 40. 9% from claiming patients formed AKI Concerning illustration characterized by altered rifle criteria. Gupta et al. [18] accounted for 42. 9% out for 536 patients formed AKI, Similarly as characterized Eventually Tom's perusing altered pRIFLE criteria. Plotz et al. [19] news person occurrence about 58% for AKI Previously, PICU. Same time Akcan et al. [20] indicated a secondary frequency from claiming 82%. Those accounted for distinction to occurrence for AKI in distinctive investigations Might be expected with different contemplate population, PICU surroundings or as stated by meaning about AKI.

In this study, there might have been no measurable distinction the middle of patients for sure AKI Furthermore patients with negative AKI in regards to their age, sex or weight.

In Naik et al. [17] study, the mean (SD) agdistis of the whole companion might have been 3. 30 (3. 80) A long time (range 1 month should 16 years). Intend (SD) agdistis about know youngsters in the AKI gathering might have been 2. 35 (3. 24) years, inasmuch as in the non-AKI one assembly might have been 3. 95 (4. 02) yrs (P = 0. 002). There might have been no importance distinction the middle of AKI assembly What's more non-AKI aggregation in regards to their sex. On the examination about confirmation analysis Previously, AKI and non-AKI patients; Sepsis, gastroenteritis, status epilepticus, bronchopneumonia Also focal sensory system infections were essentially All the more as a relatable point in patients for AKI.

Clinched alongside De-zan et al. [21] study, the mossycup oak regular PICU confirmation analysis done AKI situations were coronary illness (38. 6%), respiratory disappointment (16. 8%) What's more postsurgical non-cardiac patients (11%). Same time for Rustagi et al. [22] study, those practically basic analysis underlying AKI were intense more level respiratory tract infection, cns sickness Also extreme parchedness. This distinction the middle of investigations clinched alongside confirmation finding may be because of diverse ponder number.

In this study, there might have been a measurable distinction between patients with AKI and patients without AKI in regards RAI score to d 0 (the imply RAI score might have been 22. 7±15. 4 Previously, AKI Also 12. 33±12. 47 to non- AKI, p=0. 001).

Over Kaur et al. [14] study, RAI positivity might have been seen done 16. 7% cases, of which 36. 2% created AKI toward 4 times vs. 2. 3% in RAI-negative cases ($p < 0.001$).

Previously, Gawadia et al. [12] study, on day 0, 86/162 (53%) Youngsters required An RAI ≥8. The most reduced RAI from claiming 1 might have been seen over 32 (19. 8%) children, same time 15 (9. 3%) required those most noteworthy RAI of 40. Of the 86 kids who were RAI sure once day 0, 62 (72. 1%; 95% ci 62. 6 %-81. 4%) formed extreme AKI ahead day 3 as opposed to 2/76 (2. 6%) Youngsters who were RAI negative (RR 95. 5; 95% ci 21. 7, 420. 4; $p < 0.001$).

In this study, roc bend investigation demonstrated that certain RAI score What's more certain creatinine could altogether anticipate AKI In those cutoff values. For auc (RAI score=0. 730 and sure creatinine =0. 629). RAI might have been more delicate Furthermore particular over creatinine.

This might have been On consent with Sethi et al. [15] study, RAI score Might anticipate D3 AKI with AUC= 0. 73 (CI: 0. 61-0. 82), for affectability 81. 8 and specificity 69. 6 , PPV to anticipate D3 AKI might have been 56. 3 and same way as the NPV with anticipate D3 AKI might have been 88. 9.

To Gawadia et al. [12] study, a certain day 0 RAI might have been discovered will bring An affectability from claiming 96. 9%, An specificity about 75. 5%, An certain predictive worth for 72% Also An negative predictive esteem about 97. 4%. A collector working trademark (ROC) bend might have been constructed to surveying unique qualities about day 0 RAI to foreseeing extreme AKI on day 3, with an auc (Area under those Curve) of 0. 90 (95% ci 0. 85, 0. 95). Serum creatinine toward enrolment and rate fall in eCrCl from benchmark indicated auc (0. 68 Also 0. 73, respectively) considerably subpar to that about RAI.

In Sundararaju et al. [13] study, recipient driver trademark curves will analyze the symptomatic correctness about RAI score done segregating patients for extreme AKI demonstrated auc about 0. 82 (95% CI: 0. 73–0. 90) to extreme AKI around day 3 Also auc about 0. 73 (95% CI: 0. 62–0. 84) for extreme AKI on day 7 , an RAI score for ≥12 alternately ≥20 needed higher symptomatic utility over RAI ≥8 clinched alongside foreseeing extreme AKI ahead day 3 Also day 7. RAI thresholds from claiming 8 and also 12 alternately 20 needed acceptable affectability (82. 8% and 79. 3%, respectively) What's more helter skelter same way as the NPV (96. 5% What's more 97%, respectively) for those improvement for extreme AKI on day 3.

5. Conclusion

The RAI is easy to perform and can be done at bedside in the PICU. Identification of patients at a higher AKI risk using RAI stratification could theoretically guide the enrollment for a novel AKI biomarker or therapy trial, which could ultimately guide treatment strategy. Moreover, this can help physicians in judicious fluid and drug management in these patients. We feel that RAI should also be done in all critically ill children along with illness severity scores at the time of admission.

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