ORIGINAL ARTICLE

STUDY OF ACUTE KIDNEY INJURY IN CHILDREN: ITS AETIOLOGY, CLINICAL PROFILE AND OUTCOME

Garuda Rama[1]

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ABSTRACT: OBJECTIVES: To determine the incidence, age & sex ratio, analyse the spectrum of Acute Kidney Injury (AKI) in its aetiopathology, complications including mortality, prognostic factors and the role of dialysis in the management. **METHODS**: This prospective observational study was conducted on serial cases of 30 patients admitted in Paediatrics department from Feb 2012-Aug 2014 (30 months). **RESULTS**: The incidence of AKI was 0.44%. Children in age group of 0-4 yrs were affected most, predominantly males. Distribution of AKI according to aetiopathogenesis was Acute Tubular Necrosis (ATN) 50%, Haemolytic Uraemic Syndrome (HUS) 19.8%, Glomerulonephritis (GN) 13.2%, Obstructive uropathy 9.9% and Acute on Chronic renal failure (CRF) 6.6%. Dialysis was required in 53.3% of patients. Mortality was 57%. Patients with complications of sepsis, neurological & respiratory problems, hyperkalemia, metabolic acidosis and gastrointestinal bleeding were associated with high mortality. **CONCLUSIONS**: AKI is a common life threatening condition seen in childhood. Early referral, proper assessment, adequate & timely treatment and prompt institution of dialysis helps in decreasing mortality.
KEYWORDS: Acute Kidney Injury, Hemolytic Uremic Syndrome, Hyperkalemia.

INTRODUCTION: Acute renal failure is a serious condition in children.[1] The term 'Acute Renal Failure' (ARF) was replaced by 'Acute Kidney Injury' (AKI) to provide uniform definition, classification and standardize patient care.[2] AKI is defined as abrupt (within 48hrs) reduction in kidney function, defined as an absolute increase in serum creatinine of >0.3mg/dl or reduction of urine output (oliguria of <0.5ml/kg/hr for more than 6 hrs).[2] Detection of the incidence, aetiological profile and outcome of AKI is important for commencement of preventive and therapeutic strategies. Few studies have been conducted to study AKI in children in the developing world in recent years. Considering the limited data available on paediatric AKI in India, the present study was undertaken.

MATERIAL AND METHODS: The present prospective study is on a series of 30 patients, admitted in the department of Paediatrics, from Feb 2012-Aug 2014 (30 months), for AKI of any aetiology.

Selection of Cases: Patients below 12yrs were included. ARF was diagnosed when serum creatinine rose to more than 2.0mg/dl and blood urea >40mg/dl with or without oliguria. Patients with pre-renal azotemia and chronic renal failure were excluded. However 2 patients of CRF with acute deterioration were included.

METHODS: Diagnostic work-up included thorough history taking, clinical examination and investigations. Investigations included urine analysis, urinary indices in 15 cases of ATN, blood urea nitrogen, serum creatinine, serum electrolytes, serum calcium & phosphorus, serum proteins, x-ray chest, ultrasound abdomen for kidney size and congenital anomalies if any. Investigations for intravascular hemolysis included hematocrit, reticulocyte count, complete blood counts, urinary haemoglobin and serum bilirubin. Complement C3 levels and ASO titres were done in glomerulonephitis. Intravenous pyelography and micturating urography were done in patients with obstructive uropathy. Blood, urine, throat swab and stool were cultured to isolate micro-organisms. Widal test, QBC malaria and Dengue serology were done wherever indicated. Renal biopsy was done in 5 cases of prolonged oliguria and clinical suspicion of illness other than ATN. Hemolytic uremic syndrome was diagnosed on basis of thrombocytopenia with intravascular hemolysis. Glomerulonephritis was suspected when patients presented with nephritic syndrome and urine showed RBC, RBC casts and proteins, low levels of complement C3 and raised ASO titre. ATN was diagnosed based on the initial presentation of the disease and exclusion of other causes. Management included correction of fluid and electrolyte balance, control of hypertension, correction of metabolic acidosis and anemia. Peritoneal dialysis was performed in 16 patients who had complications of encephalopathy, fluid overload, metabolic acidosis, hypertension, hyperkalemia, azotemia and prolonged oliguria.

Analysis: All patients were grouped for determination of incidence, age and sex distribution. They were divided according to aetiology as pre-renal, renal and post-renal factors. They were categorized as Acute Tubular Necrosis (ATN), Hemoytic Uremic Syndrome(HUS), Glomerulonephritis (GN), Obstructive nephropathy and Acute on Chronic renal failure (CRF).

All patients were studied for the pattern of AKI (oliguric versus non-oliguric) and their outcome. Finally complications including mortality, prognostic factors and role of peritoneal dialysis in clinical outcome of patients were determined.

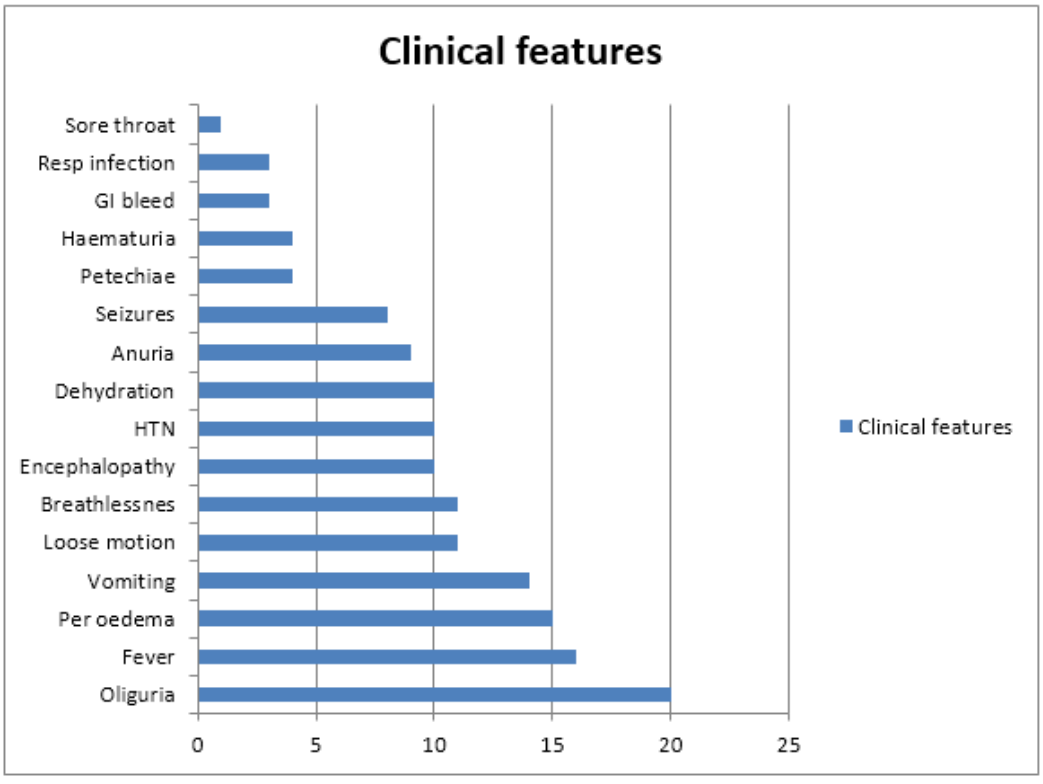
RESULTS: This present study of 30 patients were analyzed and compared with other similar studies. The incidence of AKI was 0.44%. The M:F was 2.3:1(21:9) and age distribution was 62.7% in 0-4yrs, 23.1% in 4-8yrs and 13.2% in 8-12yrs. The high incidence of AKI in age group of 0-4yrs was due to high incidence of gastroenteritis and HUS. Glomerulo-nephritis was common in age group of more than 5 yrs.

	Age Incidence		**Sex distribution**	
Age	Number	%	Male	Female
0-4	19	63.33	12	7
4-8	7	23.33	5	2
8-12	4	13.33	4	-
Total	30	100	21	9

Clinical Features:

Clinical Feature	Number of cases	% of cases
Oliguria	20	66.66
Fever	16	53.3
Peripheral edema	15	50
Vomiting	14	46.6
Loose motion	11	36.6
Breathlessness	11	36.6
Encephalopathy	10	33.3
Hypertension	10	33.3
Dehydration	10	33.3
Anuria	9	30
Seizures	8	26.6
Petechiae	4	13.3
Gross hematuria	4	13.3
GI hemorrhage	3	10
Respiratory infection	3	10
Sore throat	1	3.3

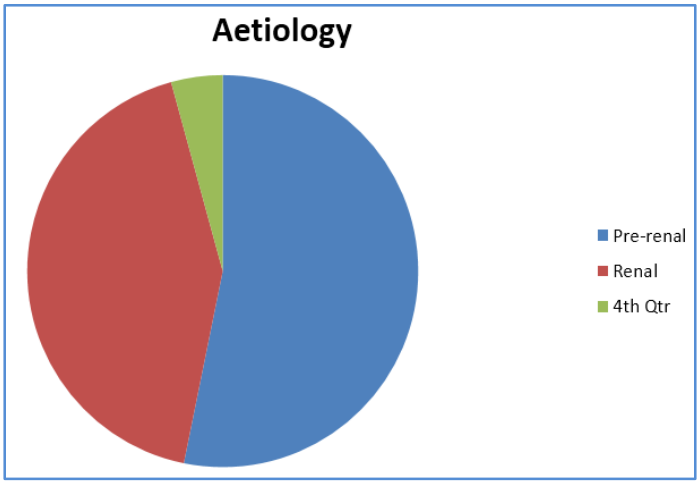
Clinical Features:



Graph -1

Aetiology (Graph - 2): Distribution of 30 patients according to aetiology: 15(50%) belonged to pre-renal factors, 12 patients (40%) had intrinsic renal disease and 3 patients (10%) are due to post renal problems.

	Number	%
Pre-renal	15	50
Renal	12	40
Post-renal	3	10

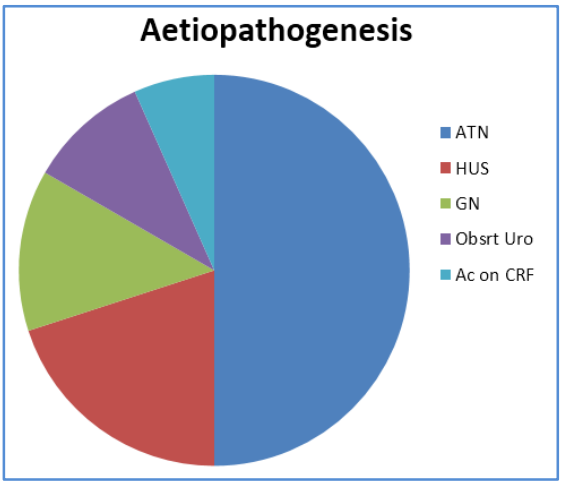


Graph -2

Aetiopathogenesis (Graph-3)

AKI is divided into 5 categories: ATN, HUS, Glomerulonephritis, Obstructive uropathy and Acute on Chronic renal failure.

Type	Number	M	F	%
1. Acute Tubular Necrosis	15	10	5	50
Gastroenteritis	11			
Septicemia	1			
Dengue fever	1			
Snake poisoning	1			
Fluid loss(skin)	1			
2. Haem Uremic Synd	6	3	3	20.0
3 Glomerulonephritis	4	3	1	13.3
PIGN	1			
H.S Purpura	1			
RPGN	2			
4 Obstuctive uropathy	3	3	-	10.0
PUV	2			
Neurogenic bladder	1			
5 Acute on CRF	2	2	-	6.7

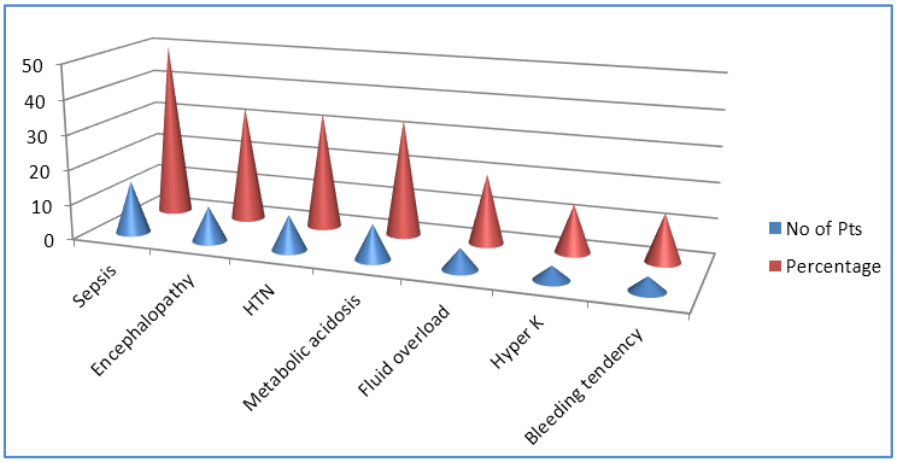


Graph -3

Complications: (Graph-4)

Many patients had more than one complication and the commonest of all was sepsis. Sepsis was the main cause of mortality too. The complications associated were as follows:

	Complication	no.	%
1.	Sepsis	15	50
2.	Encephalopathy	10	33.3
3.	Hypertension	10	33.3
4.	Metabolic Acidosis	10	33.3
5.	Fluid overload	6	19.8
6.	Hyperkalemia	4	13.6
7.	Bleeding tendency	4	13.6



Graph -4

Role of Peritoneal Dialysis: (Table-1)

In the present series, only 16 patients underwent peritoneal dialysis and the rest managed conservatively. The mortality in the dialyzed group was 37.5% and in non-dialyzed 72.5%, which means early dialysis reduces mortality.

Treatment mode	No. of patients	Survival	Death (%)
Peritoneal Dialysis	16	10	6 (37.5)
Conservative management	14	3	11 (72.5)

Table 1

Mortality: (Tables-2, 3, 4)

The overall mortality in present study was 57% (17 out of 30). Distribution according to age, etiology and complications are shown in the following tables.

Age (Yrs)	No. of Pts	No. of Deaths	Mortality %
0-4	19	13	68.3
4-8	7	2	28.5
8-12	4	2	50

Table 2: Mortality with reference to age

Aetiology	No. of Patients	No. of Deaths	Mortality %
ATN	15	10	66
HUS	6	3	50
GN	4	2	50
Obstr Uropathy	3	1	33
Ac on CRF	2	1	50

Table 3: Mortality of AKI in different etiology

Complication	%
Sepsis	84.4
Encephalopathy	77.9
Bleeding Tendency	72
Hyperkalemia	63
Fluid overload	58
Metabolic acidosis	48
Hypertension	36

Table 4: Mortality associated with Complications

DISCUSSION:

Age and Sex Distribution: It varies from study to study, because incidence and etiology varies with age and geographic area.[3]

Age (Yrs)	Arora[4]	Srivastava[5]	Md Ajaz[6]	Present
0-4	51.9	77	40	62.7
5-8	30.8	12	33.9	23.1
9-12	17.3	9.6	26.8	13.2

Present study shows highest incidence in 0-4yrs due to ATN from gastroenteritis and HUS and is comparable to few other studies.[4, 5,] In Md Ajaz'study,[6] the incidence is highest in age groups >5yrs due to GN.

Male preponderance of 2.3:1 is found in the present study. Similarly Srivastava[5] et al and Agarwal[1] et al reported as male preponderance.

Clinical Presentation: Oligo-anuria was the commonest presentation (96.6%) in the present study and only one patient presented with non-oliguria. This is similar to other studies.[3, 4, 6, 7,] Next common was fever from septicemia. Peripheral edema was present in 50% as shown by Acharya et al.

Etiology and Etiopathogenesis: (Table-5): ATN due to gastroenteritis was the commonest aetiology followed by HUS and GN, same as in some studies in India.[8, 9, 10, 3, 1]

On the contrary, Srivastava et al[11] and Arora et al[4] reported HUS to be the commonest cause, whereas Kanodh[7] and Md Ajaz[6] reported GN as the commonest.

In developed countries HUS and complications following major surgery are common causes.[12]

So it is obvious that etiology of AKI in children varies not only with different parts of the world but also within different regions of our country.[2, 3, 10]

Aetiopath	Present	Chaudhary[8]	BV Shah[13]	Arora[4]	Md Ajaz[6]	Edelman[12]
ATN	50	61.3	52.5	28.8	17.8	25
HUS	20	8.8	22	30.8	5.4	40
GN	13.3	28.4	19.5	19.2	35.7	15.2
Obstr Uro	10	1.5	6	21.2	10.7	1
Ac / CRF	6.7	-	-	-	-	1
Others	-	-	-	-	30.4	17.8

Table-5: Aetiopathogenesis incidence in different studies – in %

Complications: In this study, patients who presented with sepsis, neurological complications, hypertension, hyperkalemia, fluid overload, metabolic acidosis and gastro-intestinal bleeding with

high serum creatinine had high mortality. Observation in studies of Kandoth et al[7] and Arora et al[4] showed increased mortality with CNS complication and that of Srinivastava et al[5] sepsis.

Outcome: (Table-6)

The mortality in present study was 57% and highest in young age group[10] and in patients with ATN and HUS than with GN.[6]

The mortality shown in various studies are shown in table.

Study	No. of Pts.	%
Present	30	7
Shah[13]	66	62
Arora[4]	52	34.6
Acharya[3]	41	73.1
Kandoth[7]	48	41.7
Md Ajaz[6]	56	25

Table 6

The mortality was less in Md Ajaz study[6] because the commonest cause was AGN which has a better prognosis than ATN and HUS.

Prognostic Factors:

1. Age: High mortality rate of 68.3% was found in children less than one year. Hence young age is associated with high mortality.[5]
2. Aetiology: Mortality varies with aetiology and was highest in ATN (66%). It was noticed that survival was better when there was primary renal lesion and poor when AKI was precipitated by an underlying illness [Shah B. V,[13]]. It is therefore suggested that primary illness should be promptly treated to prevent AKI and if ARF is established early and frequent dialysis[13] is to be done.
3. Complications: Mortality was higher in patients with complications, sepsis and neurological complications are associated with highest mortality.[5,7,4]
4. Duration of oliguria: Mortality increased with duration of oliguria. It increased from 16% in patients with <24 hours duration of oliguia to >50% in patients with >7 days of oliguria.[6]
5. Time lag between need and institution of dialysis: Early institution of dialysis was associated with less mortality.[4]

CONCLUSION: Spectrum of AKI and pathogenic factors operating were correlated with the same from other studies in India. Early recognition, referral and prompt institution of dialytic support and treatment of complications improves the outcome.

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AUTHORS:

1. Garuda Rama

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Paediatrics, Konaseema Institute of Medical Sciences, Amalapuram, Andhra Pradesh, India.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Garuda Rama,
Associate Professor,
Department of Paediatrics,
Konaseema Institute of Medical Sciences,
Amalapuram, Andhra Pradesh – 533021, India.
E-mail: garudarama@yahoo.co.uk

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