

Study Of Incidence, Etiology, Presentation, Complication and Outcome of Acute Renal Failure In Children 1-15 Years

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Abstract

Aim: The aim of the present study was to determine the incidence of acute renal failure in children.

Material and Methods: A Prospective observational study with 78 patients with ARF were included in the Upgraded Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India in between one year from April '2015 to March' 2016. Systematic record of case history, physical signs of patients with ARF was recorded. Blood, urine, kidney tissue and other necessary tests of patient carried out. X-Ray, USG, ECG and other investigation reports of patient done during hospital stay.

Results: Most common cause of ARF in children in our study was Acute gastroenteritis (18 cases, 23.07 %) followed by post streptococcal glomerulonephritis (16 cases, 20.51%). six cases were due to pneumonia and four cases each were due to sepsis, Pyogenic meningitis, systemic lupus erythematosus (SLE), pyelonephritis and posterior urethral valve (PUV) each. According to age distribution of cases, 12 cases (15.38%) were admitted in 1 to 2 year age group (age up to 2 year included). Similarly 22 cases (28.20%) were admitted in 2 to 5 years age group (age above 2 year and up to 5 years included) and 44 cases (56.41%) were admitted in 5 to 15 years age group (age above 5 years and up to 15 years).

Conclusion: ARF in children was most commonly found in 5 to 15 years age group (53.84%). DIC and arrhythmia were the two worst complications with high mortality rate. Dialysis remains the most important tool to bridge the time needed for recovery of renal function. The awareness of prevention, early diagnosis and proper management can also change the mortality rate significantly as seen in acute gastroenteritis cases.

Keywords: Acute Renal Failure, Children, Incidence.

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Introduction

ARF may be defined as abrupt but potentially reversible reduction of glomerular filtration with or without concomitant reduction of tubular function leading to accumulation of nitrogenous wastes and the inability of the kidney to

appropriately regulate fluid and electrolyte homeostasis leading to severe metabolic derangement in the body. Acute renal failure is the sudden cessation of ability of kidney to excrete wastes, concentrate urine, conserve electrolytes and maintain

fluid balance. ARF is a life-threatening condition, especially in children and have significant morbidity and mortality. Five to ten percent of patients in PICU have evidence of renal insult, and ARF occurs in 8% of neonates in the NICU.[1,2] The high frequency of occurrence and substantial morbidity and mortality of ARF demands a logical approach to its prevention and early diagnosis, and the prompt recognition and management of its complication.

ARF is an abrupt cessation of kidney function, with life threatening consequences [3] and sometimes is associated with significant multiple organ system failure (MOSF),[4] until recently there is lack of understanding of the exact pathophysiology and the cellular, molecular and metabolic alterations associated with loss and restitution of epithelial cell integrity and functions.

Detection of renal insult in its early stage before it progress to ARF may enable to prevent morbidity and mortality. So, the term Acute Kidney Injury (AKI) rather than ARF is now preferred. The criteria for the definition of AKI by Acute Kidney Injury Network (AKIN)[5] was as below. Abrupt (within 48 hours) reduction in kidney function, involving:

1. Absolute increase in serum creatinine more than or equal to 0.3 mg/dl from baseline.
2. Increase in serum creatinine more than or equal to 50% (1.5-fold from baseline).
3. Reduction in urine output (documented oliguria of less than 0.5 ml/kg / hour for more than 6 hours).

But in practical field most of the cases the baseline creatinine is not available. ARF may be non-oliguric or even polyuric in 10 to 15% of cases, which may lead to miss the diagnosis on clinical assessment if we rely on daily urine output only.[6] Because of improvement of medical pharmacology and technology now a days children with

acute and chronic illness receive more complex therapy, that can be associated with ARF and can create new complications. So, it is essential and critical to re-evaluate the incidence, etiology, presentation, complication and outcome for children with ARF in age group of 1-15 year which help to take preventive strategies and to implement appropriate supportive care.

The aim of the present study was to determine the incidence of acute renal failure in children.

Material & Methods

A Prospective observational study with 78 patients with ARF were included in the Upgraded Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India in between one year from April '2015 to March' 2016.

Inclusion criteria:

- a) All patients admitted in paediatric medicine department in PMCH, Patna, with renal insufficiency characterized by serum creatinine level more than 1.5 mg/dl have been included in this study.
- b) Patients aged 1- 15 years were included in this study.

Exclusion criteria:

Patient with history of any previous renal disease

Study Tools:

- Systematic record of case history, physical signs of patients with ARF was recorded.
- Blood, urine, kidney tissue and other necessary tests of patient carried out.
- X-Ray, USG, ECG and other investigation reports of patient done during hospital stay.

Study Technique:

1. All ARF patients in this study were examined clinically along with proper and complete history recording.

2. Simple laboratory investigations like serum urea, creatinine, sodium, potassium, cholesterol, triglyceride, complete blood count, routine and microscopic urinary examination etc have been done in all cases. Other special investigations like USG, ANA, Anti dsDNA, ASO titer, C3 level, kidney biopsy etc have been done whenever necessary.
3. Complications arising from ARF and outcome of each case have been recorded in detail.

Results

Table 1: Etiological distribution of ARF in children

Etiology of ARF	N	%
Acute gastroenteritis	18	23.07%
Post streptococcal glomerulonephritis	16	20.51%
Pneumonia	6	7.69%
Sepsis	4	5.12%
Pyogenic meningitis	4	5.12%
Systemic lupus erythematosus (SLE)	4	5.12%
Hemolytic uremic syndrome (HUS)	2	2.56%
Falciparum malaria	2	2.56%
Pyelonephritis	4	5.12%
Posterior urethral valve (PUV)	4	5.12%
Non-Hodgkin lymphoma	2	2.56%
Neuroblastoma	2	2.56%
Nephrocalcinosis	2	2.56%
Rapidly progressive glomerulonephritis(RPGN)	2	2.56%
Tubulointerstitial nephritis	2	2.56%
Atypical minimal change nephrotic syndrome	2	2.56%
Snake bites	2	2.56%

Most common cause of ARF in children in our study was Acute gastroenteritis (18 cases, 23.07 %,) followed by post streptococcal glomerulonephritis (16 cases, 20.51%). six cases were due to pneumonia and four cases each were due to sepsis, Pyogenic meningitis, systemic lupus erythematosus (SLE), pyelonephritis and

posterior urethral valve (PUV) each. Other cases were due to falciparum malaria, nephrocalcinosis, rapidly progressive glomerulonephritis, non-Hodgkin lymphoma, neuroblastoma, hemolytic uremic syndrome, pyogenic meningitis, atypical minimal change nephrotic syndrome and tubulointerstitial nephritis.

Table 2: Age distribution of different etiological factors

Etiology	1 – 2 year	2 – 5 years	5 – 15 years	Total
1. Acute gastroenteritis	0	2	16	18
2. PSGN		4	12	16
3. Pneumonia	4	2		6
4. Sepsis	2	2		4
5. Pyogenic meningitis	4			4
6. SLE			4	4
7. HUS		2		2
8. Falciparum malaria		2		2

9. Pyelonephritis		2	2	4
10. PUV		2	2	4
11. NHL			2	2
12. Neuroblastoma			2	2
13. Nephrocalcinosis	2			2

According to age distribution of cases, 12 cases (15.38%) were admitted in 1 to 2 year age group (age up to 2 year included). Similarly 22 cases (28.20%) were admitted in 2 to 5 years age group (age above 2 year

and up to 5 years included) and 44 cases (56.41%) were admitted in 5 to 15 years age group (age above 5 years and up to 15 years).

Table 3: Sex distribution of etiological factors

Etiology of ARF	No. of cases	Male	Female
Acute gastroenteritis	18	8	10
Post streptococcal glomerulonephritis(PSGN)	16	10	6
Pneumonia	6	2	4
Sepsis	4	2	2
Systemic lupus erythematosus (SLE)	4	0	4
Pyogenic meningitis	4	2	2
Hemolytic uremic syndrome (HUS)	2	2	0
Falciparum malaria	2	2	0
Pyelonephritis	4	2	2
Posterior urethral valve (PUV)	4	4	0
Non-Hodgkin lymphoma (NHL)	2	2	0
Neuroblastoma	2	0	2
Nephrocalcinosis	2	2	0
Rapidly progressive Glomerulonephritis (RPGN)	2	0	2
Tubulointerstitial Nephritis (TIN)	2	2	0
Atypical minimal change nephrotic syndrome	2	2	0
Snake bite	2	0	2

In female patient most common cause was Acute gastroenteritis (10 cases, 27.77%) followed by acute post streptococcal glomerulonephritis (6 cases, 16.66%), systemic lupus erythematosus (4 case 11.11%), pneumonia (4 case 11.11%) and 2 cases each were due to 6 other etiologies.

Table 4: Presentation of ARF

Etiology	Swelling	Ascitis	Oliguria /Anuria	Oedema	Hematuria	Dehydration	Pain abdomen	Altered sensorium	Pallor	Hypertension	Skin infection	Hepatomegaly (HM) /Splenomegaly (SM)	Nausea / Vomiting	Fever
Sepsis	2	-	4		-	4	2	4	4	4	-	-	-	4
PSGN	16	6	16	16	14		2	2	6	14	8	6	8	4
Snake bite	2		4	2	2	2	2	2	2	2	-	-	-	-
PUV			4	-	2	-	-	4	-	-	-		-	2
SLE	2	2	4	2	16		4		4		2	4	2	2
Acute gastroenteritis	10	4	18	8	-	10	10	10	12	2	2	2	6	6
RPGN	2	2	2	2	-	-	-	-	2	2	-	2	-	4
Tubulointerstitial nephritis	2		-	2	-	-	-	-	2	-	-	-	2	2
Atypical MCNS	2	2	2	2	-	-	2	-	-	2	-	-	-	2
Pyogenic meningitis	-	-	2	-	-	2	-	2	-	-	-	-	2	2
Pneumonia	-	-	6	-	-	4	-	2	4	-	-	-	2	6
HUS	2	-	2	2	2	-	2	2	2	-	-	2	2	2
NHL	2	-	2	2	-	-	2	2	2	2	-	-	2	2
Nephrocalcinosis	2	2	2	2	-	-	2	2	2	-	-	-	-	2
Neuroblastoma	2	-	2	2	-	-	2	-	2	2	-	-	-	2
Falciparum malaria	-	-	2	-	2	-	-	2	2	2	-	2	-	2
Pyelonephritis	4	2	4	2	2	-	4	-	2	4		2	4	2
Total	50	20	76	46	40	22	34	34	48	36	12	20	30	46

In our study, the most common presenting symptom was oliguria (76 cases, 97.43%). Oliguria was present in all cases except one, which was non- oliguric renal failure due to tubulointerstitial nephritis. Other common presenting symptoms were, swelling (50 cases, 64.10%), fever (46 cases, 58.97%), pain abdomen (34 cases

43.59%), nausea or vomiting (30 cases, 38.46%). Common presenting clinical signs were edema (46 cases , 58.97%), altered sensorium (34 cases, 43.59%), hematuria (40 cases, 51.28%), hypertension (36 cases, 46.15%), hepato-splenomegaly (20 cases , 25.64%) and others.

Table 5: Outcome in different complications

Complication	CR	PR	Death	Total
1. Hypertension	16 (53.33%)	10 (33.33%)	4 (13.33%)	30
2. Anemia	10 (35.71%)	12 (42.85%)	6 (21.42%)	28
3. Hyparkalemia	10 (50%)	4 (20%)	6 (30%)	20
4. Pneumonia	6 (50%)	2 (16.66%)	4 (33.33%)	12

5. Seizure	2 (33.33%)	2 (33.33%)	2 (33.33%)	6
6. DIC			4 (100%)	4
7. Meningitis	2 (50%)		2 (50%)	4
8. Pleural effusion	2 (100%)			2
9. Arrhythmia			2 (100%)	2

Among 14 patients who died, 6 (42.85%) had hyperkalemia, 4 (28.57%) had hypertension, 6 (42.85%) had anemia, 4 (28.57%) had pneumonia and 4 (28.57%) had DIC. Out of 16 patient who had persistent abnormality of renal function, 8 patient (50%) had hypertension, 10 (62.5%) had anemia, 4 (25%) had hyperkalemia, 2 (12.5%) had pneumonia and another had seizure as complication during hospital stay.

Discussion

The incidence of ARF among the children admitted in paediatric department of this hospital was 2.56% Vachvamichsanong et al[7] in their 22 years study reported that the incidence of ARF among total paediatric admitted cases had been dramatically increased after 1995. Another study by Assounga Alain G et al[8] reported that the incidence of ARF among the children admitted in paediatric department was 0.99%. In our study, out of total 78 cases, 42 cases were males and 36 cases were females. Therefore, the male female ratio (M: F) in our study was 1.17:1. So, there was slight male preponderance. Akhtar Ali et al[9] reported that male outnumbered the female by a ratio of 2:1. Bourquia A et al[10] reported 60% of their cases were boys and 40% cases were girls and the male female ratio was 1.5: 1.

Out of total 78 cases, 23.08% cases were (1 to 2 year) and pre-school children (1 to 5 year) separately. Majority of our children (53.84%) were from 5 to 15 years age group. Mean age of presentation in our study was 6.14 years. Mean age in male child was 6.12 years and in female was 6.15 years. Therefore, the mean age of presentation was almost equal in males and

females. In Olowu WA et al[11] study mean age was 6.28 +/- 4 years, Anochie IC et al[12] reported 5.6 +/- 4.7 years and Bourquia A et al[10] reported 6.8 + 5 years, all of which were similar to our study report. Though Wong W et al[13] reported that mean age of their ARF cases was 2.25 years but their study was done in a paediatric intensive care unit (PICU). In our study most common cause of ARF was acute gastroenteritis (23.07%). Other causes included pneumonia (7.69%), SLE (5.12%), PUV (5.12%). Similarly, Shah BV et al[14] reported that acute gastroenteritis, acute glomerulonephritis, hemolytic uremic syndrome were the most common causes of ARF in their study. Choudhury et al[15] also reported similar causes as common etiological factors.

In present study we found 18 cases of acute gastroenteritis (AGE) resulting in ARF among the total 78 cases. Therefore, gastroenteritis contributes 23.07% of ARF in this study which is similar to above mentioned previous reports. Hemolytic uremic syndrome is one of the common etiologies of ARF in children. Srivastava and Bagga mentioned that hemolytic uremic syndrome (HUS), acute tubular necrosis and glomerulonephritis were the leading causes of ARF in children.[16] Counahan R. et al [17] from London and Ali A et al [8] from Peshawar ,both reported that 12% of their study cases of ARF was due to HUS. Otukesh et al[18] from Iran also reported that 24.1% of cases of ARF was due to HUS. In contrast to their reports, in our study we found only 2 case (2.56%) of HUS leading to ARF in our study. Interestingly, Meadow et al[19] from London reported that no case of HUS was responsible for ARF in their 18-month long study.

Second most common etiological factor responsible for ARF in our study was acute post streptococcal glomerulonephritis (APSGN), which contributed for 20.51% of total cases. This is comparable to several previous studies. Otukesh et al [18] reported 24 % of there ARF cases were due to acute glomerulonephritis. In our study among the APSGN male were slightly predominant than female cases and most (75%) cases were in the 5 to 12 years age group, which is similar to Vachvanichsanong et al study[7] (71% in 5 to 13 year age group). No cases of APSGN cases died, 87.5% cases recovered completely and only one patient had persistent renal dysfunction. So the mortality was also same like Vachvanichsanong et al [6] study (0% mortality).

Pneumonia leading to pre-renal failure contributed 7.69% (6 cases) of cases in our study. 4 of them were female and TWO was male. Among the 6 cases, 4 patients died and 2 survived. Therefore, the mortality rate was 66.67%, which was very high compared to overall mortality rate. PUV contributed 5.12% of ARF cases. Counahan et al [17] also reported that 5.55% of their cases was due to PUV. Obstructive ARF is rare in children and is usually due to nephrolithiasis and congenital anomalies of the urinary tract.[20,21] Urinary tract obstruction leading to post renal ARF was seen in 10.26% cases of our study. 4 of them were due to PUV, 2 were due to non-Hodgkin lymphoma and 2 cases were due to neuroblastoma. Urinary tract obstruction contributed 5.9% of cases of ARF in children in a recent study by Bourquia A et al.[9] Similar to our study Olowu WA et al[11] and Gallego N et al[21] reported that 8.05% and 8.69% respectively of their ARF in pediatric children was due to obstructive uropathy.

2 of our cases (2.56%) developed ARF due to falciparum malaria. Malaria had also

been reported as one of the leading infective causes of ARF in children by Assounga AG et al [7] and in their report, it contributed 12.38% of ARF which was higher than our study. ARF was caused by acute tubulointerstitial nephritis (ATIN) in 2 children contributed 2.56% of total cases of ARF in this study. Bourquia A et al [9] on the other hand reported more cases (7.5%) of their ARF patients were due to ATIN. 4 patient of ARF in our study were due pyelonephritis and contributed for 5.12% of all ARF cases. Hui-Stickle et al[22] reported pyelonephritis as cause of ARF in 1.96% cases of their study and Counahan et al[17] reported 2.77% of their ARF caseas were due to urinary tract infection which was not accordance to our study.

ARF is usually classified into pre-renal, renal and post-renal. Prerenal azotemia was diagnosed in 20.51% of our study patients as in other studies.[20] Delay in diagnosis and inappropriate management leads to increased mortality in this group (37.5%), compared to overall mortality of 17.94%. Intrnsic renal cause of ARF was seen in 69.23% cases and post-renal ARF in 10.26% cases. Hypertension was the most frequent complication in our study seen in 38.46% of cases, followed by anemia (35.89%) and hyperkalemia (25.64%). Hypertension was noted in 40% of their cases by Akhtar Ali et al[9] which is similar to our study. Other complications like convulsion were noted in 6 patients (10.7%) which is similar to Counahan et al study [17] (11.11%) but Shah BV et al [14] found convulsion in higher number (29.4%) of cases. Akhtar Ali et al[9] reported convulsion in 6% of their cases. Mortality was very high in children who had complications like DIC (100%), arrhythmia (100%), seizure (33.33%) and pneumonia (33.33%).

Conclusion

ARF in children was most commonly found in 5 to 15 years age group (53.84%). Infant (1 to 2 years) and pre-school (2 to 5

year) children contributed 23.08% each separately. Mean age of presentation was 6.14 years. Male female ratio in this study was 1.17: 1. 5 Most common presenting clinical feature in our study was oligo-anuria (97.43%), others were swelling (69.23%), fever (84.10%), pain abdomen and nausea-vomiting (41.02%). Common clinical signs were oedema (66.66%), altered sensorium (51.28%), haematuria (48.71%), hypertension (38.46%) etc. Acute gastroenteritis and acute post streptococcal glomerulonephritis were the two most common causes of ARF in children in our study. DIC and arrhythmia were the two worst complications with high mortality rate. Dialysis remains the most important tool to bridge the time needed for recovery of renal function. The awareness of prevention, early diagnosis and proper management can also change the mortality rate significantly as seen in acute gastroenteritis cases.

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