ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

Original Research Article

CLINICOPATHOLOGICAL PROFILE OF AKI IN CHILDREN IN A TERTIARY HEALTH CENTRE

Dr. Deshish Kumar Panda[1], Dr. Surjit Naik[2], Dr. Rabindra Kumar Meher[3] Saiprasanna Behera[4].

[1.] Assistant Professor, Dept. of Pediatrics, BBMCH, Bolangir.
[2.] Assistant Professor, Dept. of Pediatrics, BBMCH, Bolangir.
[3.] Senior Resident, Dept. of Pediatrics, BBMCH, Bolangir.
[4.] Research Associate, CRO Pharmatrendz Private Limited.

Corresponding Author
Dr. Saiprasanna Behera,
Research Associate,
CRO Pharmatrendz Private Limited,

Abstract:

Background: In view of the magnitude of AKI problem and the changing scenario concerning the age composition, etiological pattern, clinical manifestations and benefit of early detection and appropriate management, this particular study was undertaken to analyze the various aspects of AKI in children in our setup.

Objectives: To determine the etiology, clinical profile, incidence & short term outcomes in hospitalized children aged 1 month to 14 years with acute kidney injury (AKI).

Methods: This prospective observational study was conducted in the pediatric wards of a tertiary hospital in southern Odisha, to study etio – clinical profile of AKI (defined according to the acute kidney injury network criteria). From July 2019 to Jun 2021, 201 children were included in the study.

Results: The incidence of AKI was 1% in the pediatric wards. AKI occurred commonly in association with malaria (41.8%) followed by sepsis (21.4%), snake bite(14.9%), acute gastroenteritis (9%) & acute glomerulonephritis (5.5%), nephrotic syndrome (3%). Most presenting feature is oliguria/anuria (86%) followed by fever (67.2%), loose stool (16.9%), H/O snake bite (14.9%). Dialysis was required in 34.3% ; mortality was 12.9%.

Conclusions: The incidence of AKI is more common in age group 5 – 10 yr, males being affected more. Intrinsic renal mechanism was commonest mode of AKI.

Key words: Acute kidney injury, Hospitalized children, Incidence, peritoneal dialysis, serum creatinine.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

Introduction:

The incidence of AKI has been increasing and likewise the mortality rate also varies widely in different reports. The rates of mortality have remained unchanged till today even with modern methods of treatment like dialysis. This is because of the change in characteristics of patient population like declining number of transfusion related causes and a rise in number of nephrotoxic causes, the changing pattern of surgery and the progress in resuscitation and intensive therapy which results in longer survival and development of AKI.

Such changes in the composition of age of onset of AKI and its etiological pattern is fast making the statistics on different aspects of the disease in the world literature more and more irrelevant.

However, in developing countries like India, precipitating factors like gastroenteritis with dehydration, shock, infections, nephritic syndrome, snake bite and drug abuses are more frequent in a background of predisposing factors like malnutrition, poor socioeconomic status, adverse climatic and geographic conditions, high rate of illiteracy, poor medical facilities and environmental sanitation. Scientific data of the aforementioned aspects of AKI are grossly inadequate in Indian context.

The early and established clinical features of AKI are diverse and mimic many other diseases. The biochemical parameters for early detection are not well developed and laboratory facilities for diagnosis are grossly inadequate in most institutions.

The treatment modalities developed by foreign authors are not fully applicable in our setup which leaves us with conservative and often peritoneal dialysis as a method of treatment. It remains the major life saving procedure for younger children in AKI.

Mehta et al must be congratulated for taking the first step towards understanding the natural history of AKI in hospitalized children in our country using the AKIN criteria[1]. Over recent years, there has been increasing recognition that relatively small rises in serum creatinine in a variety of clinical settings are associated with worse autcomes.[2]

An estimated 5-20% of critically ill patients experience an episode of AKI during the course of their illness and AKI receiving RRT has been reported in 4-9% of all admissions to ICU.[3] AKI is common in hospitalized patients and also has a poor prognosis with the mortality ranging from 10-80% and patients who present with uncomplicated AKI have a mortality rate upto 10%.[4]

AIMS &OBJECTIVES:

Primary:

To determine the causes and clinical profile of AKI in hospitalized pediatric patients from age 1 month to 14 years.

Secondary:

- To determine the incidence of AKI in hospitalized pediatric patients from 1 month to 14 years.
- To study the short term outcomes in AKI

Materials And Methods:

Material of this study included children beyond neonatal period at high risk of developing AKI or those who presented with AKI to pediatric ward of Bhimabhoi Medical College and Hospital, Bolangir. The selection of cases and procedures adopted in the study are detailed below.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

Setting:

Bhimabhoi Medical College and Hospital, Bolangir, tertiary care referral hospital of Southern Odisha.

Study duration:

July 2020 to Jun 2022

Selection of cases:

All children more than 28 days of age with clinical evidence of developing AKI (oligouria / anuria) were screened for evidence of AKI by laboratory parameters. Those who manifested evidence of AKI during hospital stay were also included. Those suspected clinically were screened for serum creatinine and included in the study if its value was 1.5mg/dl or more in children >1 year and 1 mg/dl or more in children between 1 month-1 year.

Exclusion criteria:

a. Acute on chronic kidney disease will be excluded initially.
b. Chronic kidney disease (CKD).

Methods:

A detailed history of illness, clinical examination, investigations, treatment and responses to therapy of each case was noted in the proforma prepared. Their nutritional status was assessed according to the India Academy of pediatrics classification.

Those cases who had predisposition for development of pre-renal type of AKI were given fluid challenge in the form of Normal saline 20ml/kg over 30 mins followed by a diuretic challenge (frusemide 2mg/kg) after correction of dehydration, hypotension or shock if associated. Those who had urination were grouped under pre-renal type and those who didn't were treated as intrinsic type of AKI. Their clinical profile and renal status were recorded and an attempt was made in each case to determine the etiology.

Statistics :

The data were noted in tabular form. Necessary statistical procedures were applied using "SPSS version 19" and Microsoft Excel software. It was used to observe the percentage of outcome variable indifferent demographic and clinical subgroups. Other parametric and non-parametric analysis, hypothesis verification was done as per necessity to arrive at a conclusion.

Results:

Table – 1: AGE & SEX DISTRIBUTION IN THE STUDY POPULATION

Age Groups (Yrs)	Sex		Total (n)
	Female	Male	
< 1	10	14	24
1- 5	26	37	63
5 – 10	32	46	78
10 – 14	15	21	36
Total	83	118	201

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

TABLE – 2: PRESENTING COMPLAINT OF PATIENTS IN THE STUDY GROUP

Symptoms	No of cases	Percentage
Oliguria	173	86.1
Fever	135	67.2
H/O Bite	30	14.9
Loose stool	34	16.9
Skin infection	8	4
Abdominal distension	41	20.4
Hematuria	29	14.4
Convulsions	31	15.4
Altered sensorium	18	9
Bleeding	20	10
Blood in stool	10	5
Past H/O UTI	13	6.5

TABLE – 3: CAUSES OF AKI IN THE STUDY GROUP

Causes	No. of patients	Percentage	Cumulative %
Malaria	84	41.8	41.8
Sepsis	43	21.4	63.2
Snake bite	30	14.9	78.1
AGE	18	9	87
AGN	11	5.5	92.5
NS	6	3	95.5
AVH	3	1.5	97
HUS	2	1	98
PUV	2	1	99
IgA Nephropathy	2	1	100

TABLE – 4: SERUM UREA VALUES OF THE STUDY GROUP (n=201)

Urea (mg/dl)	No. of patients	Percent	Cumulative %
40-100	108	53.7	53.7
100-200	66	32.8	86.6
>200	27	13.4	100
Total	201	100	-

TABLE – 5: SERUM CREATININE VALUES OF THE STUDY GROUP (n=201)

Creatinine (mg/dl)	No. of patients	Percent	Cumulative %
1-1.5	8	4	4
1.5-3	115	57.2	61.2
3-6	34	16.9	78.1
>6	44	21.9	100
Total	201	100	-

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

TABLE – 6: SERUM Na^+ VALUES OF THE STUDY GROUP

Na^+ Values (mEq/L)	No. of patients	Percent	Cumulative %
<135	46	22.9	22.9
135-145	137	68.2	91
>145	18	9	100
Total	201	100	-

TABLE – 7: SERUM K^+ VALUES OF THE STUDY GROUP

K^+ Values (mEq/L)	No. of patients	Percent	Cumulative %
<3.5	32	15.9	15.9
3.5-5.5	139	69.2	85.1
>5.5	30	14.9	100
Total	201	100	-

TABLE – 8: AKIN STAGING OF AKI IN THE STUDY GROUP

Stage	No. of patients	Percent	Cumulative %
I	57	28.4	28.4
II	61	30.3	58.7
III	83	41.3	100
Total	201	100	-

TABLE – 9: CAUSES IN RELATION TO TYPE OF AKI IN THE STUDY GRUOP

Causes	Intrinsic	Pre	Post	Total
Malaria	77	7	0	84
Sepsis	25	18	0	43
Snake bite	26	4	0	30
AGE	0	18	0	18
AGN	9	2	0	11
NS	6	0	0	6
AVH	3	0	0	3
HUS	2	0	0	2
PUV	0	0	2	2
IgA Nephropathy	2	0	0	2
Total	150	49	2	201

TABLE – 10: OUTCOME OF PATIENTS IN THE STUDY GROUP

Outcome	No. of patients	Percent	Cumulative %
Death	26	12.9	12.9
Recovery	175	87.1	100
Total	201	100	-

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

TABLE – 11: OUTCOME IN RELATION TO TYPE OF AKI IN THE STUDY GROUP

Type of AKI	OUTCOME				Total
	Outcome Death		Total Recovery		
	n	%	n	%	
Post-renal	0	0	2	100	2
Pre-renal	6	12.2	43	87.8	49
Intrinsic renal	20	13.3	130	86.7	150
Total	26	12.9	175	87.1	201

Table – 1 : Shows the sex composition of the study population in each age group Male : Female ratio=1.4. Table – 2 : Shows the presenting symptomatology of study population. Oliguria/Anuria was the most common presenting complaint among 86%. Fever was the next common presenting feature I 67%.Table – 3 : Shows the case distribution according to etiology. Four major causes of AKI in this study in order are Malaria, Sepsis, Snake Bite & AGE contributing to 87% of the study population.Table – 4 : Shows the distributionof cases according to level of UREA on presentation. Maximum (53.7%) cases had deranged level within 100 mg/dl. Only 13.4% of subjects had very high UREA level (>200).Table – 5 : Shows of the frequency of patients with initial creatinine values 57.2% among the study group had creatinine levels >1.5-3 mg/dl. 21.9% had very high levels (>6 mg/dl).Table – 6 : Shows the outlines of the serum Na+ values scattered in the study group. Majority (68.2%) cases are found to be isonatremic. Table – 7 : Showsthe serum K^+ levels of patients in the study group. Maximum cases (69.2%) had normal serum K^+ levels. 15% cases were hyperkalemic.
Table – 8 : Shows the patients grouped into stages of AKI. Maximum (41.3%) cases were found to have stage III of AKI.Table – 9 : Shows etiologies basing on the type of AKI. Snake bite and Malaria cases had predominantly intrinsic type of AKI. Sepsis had more of intrinsic type of AKI.Table – 10 : Shows that the mortality in our series was 12.9%.Table – 11 : Shows the outcome in relation to type of AKI in the study group.

Discussion:

Out of total no. of 18367 admission to department of pediatrics in stated age group during the study period, 201 cases fulfilling inclusion criteria were included in the present study. So, incidence of AKI in hospitalized patients in the present study accounted for 1 %. Similar incidence of approx. 1% was observed by R N Srivastava et al[5] but other authors have reported an incidence between 5% to 10%, which is much higher than present study. This difference may be due to inclusion of newborn cases and higher number of study cases in their series.

Table 1 indicates age incidence of AKI cases in the present study. Majority of cases, 38.8% were observed in the age group of 5-10 years followed by 31.3% in 1-5 years. 44% cases occurred in the under 5 age group in our study. Similar age distribution was observed by P.Arora et al.[6] (51.9% below 4 years) R.N. Srivastava et al (49% in less than 4 years age group) and U.T.N Acharya et al[7] (51.2% between 1-4 years).

In the present study male children outnumbered females (M:F=1.4:1) as shown in Table 1. P. Arora et al, R.N Srivastava et al and U.T.N Acharya et al also reported a similar male dominance, though the ratio was different being 3:1, 2.3:1,2.1:1 respectively. This discrepancy might be due to regional and social difference in the above three studies which were conducted

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

in the states of UP, Delhi and Northern India. The reason for male preponderance could be because of gender bias favouring male children, secondly due to higher susceptibility to infection and also more outdoor activities leading to snake bite, mostly in the above 5 years age group. Males are also more prone for certain congenital anomalies like PUV.

Table 2 indicates the various clinical feature observed in AKI cases in the present work. Oliguria / anuria was present in approx. 86% of cases, next most common presenting feature was fever in 67.2% followed by H/O snake bite in 14.9%, loose stool in 16.9% cases amongst the study group.Oligouria / anuria was the presenting feature in 100% cases of the study undertaken by U.T.N Acharya et al (Anuria in 95.1% and Oliguria 24.9) and P. Arora et al (anuria in 53.6% and oliguria in 46.4%). This difference is due to detection of biochemical derangements in snake bite cases mostly during their hospital stay and in this study these cases contributing to significant number among study population. Loose stool was found in 16.9% cases admitted as AGE in our study population as against 58.5% in U.T.N Acharya et al, 17% in R. N Srivastava et al, difference attributed to the regional and cultural practices, increasing level of awareness among the people regarding oral rehydration. We observed presence of skin infection as a marker of AGN (4%), altered sensorium (9%), hematuria (14.4%), convulsion (15.4%), abdominal distension (20%), bleeding manifestation and bloody stool (5%) cases amongst the study population. Agarwal et al[8] observed main presenting complaints were diarrhea (86%), oliguria (72%), rapid respiration (37%), oedema (37%), vomiting (19%) and seizures (13%) in their study population.

In our study, peripheral edema was found in 38.3% cases as against 48.8% in the study of U.T.N Acharya et al. Dehydration was found in 17.4% cases and hypotension in 5.4% cases.

The various etiological diagnosis of AKI in the present work is outlined in Table-5. Malaria is the leading cause (41.8%) followed by sepsis (21.4%), snake bite (14.9%), acute gastroenteritis (9%) and acute glomeruloncephritis (5.5%). We had 3% cases of nephrotic syndrome, 1.5% cases of acute viral hepatitis & 1% cases each of HUS, PUV and IgA nephropathy.

Odisha is a state with high incidence of venomous snake bite and is endemic for malaria and more sickle cell disease cases, this explains the different statistical picture of etiology in the present study. The infectious etiology includes malaria, sepsis, AGE, AGN, HUS and acute fulminant hepatitis which accounted for 80.1% cases in the present study opposed to 86% in the study by A.S. Gokalp et al.[9] Our study depicted similarity with observation of R.N Srivastava et al with respect to AGE and sepsis but other two authors differed.

P.Arora et al, U.T.N Acharya et al and A.S. Gokalp et al observed AGN in 19.2%, 17.1% and 9% cases respectively, our figure of 5.5% is much lower. HUS was a leading cause of AKI in children as per study of R.N Srivastava et al and P. Arora et al, accounting for 36% and 30.8% respectively. In the present study, HUS takes 1% of the study group. This change in pattern is due to geographic variation in the causation of AKI with different referral institutions where the studies were undertaken. On analysis of the common etiological diagnosis in each age group. It was found that in infancy, sepsis (69%) is the most common cause followed by AGE (35). In 1 to 5 years age group malaria (24%) and AGE (24%) are leading cause followed by sepsis (18%). Among 5 to 10 years age group malaria (52%) followed by snake bite (26%) and AGN (10%) and in older children above 10 years snake bite (57%) was detected to be the leading cause.

Serum urea results tabulated in table 4 shows maximum no of cases, 53.7% were clustered in 40-100mg/dl group and 13.4% of cases had high level of urea more than 200 mg/dl.

Serum creatinine results as shown in Table 5, revealed majority cases 57.2% with mild derangement of creatinine values within 1.5-3mg/dl (5 infants with values between 1-1.5 mg/dl),

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

16.9% cases were with moderate (>3-6 mg/dl) and 21.9% cases with severe (>6 mg/dl) derangement.

Serum electrolyte results in Table 6&7 reveals that isonatrenia (135-145 mEq/L) was present in majority of cases (68.2%). Hyponatremia 135 mEq(1) mostly in cases with sepsis and those undergoing dialysis therapy, in 22.9% cases. Hypernatremia (>145 mEq/L) was found in only 9%, mostly in age cases, Hyperkalemia (>5.5 mEq/L) was found in 15% cases mostly in cases with significantly deranged KFT. Isokalemia (3.5-5.5 mEq/L) was found in 69.2% cases.

U.T.N Acharya et al found similar correlation, the patients who died had significantly higher ($p<0.001$) levels of blood urea (292.3 ± 81.7 vs 4.8 ± 1.6) in comparison to those who recovered.

KFT like BUN, serum creatinine, serum electrolytes have remained the most conventional method for diagnosis and monitoring of AKI in which blood levels of urea and creatinine are raised and those of electrolytes varies according to the etiology of AKI. In our study group, the mean creatinine level in prerenal type was 2.2mg/dl whereas that of Urea was 90.8mg/dl, ratio being > 40.

Ultrasonography of abdomen and pelvis carried among 33 patients turned out to be normal in 69.6%, in others showed medical renal disease in 5 cases, PUV suspicion in 3 and features of hepatic parenchymal disease in other 3. Other specific investigation were carried out to determine the etiology as warranted.

Table 8 shows case distribution according to AKIN staging. AKIN stage III accounts for the majority of case distribution (41.3%), followed by stage II (30.3%) and stage 1 (28.4%).

Table 9 shows distribution of type of renal failure as per etiology. Snake bite and malaria mostly cause intrinsic type of AKI whereas cases are unequally distributed in sepsis case with 63% producing intrinsic type AKI, and equally distributed among nephrotic syndrome cases. Sole intrinsic failure occurs in AGN, HUS and IgA nephropathy. AGE has 100% in prerenal type.

Table 10 shows ultimate outcome of cases in our study group where we found 12.9% case fatality and recovery in 87.1%.

Lastly, table 11 shows the outcomein relation to type of AKI and AKIN staging in the study group respectively.

Conclusion:

This study concludes that acute kidney injury cases were more common in children of age group 5-10 years, males being affected more. Oliguria /anuria was the commonest mode of presentation with malaria as the most frequent etiology followed by sepsis. Intrinsic renal mechanism was commonest mode of AKI. There was moderate derangement of kidney function in majority of cases with hyperkalemia in a significant group of patients. 34% of patients required dialytic support and case fatality was 13%.

Outcome prediction was correlated significantly with anemia, leucocytosis, level of urea, creatinine and potassium, blood pressure at the time of presentation, type of management undertaken but no association was with age, sex, nutritional status, duration of oliguria, type of renal failure, level of CRP(Q) and serum sodium level.

The present study was an effort to focus the various domains of acute kidney injury in children presenting to the hospital which included well characterized, diverse study population and depicted the etiological trends in this part of state and some parts of Eastern India.

The etiology of AKI in children in diverse and varies not only in different parts of the world but also among different regions of same country. The increasing facets of modern

ISSN: 0975-3583,0976-2833 VOL13, ISSUE05, 2022

medical amenities are though capable of having prompt reversal of deranged kidney function, but clinical awareness, early detection and immediate action is the need of the hour.

References:

1. Mehta RL, Kellum JA, Shah SV, et al. 2007. Acute Kidney Injury Network (AKIN): report of an initiative to improve outcomes in acute kidney injury. Critical care, 11, R 31.
2. Praught ML, Shlipak MG. are small changes in serum creatinine an important risk factor? Cure opin nephrol hypertens 2005; 14, 265-270
3. Metnitz PGH, Krenn CG, Steltzer H, et al. effect of acute renal failure requiring renal replacement therapy on outcome in critically ill patients. Crit Care Med 2002;30:2051-2058.
4. Shusterman N, Strom BL, Murray TG, Morrison G, West SL, Maislin G Risk factors and outcome of hospital-acquired acute renal failure. Clinical epidemiologic study. Am J Med 1987;83:65-71.
5. Srivastava RN, Chaudhury VP: Ind. Jpedia 1982;49:65-70
6. Arora P, Kher V, Gupta A, Kohli BS, Gulati S, Rai PK, Kumar and Sharma RK: Pattern of acute renal failure at a referral hospital India pediatrics 1994;31:1047.
7. Acharya UTN, Singla PN, Singh RJ, Usha, Mishra OP: Outcome of dialysed patients with ARF Jnd. Pediatrics Vol33(5); may 1996:387-390
8. Agarwal I, Kirubakaran C, Markandeyulu V: Clinical profile and outcome of acute renal failure in South India Children j Indian Med Assoc. 2004 Jul; 102(7):353-4, 356.
9. A.S.Gokalp, A.Oguz, A, Gultekin: ARF related to infectious disease in infancy and childhood Annals of Ttopical Pediatrics (1991); 11:119-121.
10. Gallego N, Gallego A, Pascual J et al: Prognosis of patients with acute renal failure without cardiopathy. Nephron 1993;64(3): 399-404.