

Incidence of Acute Kidney Injury In Children Admitted In Pediatric Intensive Care Unit, Gauhati Medical College And Hospital, Guwahati, Assam, India.

^{*1}Dr. Rukeya Begum ^{2*}Dr. Golam Osmani, ³Dr. Himadri Das
Department Of Paediatrics, Gauhati Medical College, Guwahati, Assam, India.

*Corresponding author: 1Dr. Rukeya Begum

Abstract

Objective: To Determine The Incidence Of Aki As Defined By The Acute Kidney Injury Network (Akin) Classification In Paediatric Patients From 1 Month To 13 Years Admitted To The Picu.

Design: Prospective, Observational.

Setting: Tertiary Care Center.

Participants/Patients: Patients Admitted In Picu, 1 Month To 13-Yr Old.

Intervention: None.

Main Outcome Measures: Incidence Of Aki Based On The Serum Creatinine Criteria Proposed By The Aki Network.

Results: During July 2014 To June 2015, The Incidence Of Aki In Picu In The Present Study Was 21.3% (78/367). Mean Duration Of Hospital Stay Of Aki Patients Is 9.53 Days And Standard Deviation 5.7 Days Which Is Higher Than The Mean Duration Of Hospital Stay Of Non Aki Patients Is 7.95 Days And Standard Deviation 3.84 Days. The Overall Picu Mortality During The Study Period Was 29.43% (108/367). Aki Mortality (42.3%) Was Statistically Significant As Compared To Overall Picu Mortality And Non Aki Mortality Rate (25.95%). Mortality Was More In Younger Patients. Mortality Was Also Higher In Patients In Akin Stage 3 (66.67%, 12/18) And Stage 2 (45.83%, 11/24) As Compared To Stages 1 (27.78%, 10/36) But The Difference In Mortality Between Stage 1 And Stage 3 Is Statistically Significant. 85.71% (6/7) Cases Receiving Rrt Expired During Their Picu Stay. 38 (48.72%) Patients With Aki Were Under Mechanical Ventilation And 29 (76.32%) Expired During The Picu Stay ($P < 0.0001$).

Conclusions: Aki Is Common In Picu, Especially Younger Patients And Results In Increased Hospital Stay And High Mortality Especially Those Who Are Under Rrt And On Mv.

Keyword: Aki, Acute Kidney Injury, Renal Replacement Therapy, Mechanical Ventilator.

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I. Introduction

Epidemiology Of Acute Renal Failure Changes Over Time, This Is Partly Be Caused By A Change In Patient Characteristics But More Importantly By A Change In Definition Of A Disease. Recent Research Emphasises The Clinical Importance Of Less Severe Impairment Of Kidney Function Resulting In Broader Term Acute Kidney Injury. It Need To Be Stressed, Aki Is Common Clinical Problems In Critically Ill Patient Is Associated With Significant Morbidity And High Mortality Rate⁽¹⁾. The Incidence Of Acute Kidney Injury (Aki) (Previously Called Acute Renal Failure) Has Increased Over The Past Several Years And Aki Leads To Substantial Morbidity And A High Mortality Rate^(1, 2, 3, 4). The Prevalence Of Aki In The Paediatric Hospital Setting Appears To Be Increasing⁽⁵⁾ Likely As A Result Of The Increased Availability Of Treatment Options For Many Critical Illnesses And Advances In Paediatric Critical Care⁽⁶⁾. The Incidence Of Aki Among Children Admitted To Intensive Care Units Has Been Estimated To Range From 10% To 35%^(7,8,9). In More Severely Critically Ill Children, The Incidence Of Aki Has Been Reported To Occur In 90% Of Patients With Traumatic Injuries Or Those Needing Vasopressor Support And Requiring Mechanical Ventilation⁽¹⁰⁾. The Incidence Of Aki Ranges From 30% To 50% In Children Undergoing Cardiac Surgery^(11,12,13). Even Among Noncritically Ill Children Receiving Nephrotoxic Medications, The Incidence Of Aki Has Been Estimated To Be 34%⁽¹⁴⁾. The Epidemiology Of Aki Is Quite Different In Developed And Developing Countries. Prospective Studies From Our Country Suggest That 4-6% Of Paediatric Inpatients In General Wards And Up To 40% In Picus Show Aki, And That Renal Failure Is Important Determining Morbidity And Mortality. This Study Aims To Prospectively Determine The Incidence And Outcome During Hospital Stay Of Aki In Children Admitted In Picu.

II. Methods

This Prospective Observational Study Was Carried Out On Consecutive Patients, Between The Ages Of 1 Month And 13 Years, Admitted To The Pediatric Inpatient And Pediatric Intensive Care Unit (Picu) At The Gauhati Medical College , Guwahati From July,2014 To June 2015. A Total Of 551 Patients Were Admitted In Picu During This Period. A Total Of 367 Patients Were Enrolled In The Study. The Following Patients Were Excluded: (I) Chronic Kidney Disease Stage 5;(Ii) Bilirubin Level >5 Mg/Dl; (Iii) Hospital Stay For Less Than 24 H; (Iv) Known Aki At Admission, With Serum Creatinine >1.5 Mg/Dl; And (V) Serum Creatinine Not Done At Admission Or At 48 H.Following An Informed Parental Consent, Clinical History And Examination Was Done And Relevant Data Regarding Investigations Was Collected For All Children Admitted To Picu.Serum Levels Of Creatinine Estimated At Admission And At Daily Intervals In Picu Patients Till Discharge From Picu Or Death. Urine Output Measured And Recorded As ml/Kg/Hour Every 6 Hourly. Serum Creatinine Was Estimated By Enzymatic Sarcosine Methods Using Auto Analyser Vitros-5600. Normal Serum Creatinine For Age Are 0.2-0.4 Mg/Dl For Infants, 0.3-0.7 Mg/Dl For 1-12 Years, 0.5-1 Mg/Dl For >12 Years.⁽¹⁵⁾Diagnosis And Staging Of Aki Was Based On Akin Definition &Classification(Table 1). Either Serum Creatinine Or Urine Output Was Used To Diagnose And Stage Aki, Using A Criterion That Led To Higher Stage Classification.Indications For Admission To Picu Included One Or More Of The Following: Impaired Consciousness (Glasgow Coma Scale <7), Signs Of Increased Intracranial Pressure (E.G., Hypertension, Bradycardia, Papilledema), Respiratory Failure, Poorly Controlled Seizures, Hypotension Requiring Inotropic Support, Requirement Of Rrt And Fulminant Hepatic Failure.

Table 1: Akin Staging Classification.

Classification	Stage	Creatinine Criteria	Urine Output Criteria
Akin (Mehta Rl Et Al., 2007) ⁽²⁶⁾	1	Increased Creatinine By ≥ 0.3 Mg/Dl Or To 1.5- 1.99 Times Baseline	< 0.5 ml/Kg/H For > 6h
	2	Increased Creatinine To 2- 2.99 Times Baseline	<0.5 ml/Kg/H For > 12h
	3	Increased Creatinine To ≥ 3 Times Baseline Or Creatinine ≥ 4.0 Mg/Dl With An Acute Increase Of 0.5 Mg/Dl Or Initiation Of Rrt Or Egfr < 35 ml/Min Per 1.73m ² (<18 Years)	<0.3 ml/Kg/H For 24h Or Anuria X 12h

The Aetiology Of Aki, Need For Rrt And Short Term Outcomes (Survived Or Death) Were Noted. Acute Tubular Necrosis (Atn) Was Defined As Renal Dysfunction In A Setting Of Diarrhoea With Dehydration, Cardiac Disease, Haemorrhage, Sepsis, Nephrotoxic Drugs, Tropical Febrile Illnesses, Envenomation, In The Absence Of An Active Urinary SedimentThe Diagnosis Of Sepsis Was Made According To The International Pediatric Sepsis Consensus Conference Definition. (Goldstein Et. Al. 2005)⁽¹⁶⁾.Shock Was Defined In Presence Of Tachycardia, Feeble Pulses, Cool Peripheries, Hypotension Or Capillary Filling Time >3 Seconds.Hypertension Was Defined As >95th Percentile Blood Pressure For Age, Height And Gender.⁽¹⁷⁾ Nephrotoxic Drugs Considered Were Aminoglycosides And Vancomycin. Other Details Like Mechanical Ventilation, Total Hospital Stay And Picu Mortality Were Noted.Indications For Renal Replacement Therapy Included Patients With One Or More Of The Following : Oligoanuria, Dyspnea, Uremic Features, Uncorrectable Metabolic Acidosis And Hyperkalemia. Peritoneal Dialysis Was Done To Children Who Require Dialysis. The Patients Were Followed Up Till Discharge/Death.

III. Statistical Analysis

Data Were Recorded Into A Preformed And Pretexted Performa. Statistical Analysis Was Done By Ms Excel 2010 And Instat Software. P <0.05 Was Considered Significant.

IV. Results

Total 551 Patients Were Enrolled In The Present Study Out Of Which 184 Patients Were Excluded. Causes Of Exclusion Are Follows

1. Chronic Kidney Disease Stage V = 5
2. Bilirubin Level >5 Mg/Dl = 7
3. Hospital Stay For Less Than 24 H = 92
4. Known Aki At Admission, With Serum Creatinine >1.5 Mg/Dl = 21
5. Sample Missed = 59

In This Present Study 78 (21.3%) Patients Developed Aki After Admission In Picu Out Of 367 Cases Admitted To Picu During The Study Period. The Mean Age Of The Patients In This Present Study Was 36.08 Months And Standard Deviation 43.95 Months, With A Range From 1- 145 Months. The Highest Number Of Patients Was In The Age Group Of 1 -12 Months Followed By Patients Who Were In The Age Group Between 61 To 156 Months. The Mean Age Of The Patients With Aki In This Present Study Was 43.18 Months With Standard Deviation 49.88 Months (Mean Age Of Non Aki Patients Is 34.11 Months), With A Range From 1 – 144 Months. The Highest Number Of Patients Was In The Age Group Of 1 -12 Months Followed By Patients Who Were In The Age Group Between 61 To 156 Months..

In The Present Study Out Of 367 Cases, 226(61.58%) Were Males While 141 (38.42%) Were Females. Male Female Ratio Was 1.6:1. Out Of 78 Cases Of Aki, 46 (58.97%) Were Males While 32 (41.03%) Were Females. Male Female Ratio Was 1.43:1. (Table 2) Patients Developing Aki In Picu Were Staged According To Akin Criteria Into Stage 1, 2 And 3. Out Of The 78 Cases, 36 (57.14%) Were In Stage 1, 24 (27.38%) In Stage 2 And 18 (15.48%) Were In Stage 3. (Table 3) Most Of The Cases Admitted Were Due To Sepsis 26/78 (33.33%), Followed By Pneumonia 8, (10.26%), Meningitis 6 (7.69%), Malaria 6 (7.69%), Agn 5 (6.41%), Encephalitis 5 (6.41%), Heart Disease 5 (6.41%), Acute Gastroenteritis 4 (5.13%), Nephrotic Syndrome 2 (2.56%), Dka 2 (2.56%), Tuberculosis 2 (2.56%), Upper Gi Bleed 2(2.56%), And Others. (Table 4) Out Of 78 Cases, 33 (42.3%) Patients Expired And 45(56.7%) Survived During Picu Stay. During The Study Period, 108 Patients Out Of 367 Expired, With An Overall Picu Mortality Rate Of 29.43 %. Aki Mortality Was 42.3 % (33/78). The Difference In Mortality Is Statistically Significant (P Value 0.0319 And 95% Ci: 0.01007 To 0.1620).

Table 2: Patients Characteristics:

	Aki	Non Aki
No Of Patient	78	289
1 - 12 Months	39	153
13 – 60 Months	17	66
61 – 144 Months	22	70
Male	52	174
Female	32	109
Mortality	33	75
1 - 12 Months	22	45
13 – 60 Months	5	17
61 – 144 Months	6	13

Aki Mortality Rate Was 42.3 % And Non Aki Mortality Rate Was 25.95 (75/289) And The Difference In Mortality Is Statistically Significant. Out Of 192 Patients From 1- 12 Months 67 (34.89%) Expired, Out Of 83 Patients From 13 – 60 Months 22 (26.5%) Expired And Out Of 92 Patients From 61 – 156 Months 19 (20.65%) Expired. Difference In Mortality Rate Was Statistically Significant Between 1-12 Months And 61- 145 Months Age Groups. Out Of 39 Patients From 1- 12 Months 22 (56.41%) Expired, Out Of 17 Patients From 13 – 60 Months 5 (29.41%) Expired And Out Of 22 Patients From 61 – 156 Months 6 (27.27%) Expired. Difference In Mortality Rate Was Statistically Significant Between 1-12 Months And 61- 145 Months

3.1 Age Groups.

There Were 36 Cases In Stage 1, 24 In Stage 2 And 18 In Stage 3. In Stage 1, 10 (27.78%) Patients Expired And 11 (45.83%) From Stage 2 And 12 (66.67%) Patients In Stage 3 Expired. Mortality Was Also Higher In Patients In Stage 3 As Compared To Other Stages. The Difference In Mortality Between Stage 1 And Stage 3 Was Statistically Significant.

Table 3: Aki Staging (Akin) And Mortality

Stage	No Of Patients	No Of Patient Expired
1	36	10 (27.78%)
2	24	11 (45.83%)
	18	12 (66.67%)

Out Of 78 Cases Developing Aki, 7 (8.97%) Patients Received Peritoneal Dialysis, And 6 (85.71%) Patients Expired. Difference In Mortality Was Is Statistically Significant. (P Value 0.0377) 38 (48.72%) Patients With Aki Were Under Mechanical Ventilation And 29 (76.32%) Expired During The Picu Stay. Difference In Mortality With Non Ventilated Patients Was Statistically Significant. (P Value < 0.0001). Mean Duration Of Hospital Stay Of Aki Patients Is 9.53 Days And Standard Deviation 5.7 Days. Mean Duration Of Hospital Stay Of Non Aki Patients Is 7.95 Days And Standard Deviation 3.84 Days.

Table 4: Aetiology Of Aki

Disease	No. Of Cases	Percentage (%)
Encephalitis	5	6.41
Meningitis	6	7.69
Sepsis	26	33.33
Pneumonia	8	10.26
Acute Gastroenteritis	4	5.13
Malaria	6	7.69
Agn	5	6.41
Nephrotic Syndrome	2	2.56
Dka	2	2.56
Tuberculosis	2	2.56
Heart Disease	5	6.41
Others	7	8.97

V. Discussion

This Prospective Study, Observed That The Incidence Of Aki In Picu Was 21.3%. Depending On The Definition, Prospective Studies From Our Country Suggest Incidence Of Aki Was Up To 40% Picu Patients.⁽¹⁹⁾ The Present Study Is Comparable With Alkandari O Et Al., 2011⁽⁷⁾, Bhojani S Et Al., 2012⁽²⁰⁾ Krishnamurthy S Et Al., 2013⁽²¹⁾ Prasetyo Rv Et Al., 2015⁽²²⁾ T.S.Prabhakar Et Al., 2015⁽²³⁾ Who Found Incidence Of Aki In Picu 17.9%, 16%, 25.1%, 26.8% And 17.5% Respectively. The Difference In Incidence In Various Studies May Be Due To Different Protocols For Picu Admissions, Different Type Of Study And Different Definition Of Aki Being Used. The Difference In Incidence May Also Due To Different In Age Group Where The Studies Were Conducted. The Baseline Characteristics (Age, Sex)Of Both Aki And Non Aki Group Are Comparable. In The Present Study By Akin Criteria Out Of The 78 Cases, 36 (57.14%) Were In Stage 1, 24 (27.38%) In Stage 2 And 18 (15.48%) Were In Stage 3. Present Study Compare Well With Alkandari O Et Al., 2011⁽⁷⁾. In Their Study, They Found 54.6% Patients Were In Stage 1, 24.13% Patients Were In Stage 2 And 21.2% Patients Were In Stage 3. Present Study Also Comparable With Mehta P Et Al., 2012⁽²⁴⁾ With Incidence At Stage 3. In Their Study By Akin Criteria 65.7% Patients Were In Stage 1, 17.8% Patients Were In Stage 2 And 16.3% Patients In Stage 3. Krishnamurthy S Et Al., 2013⁽²¹⁾, T.S.Prabhakar Et Al., 2015⁽²³⁾ Although Reported An Overall Incidence Of Aki In Picu Which Is Comparable To Present Study But Incidence According To Stage Were Different From Present Study. Incidence In Stage1 Were 35.2%, 85.7% Stages 2 Were 25.9%, 11.4% And Stage3 Were 38.9%, 2.9% Respectively. These Differences In Incidence From The Present Study Are Possibly Due To Difference In Sample Size In Their Study. However, Incidence Of Aki In Stage 2 In The Study By Krishnamurthy S Et Al., 2013⁽²¹⁾ Is Comparable To Present Study. Using Prifle Criteria Shweta Naik Et Al., 2014⁽²⁵⁾ Observed 37.9% Were Classified As Risk (R), 35.9% As Injury (I), And 26.2% As Failure (F), Which Corresponds To Stage 1, 2 And 3 Of Akin Criteria Respectively. Prasetyo Rv Et Al., 2015⁽²²⁾ Found That The Distribution Of Patients In The 3 Stages Of Aki (Risk, Injury, Failure) Were Almost Equal In Numbers. The Difference In Incidence From The Present Study Is Probably Due To The Use Of Different Criteria (Prifle) For Aki Staging. In The Present Study Most Of The Cases Admitted Were Due To Sepsis 26/78 (33.33%), Followed By Pneumonia 8, (10.26%), Meningitis 6 (7.69%), Malaria 6 (7.69%), Agn 5 (6.41%), Encephalitis 5 (6.41%), Heart Disease 5 (6.41%), Acute Gastroenteritis 4 (5.13%), Nephrotic Syndrome 2 (2.56%), Dka 2 (2.56%), Tuberculosis 2 (2.56%), Upper Gi Bleed 2(2.56%), And Others. The Incidences Of Pneumonia And Sepsis In The Present Study Are Comparable To The Study By Mehta P Et Al., 2012⁽²⁴⁾. However, The Difference In The Other Causes With The Present Study Is Possibly Due To The Different Protocols Followed By Different Picus And The Difference In The Prevalence Of Disease In Different Part Of The Country. In The Present Study Out Of Out Of 78 Cases, 33 (42.3%) Patients Expired And 45(56.7%) Survived During Picu Stay. Overall Picu Mortality Rate Of 29.43% And Mortality Rate Of Non Aki Pateints Is 25.95%. In The Present Study Mortality Of Aki Patients Is Comparable To Study Conducted By Alkandari O Et Al., 2011⁽⁷⁾, Mehta P Et Al., 2012⁽²⁴⁾, Krishnamurthy S Et Al., 2013⁽²¹⁾, Prasetyo Rv Et Al., 2015⁽²²⁾. Who Observed 39%, 37%, 46.3% And 46.7% Respectively. Reported Mortality In Picu Patients With Aki Varies Considerably Between Studies Depending On Aki Definition And The Patient Population Studied. The Higher Mortality Rate Of Some Studies May Be Due To Different Criteria And Protocol Applied For Picu Admission. The Present Study Observed Higher Mortality In The Age Group Of 1-12 Months Which Is Comparable With The Study By Krishnamurthy S Et Al., 2013⁽²¹⁾ Who Observed Age Less Than 10 Months As A Predictor Of Mortality.

The Present Study Observed That Mortality Is Higher In Patients In Stage 3 As Compared To Other Stages. Out Of 78 Cases Developing Aki, 7 (8.97%) Patients Received Peritoneal Dialysis, And 6 (85.71%) Patients Expired. Difference In Mortality Is Statistically Significant. Similar Finding Was Observed By Shweta Naik Et Al., 2014⁽²⁵⁾, In Their Study Incidence Of Cases Receiving Rrt (5.8%) And The Mortality Rate Was 66%. Mehta P Et Al., 2012⁽²⁴⁾, Krishnamurthy S Et Al., 2013⁽²¹⁾ Observed A Higher Incidence Of Cases Receiving Rrt (15.1 %, 27.4%) Respectively And The Difference In The Mortality Rate Was Statistically Significant.

38 (45.24%) Patients With Aki Were Under Mechanical Ventilation And 29(76.32%) Expired During The Picu Stay. Difference In Mortality With Non Ventilated Patients Was Statistically Significant. Similar Finding Was Observed By Mehta P Et Al., 2012⁽²⁴⁾, In Their Study 35 Patients (48 % Of The Aki Cases) Were Under Mechanical Ventilation. Krishnamurthy S Et Al., 2013⁽²¹⁾ Observed A Higher Incidence Of Cases Under Mechanical Ventilation (79.6%) And Shweta Naik Et Al., 2014⁽²⁵⁾, Observed A Lower Incidence Of Cases Under Mechanical Ventilation. Mean Duration Of Hospital Stay Of Aki Patients Is 9.53 Days And Standard Deviation 5.7 Days. Mean Duration Of Hospital Stay Of Non Aki Patients Is 7.95 Days And Standard Deviation 3.84 Days. Present Study Is Comparable With Mehta P Et Al., 2012⁽²⁴⁾ In Their Study They Found That Patients With Aki Had A Significantly Longer Duration Of Hospital Stay (9 Days Vs. 7 Days, P<0.02).

V Conclusion

Aki Is Common In Picu, Especially Younger Patients And Results In Increased Hospital Stay And High Mortality Especially Those Who Are Under Renal Replacement Therapy And On Mechanical Ventilator.

5.1 What Is Already Known?

Acute Kidney Injury (Aki) Is Common In Hospitalized Critically Ill Children And Is Associated With Increased Mortality

5.1 What This Study Adds?

Aki Common In Children Admitted In Pediatric Critical Care Unit.

Young Age, Need For Mechanical Ventilation, Need For Rtt Is Associated With Increase Mortality In Aki Patients Higher Stages Of Aki Are Associated With Increased Mortality

Aki Is Associated With Prolonged Hospital Stay.

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