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Original Research Article

Outcome of acute renal failure in children in Chennai, India

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ABSTRACT

Background: Acute Renal Failure (ARF) is one of the common causes of morbidity and mortality in children. With the availability of increasing knowledge and awareness, dialysis facilities and excellent supportive treatment, the overall outcome is changing. This study is undertaken to find out the outcome of ARF in children.
Methods: This prospective cross-sectional study was done in Institute of Child Health and Hospital for Children, (ICH and HC) Egmore, Chennai from February 2014 to January 2016. Children with elevated blood urea (>40 mgs/dl) and serum creatinine (>1 mg/dl) were included and evaluated for etiology, treatment modality and outcome and other co-morbid features. Data was analysed on SPSS 20.0. P value of <0.05 was considered significant.
Results: A total of 105 children (65 boys, 40 girls) from newborn period to 12 years were examined. The common age of presentation of ARF is 1-4 years with a male preponderance and acute glomerulonephritis were found to be commonest cause. There was no statistically significant difference in mortality in relation to age group (P 0.98). There was a statistically significant difference in mortality in relation to duration of oliguria (P 0.02), Serum creatinine levels (P 0.03). The role of other biochemical values like serum potassium (P 0.14), serum bicarbonate (P 0.59) were not found statistically significant. Peritoneal dialysis in general improves survival, but it is not statistically significant (P 0.33). Systemic complications associated with ARF increases mortality and it is statistically significant (Chi-square value = 9.13, P = 0.003).
Conclusions: ARF in children is due to transient disorders and early referral to major centres even with 1-2 days oliguria and early treatment will improve the prognosis. Peritoneal dialysis in severe ARF with associated complications really helped the children.

Keywords: ARF, Oliguria, Peritoneal dialysis

INTRODUCTION

Acute Renal Failure (ARF) is one of the common causes of morbidity and mortality in children. In a country like ours still acute glolmerulonephritis is one of the major causes in children resulting in acute renal failure. With the availability of increasing knowledge and awareness, dialysis facilities and excellent supportive treatment, the overall outcome is changing. The mortality in the present day ARF in children is not only due to renal failure, but also due to extra renal factors. The underlying disorders and the extra renal factors play major influence on patient and kidney survival. Acute renal failure is the most important condition in Paediatric Nephrology seen in hospital practice.[1] The aetiology of ARF and the outcome vary from place to place and have shown changes in time.

ARF and Oliguria which was considered synonymous is not the routine in present day knowledge. Children with ARF following amino glycoside therapy and septicaemia

can present with non-oliguric ARF. If Anuria or Oliguria alone is considered essential as the pointer for the diagnosis of ARF, clinically these children will be missed. So, a strong suspicion on the background of such situations for non-oliguric ARF is essential to make the clinician to do biochemical evaluation periodically and for early detection of non-oliguric or high output ARF.[1]

With the present available knowledge, it is clearly understood that to monitor renal function, it is important to use biochemical studies as well as measurement of urine volume which will help us not to miss non-oliguric renal failure.

Pre-renal failure is essentially due to reduction in the perfusion of kidney resulting in reduction in renal function. Intrinsic renal failure results from diseases of kidney while post renal failure is essentially due to obstructive disorders.[2]

The precipitating diseases form the major presenting feature. Renal failure itself can manifest with oliguria, pallor, edema, anemia, hypertension, vomiting and lethargy. Acute hypertension of ARF can manifest as hypertensive encephalopathy. Congestive cardiac failure, pulmonary oedema, arrhythmias, seizures, coma and gastrointestinal bleeding are the manifestations of complications of ARF.

In a child with renal failure, diagnosis is first made with history. With vomiting, diarrhoea, fever, dehydration and renal failure, one can doubt prerenal azotemia. But this background history may point towards Haemolytic Uremic Syndrome (HUS) and renal vein thrombosis (RVT) also.[2] Recent, past history of infection denotes post infective Glomerulonephritis (PIGN). Features of recurrent abdominal pain, arthritis and arthralgia, jaundice, wheeze and skin rashes will suggestive of vasculitis. Triad of features with abdominal pain, hematuria and renal mass will give a clue towards RVT Features of septicemia and administration of amino glycosides should arouse an index of suspicion of non-oliguric ARF.

In non-oliguric ARF, it is only the index of suspicion that will allow the clinician to diagnose the condition.[3] If urine volume alone is taken into account, we will miss this condition. On the background of septicemia and aminoglycoside therapy, if a child is not showing improvement generally and if the child develops refractory metabolic acidosis or seizures, attention to diagnose ARF by biochemical monitoring should be done. One of the hypotheses for this non-oliguric ARF is that, the tubular damage is minimal and hence backflow of tubular fluid into the interstitium is minimal. But, the primary event, tubular damage even though is minimal is sufficient enough to invoke tubuloglomerular feedback causing a reduction in GFR by decreasing the ultrafiltration co-efficient (Kt) of the glomeruli. So, by a reduction in co-efficient, the GFR is reduced but as tubular back flow is minimal, whatever is filtered at the glomeruli comes down as urine and hence non oliguric ARF.

In oliguric ARF the following approach is made. For all the children the following investigations like urine analysis, blood urea, serum creatinine, serum electrolytes, serum total proteins, serum albumin, serum globulin, chest X-ray and ultra-sonogram were done.

The prognosis depends on the aetiology and the availability of medical care.[4] In developing countries where there is a definite delay in seeking medical care, the delay will definitely play a major role in deciding morbidity and mortality. Energetic control and correction of prerenal factors, adequate control of post renal factors and with efficient treatment of intrinsic renal failure, the overall mortality and morbidity of ARF in children can be reduced to very minimal percentage. The pleasure of seeing ARF children recovering is definitely one of the important satisfying events in the career of every paediatrician and paediatric nephrologists.

METHODS

This prospective study was conducted at the Institute of Child Health and Hospital for Children, Chennai. The study was done for a period of 2 years from February 2014 to January 2016. All children under 12 years of age with documentation of ARF were included in the study.

The diagnosis of ARF was based on elevated urea above 40 mgs/dl, serum creatinine above 1 mg/dl with or without oliguria. All children had detailed clinical, haematological, biochemical and radiological evaluation. Repeat biochemical tests were done till the renal function returns to normal level on more than one occasion. Urine analysis, culture of urine and urinary sodium were done in children where urine could be collected. Kidney biopsy was not done as a routine and was done only in children where the disease never followed its natural course. Attempts were also done to find out the etiology from pointers in history, clinical examination and suitable investigations.

Prognostic factors like age, sex, etiology, period of anuria, underlying illness, respiratory complications, hyperkalemia, metabolic acidosis, and associated neurological features were evaluated, so as to find out their influence in modifying the outcome. Management included correction of electrolyte imbalance and dehydration, treatment of infection, anaemia and hypertension. Dialysis was done as and when indicated, some children needed many sessions. Indications of dialysis included, encephalopathy, intractable fluid overload, pulmonary edema, CCF, acidosis, hypertension, electrolyte imbalance, elevated creatinine beyond a critical level. Peritoneal dialysis was done using intermittent peritoneal dialysis catheters under sterile precautions.

All these data were collected periodically and entered in data entry form.

Statistical analysis

Proportions and mean with standard deviation of various characteristics of ARF were arrived at Chi-square and Fisher's exact tests were used to find out statistical significance. P value of less than 0.05 was considered for statistical significance.

RESULTS

A total of 105 Children with ARF with various causes requiring different treatment modalities were included in the present study. Most of the children (39) were between 1-4 years of age, accounting to 37.14% of children. There were 29 children (27.61%) between 5-8 years, followed by 20 (19.40%) children in the age group 9-12 years and 17 children were less than 1 year of age (16.19%). Out of 105 children, 61.9% (65 children) were males and 40 children were females, accounting to 38.09% (Table 1).

Table 1: Age and sex distribution of ARF in children admitted at ICH and HC, Chennai.

Age group (in years)	Male		Female		Total	
	No.	%	No.	%	No.	%
< 1	10	58.82	7	41.17	17	16.19
1-4	25	64.10	14	35.89	39	37.14
5-8	19	65.51	10	34.48	29	27.61
9-12	11	55.00	9	45.00	20	19.04
Total	65	61.90	40	38.10	105	100

Among the various causes of A.R.F, acute glomerulonephritis was seen in 52 out of 105 children accounting to 49.52%. This is followed by acute tubular necrosis in 26 children (24.76%). Out of 26 children with ATN 17 were caused by acute watery diarrhea (AWD), 8 were due to Nephrotic syndrome (NS) and one child with acute myeloid leukemia developed ARF during chemotherapy and associated vomiting. Posterior urethral valves accounted for 12 cases (11.4%). HUS was seen in 7 children (6.66%). Post-surgical causes were seen in 6 children (5.71 %).

The common surgical causes were tumor removal in 2 children-one was Wilm's tumor and other was ganglioneuroblastoma. One child due to leptospirosis presented with hepatic encephalopathy died. One child with bilateral renal vein thrombosis was associated with acute lymphatic leukemia and this child also expired (Table 2).

Table 2: Etiology of ARF in children admitted in ICH and HC, Chennai.

Etiology	No. of children	Percent
Glomerulonephritis (ANS)	52	49.52
Acute tubular necrosis	26	24.76
Acute watery diarrhoea	17	
Nephrotic syndrome	8	
Acute myeloid leukemia	1	
Obstructive		
Posterior urethral valves	12	11.42
Hemolytic uremic syndrome	7	6.66
Post-Surgical	6	5.71
Leptospirosis	1	0.95
Bilateral renal vein thrombosis		
Acute lymphoblastic leukemia	1	0.95

The various causes of ARF in relation to different age groups were analysed. Among the 52 children with AGN, maximum (42.30%) children were seen in the age group of 5-8 years, accounting to 22 children out of 52 children.

Next common age group was between l-4 years, with 19 children accounting to 36.53%. There were no cases of AGN below 1 year of age (Table 3).

Table 3: Causes of ARF In relation to different age group ICH and HC, Chennai.

Disease	Total no. of children		<1 Year		1-4 Year		5-8 Year		9-12 Year	
	No.	%	No.	%	No.	%	No.	%	No.	%
Glomerulonephritis	52	49.52	-	-	19	36.33	22	42.30	11	21.15
ANS	26	24.76	-	-	-	-	-	-	-	-
ATN	17	-	8	47.05	4	23.52	2	11.76	3	17.64
AWD	8	-	1	-	3	-	2	-	2	25.00
NS	1	-	-	12.50	1	37.50	-	25	-	-
AML	-	-	-	-	-	100	-	-	-	-
Obstructive (PUV)	12	11.42	4	33.33	5	41.66	2	16.66	1	8.33
HUS	7	6.66	3	42.85	2	28.57	1	14.28	1	14.28
Post-surgical	6	5.71	1	16.66	3	50	-	-	2	33.33
Leptospirosis	1	0.95	-	-	1	100	-	-	-	-
Bilateral renal vein thrombosis (ALL)	1	0.95	-	-	1	100	-	-	-	-

In A.T.N., A.W.D. was the leading cause of A.R.F and among these 17 children, 8 children (47.05%) were below the age of 1 year. As the age advanced, the risk of renal failure due to diarrhea had come down. There were 8 cases due to N.S. and among them 3 cases (37.5%) were between 1-4 years of age. AML as a cause of ATN was seen in only one child and child was in the age group of 1-4 years. Obstructive uropathy due to posterior urethral valves was seen in 12 children (11.42%). In them, 5 children were between 1-4 years. Four children (33.33 %) were below one year of age. Seven children were diagnosed to have HUS. This is about 6.66% of ARF in our children studied. Among this, 3 children (42.85 %) were below 1 year of age.

Post-surgical cases were 6 (5.71%). Among them 50% were in 1-4 years age group. Leptospirosis with hepatic encephalopathy was seen in one child and the child expired. The age group of the child was 1-4 years. Bilateral renal vein thrombosis following ALL was seen in a 5-year-old child and this child expired.

Table 4: Patient survival in different age group among ARF children admitted at ICH and HC, Chennai.

Age group	No. of cases (n=105)		Survival (n=91)		Mortality (n=14)		P value
	No.	%	No.	%	No.	%	
<1 years	17	16.19	13	76.47	4	23.52	
1-4 years	39	37.14	36	92.30	3	7.63	0.98
5-8 years	29	27.61	25	86.20	4	13.79	
9-12 years	20	19.04	17	85	3	15	

Table 5: Duration on oliguria in relation to prognosis among children with ARF: ICH and HC, Chennai.

Age group	No. of patients		Survival		Mortality		P value
	No.	%	No.	%	No.	%	
Non-oliguric	16	15.23	12	75	4	25	
Oliguric	89	84.76					0.02
< 7 days	66	27.61	62	93.93	4	6.06	
>7 days	23		17	73.91	6	26.08	

Table 6: Biochemical values or survivors and non-survivors among PD and non-PD in ARF ICH and HC, Chennai.

	PD Group (n=32)				Non PD Group (n=73)			
Biochemical investigation	Survivors (n=29)		Non-survivors (n=3)		Survivors (n=29)		Non-survivors (n=3)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
B. Urea mg/dl	103.2	52.57	114.6	57.84	99.57	50.76	105.6	53.2
S. Creatinine mg/dl	2.09	1.30	2.14	1.1	2.03	1.18	2.18	1.03
S. Bicarbonate mEq/L	27.5	1.42	27.3	1.21	27.07	1.39	27.15	1.28
S. Potassium mEq/L	4.6	4.85	6.09	6.73	4.3	4.64	6.14	6.17

The patient survival was analysed with regard to various age groups (Table 4). Children less than 1 year of age showed a poor outcome when compared to older children. Mortality was seen in 4/17 (23.52%) patients. The remaining 13 children survived. The children between 1-4 years of age showed an increasing mortality of 7.63%. The children above 5 years of age showed a slight increase in the mortality rate because of other associated infections. The mortality between 5-8 years was 13.79%. Between 9-12 years, there were 20 children, among them, 3 died accounting to 15% mortality. There was no statistically significant difference observed. (P = 0.98). Of all the main symptoms of ARF that altered the prognosis of children the duration of oliguria determines the mortality and morbidity in children. Out of 105 children with ARF 89 (84.76%) presented with oliguric renal failure. The remaining 16 children (15.23%) had non-oliguric renal failure (Table 5).

Among the non-oliguric renal failure, 75% of children survived. There were 62 children who survived out of the 66 children who have oliguria less than 7 days. But, the mortality was high, when duration of oliguria was more than 7 days. Out of 23 cases, 6 children died which accounts for about 26.8% mortality. There is a statistically significant association between the duration of oliguria and survival of patient (P = 0.02.)

Various biochemical investigations were done to document A.R.F and also to look for the recovery of patient. The biochemical values between the survivors and non-survivors among the children who had peritoneal

dialysis and who were treated conservatively (non-PD group) were analyzed (Table 6).

The children who had peritoneal dialysis (PD) generally had high blood urea when compared to non-PD group. The mean blood urea among the survivors of PD group was 103.2 mg/dl and the SD were 52.57. Whereas among the non-survivors of this group the mean blood urea was 114.6±57.84 mg/dl. In the non P.D. group, among the survivors, the mean for blood urea was 99.57±50.76 mg/dl and among the non-survivor in non P.D. group the mean blood urea was 105.6±53.2 mg/d1. The serum creatinine among the P.D. and non P.D. group were compared.

There were no significant differences in the values. But, the serum creatinine was little higher among the non-survivors when compared to the survivors. This showed that the mortality was higher when the serum creatinine was more. The serum bicarbonate was analysed and bicarbonate values also showed no significant difference between the PD group and non-PD group and also among the survivors and non-survivors. But, the serum potassium was found to be persistently high among the non-survivors in both the PD and non-PD groups. The mean serum potassium among the survivors of PD and non-PD were 4.6 and 4.3 mEq/1 but among the non-survivors, it was 6.09 and 6.14 mEq/l between the P.D. and non-PD group respectively. This clearly showed that the hyperkalemia was one of the important factors that determined the mortality in patients with renal failure.

Table 7: Biochemical investigation in relation to prognosis among ARF children: ICH and HC, Chennai.

Biochemical investigations	Survivors (Mean)	Non-survivors (Mean)
B. Urea mg/dl	110	129.42
S. Creatinine mg/dl	2.0	2.59
S. Bicarbonate mEq/L	15	12.9
S. Potassium mEq/L	4.5	5.1

The biochemical investigations were done to document ARF and also to look for the recovery of the patients. The blood urea, serum creatinine, serum bicarbonate and serum potassium were measured in all the patients. Among the survivors, the blood urea showed a mean of 110 mg/dl as compared to 129.42 mg/dl in non-survivors (Table 7). Serum Creatinine was also found to be more in the non-survivors (2.59 mg/dl) when compared to survivors (2 mg/dl).

Acidosis was noted in most of the patients with a mean of 12.9 mEq/l. Hyperkalemia was usually associated with children who are non-survivors was about 5.1mEq/l compared to about 4.5 mEq/l in survivors. The Serum creatinine was less than 4 mg% in 95 children and among them 10 children died accounting to 10.52% mortality (Table 8).

10 children presented with S. creatinine more than 4 mg/dl and among these 4 children died accounting to 40% mortality. The mortality was four times higher when the S. creatinine was above 4 mg/d1, when compared to those who had S. creatinine less than 4 mg/dl. There was a statistically significant association between S. creatinine and survival of the patients (P=0.03).

Table 8: Serum creatinine versus mortality among the ARF children ICH and HC, Chennai.

Serum creatinine (mgms/dl)	Number of children	Mortality		P value
		No.	%	
<4	95	10	10.52	0.03
>4	10	4	40	

Hyperkalemia was an important factor which contributed to the mortality. Serum potassium concentration of above 5.5mEq/l was seen in 16 children out of the 105 children. Out of these 16 children 4 died, accounting to 25% mortality (Table 9).

Table 9: Serum potassium versus mortality among ARF children: ICH and HC, Chennai.

Serum potassium	No. of cases	Mortality		P value
		No.	%	
>5 mEq/1	16	4	25%	0.14
<5.5 mEq/1	89	10	-	

There was no statistically significant association between potassium value and survival of the patient (P = 0.14).

Serum bicarbonate concentration was determined in all children with ARF. 14 children showed a bicarbonate of less than 15 mEq/L. Among them, there were only 2 deaths (14.28 %). This showed there was no statistically significant association between serum bicarbonate values and survival of patient (Table 10) (P = 0.59).

Table 10: Serum bicarbonate versus mortality among ARF children ICH and HC, Chennai.

Serum bicorbonate	No. of cases	Mortality		P value
		No.	%	
>15 mEq/1	14	2	14.28	0.59
<15 mEq/1	91	12	-	

Peritoneal dialysis is one of the main modes of treatment of children with ARF. Still some children could be treated conservatively without the peritoneal dialysis. In our study, out of the 105 children, 73 children (69.52%) were treated by conservative or non-dialysis methods (Table 11).

The remaining 32 children, accounting to 30.47% required dialysis. Among this dialysis group, 62.5 % of

children recovered with one P.D. session, but 11 out of 32 children required 2 P.D. sessions and only one child required more than 2 sessions which accounted to 3.12%.

The outcome of this peritoneal dialysis was analysed. Out of the 32 children who had PD, 29 children (90.62%) survived and only 3 children died (10.34%). But, in those children who were treated conservatively, out of 73 children, 62 survived and the remaining 11 children expired. This accounted to 15.06% (Table 12).

On general analysis it was seen that peritoneal dialysis improved the outcome. But, there was no statistically significant difference in outcome between the peritoneal dialysis (PD) and non-PD groups (P = 0.33).

Table 11: Treatment modality for ARF: ICH and HC, Chennai.

Treatment modality	No. of children (total 105)	%
Non-dialytic (conservative)	73	69.52
Dialytic	32	30.47
1 PD session	20	62.5
2 PD Sessions	11	34.37
>2 PD sessions	1	3.12

Table 12: Outcome of peritoneal dialysis among ARF: ICH and HC, Chennai.

Treatment modality	Total children	Survivors		Non-survivors		P value
		No.	%	No.	%	
Total children	105	91	86.66	14	13.33	0.33
Peritoneal dialysis	32	29	90.62	3	10.34	
Non-PD	73	62	84.93	11	15.06	

ARF, when associated with systemic complications, the mortality went very high (Table 13). The usual systemic complications were infections like respiratory, urinary tract infections or peritonitis. The neurological complications like pyogenic meningitis and encephalopathy result in very high mortality. In the present study, out of 105 children with ARF, there were 47 children (44.76%) who had associated systemic complications. Respiratory complications like bronchopneumonia or pneumonitis were seen in 10 children and had a mortality of 30%. UTI was seen in 26 cases and only 2 children presented with peritonitis.

Table 13: ARF with systemic complications among ARF children ICH and HC, Chennai.

Systemic complication	No. of children	Mortality	
		No.	%
Infection			
Respiratory infection	10	3	30
UTI	26	3	11.53
Peritonitis	2	1	50
Neurological			
Pyogenic meningitis	2	1	50
Convulsions	2	4	57.14
Total children	47	12	

Pyogenic meningitis and convulsions gave a very bad prognosis and there were 9 children who presented with these complications. Of them, 5 children expired, accounting to 50% with meningitis and 57% with convulsions. So, the percentage of children with systemic complications who died was 25.53% (Chi- square value = 9.13, P = 0.003). When there was a systemic complication the mortality was found to be more when compared to those who did not have. The difference was found to be statistically significant (P = 0.003.).

DISCUSSION

Acute renal failure is one of the important disease in the causation of mortality and morbidity in children. Various conditions leading on to ARF by themselves can lead on to various other non-renal complications thereby contributing to mortality and morbidity. In a modern world with advancement in technology one should expect everyone to prevent acute renal failure from occurring.

Pre-renal azotemia and intrinsic renal failure continue to play a major role in causing morbidity and mortality in children. In the present study, the maximum number of cases of ARF was reported between the ages of 1 to 4 years. This is correlated with the studies conducted by Corlos et al and Trornpeter et al.[1,2] This is because of the increased incidence of acute glomerulonephritis in this age group. This acute glomerulonephritis is usually secondary to skin infection occurring in these children.

With regard to the sex distribution, the males are predominantly affected when compared to females. This fact of male predominance is consistent with the observation by Arora P et al.[3] Study conducted by Kandoth et al also showed male preponderance in the ratio of 1.8:1.[4] There are few other studies which also found out that males are more affected like Lewy JE et al.[5] Whereas the study conducted by Gallego N et al

showed that there is no sex predilection among the ARF cases.[6]

ARF can occur due to number of causes. The most common being acute glomerulonephritis, followed by acute tubular necrosis following diarrheal dehydration, posterior urethral valves, post-surgical etc. In the present study, acute glomerulonephritis is the leading cause of ARF. Present study is being substantiated by the study conducted by Shah BV et al and Mahakur et al.[7,8] His study also showed that acute glomerulonephritis is the leading cause of ARF in older children. But the study conducted by Arora P et al showed hemolytic uremic syndrome as the commonest cause of ARF.[3] Niqudat P et al also showed that H.U.S as the commonest cause of ARF for which he attributes mostly due to the precipitating factor like diarrhoea and high incidence of HUS may be probably due to poor socioeconomic conditions and poor sanitary facilities, leading on to diarrhea.[9] HUS is a cause of ARF only in less than 10% of cases in the present study. This is because of recognition of complication earlier and efficient treatment of acute watery diarrhea. HUS found to be a bad prognosticator by Trornpeter RS et al, he gives a mortality of 30%". But in our study a mortality of less than 10% was noted.[2]

The patient survival is very poor when the child is less than l year of age. This fact is well appreciated in the present study. This fact is also stressed by number of other studies by Chang JCM et al, Kandoth PW et al Shah BV et al and Galligo N et al.[10,4,7,6] All these authors stressed the importance of ARF in children less than 1 year of age.

The increased mortality in this age group may be probably related to the increased incidence of associated systemic complications, delay in identifying high risk problems and functional or structural immaturity of the infant kidneys. The survival is better when the child is between 1 to 4 years of age because the most important cause of ARF in this period is due to acute glomerulonephritis. AGN is usually a benign disorder and recovery is a rule in this condition.

One of the important symptoms of ARF is oliguria. But, absence of oliguria does not rule out ARF. Nonoliguric renal failure is a well-known entity and is seen commonly following septicemia, PUV and the use of nephrotoxic drugs. The commonest presentation of ARF in the present study is oliguria. This fact is being stressed by Kandoth PW et al who also finds oligoanuria as the commonest presentation in their study.[4] The prognosis is better when the duration of oliguria is very short. This is consistent with Shah BV et al.[7]

Non-oliguric renal failure had a high mortality because it was the manifestation of underlying serious problem. The delay in diagnosing ARF in these children adds to increased mortality.

Out of 105 children, 73 children (69.52%) had non dialysis management and only 32 children (30.47 %) had dialysis therapy. This grouping was not decided by random allotment. Children coming with severe renal failure with serious complications were given dialysis therapy. Children with mild to moderate renal failure with less associated features received conservative therapy. So, to analyze the benefits of peritoneal dialysis in general cannot be derived. But, overall analysis between the two groups can be formulated. When the blood urea and serum creatinine were very high, dialysis was the main mode of treatment and the mortality was less. Children treated by conservative measures had slightly higher mortality. But, the initial urea and creatinine values of the blood are likely to reflect the extent of renal damage which means more the initial urea and creatinine, severe would be the renal damage.

Hyperkalemia was one of the factors that went in favour of increased mortality. Transient hyperkalemia was noted in children with acute glomerulonephritis. This fact is stressed by Lewy et al and Don BR et al.[5,11] These authors specifically mentioned that hyperkalemia is a transient phenomenon in the children with AGN and is due to altered renin-aldosterone axis.

Serum bicarbonate measurement revealed that there were no significant changes in both the groups of survivors and non-survivors in the present study. But, studies done by Pereira BJ et al and Rizvi et al show that metabolic acidosis has a poor prognosis.[12,13]

One another factor that alters the mortality of ARF is associated systemic complications like respiratory, urinary tract infections, peritonitis and central nervous system disorders. In the present study, about one fourth of children with systemic complication had died. Studies by Arora P et al, showed that CNS and respiratory complications were bad prognostic factors.[3] Other studies by. Kandoth PW et al and Shah BV et al also stressed this fact to a major extent.[4,7]

Surgery is always a risk factor leading on to ARF. In the present study we had 5% of cases of ARF after surgery. The high-risk factors leading to ARF include hypovolemia, sepsis or exposure to nephrotoxic drugs. This fact is enforced by Sambhik et al, and showed that the urosurgery, open heart surgery and gastric surgeries are common causes.[14]

CONCLUSION

To conclude that Acute renal failure is one of the important cause of mortality and morbidity in children. Male children with acute renal failure are more seen probably as they are more brought to the hospital for treatment than female children. Acute glomerulonephritis is the common cause of ARF followed by acute tubular necrosis. Acute watery diarrhoea is the leading cause of ARF due to acute tubular necrosis. Patient survival is

very poor in infants with acute renal failure. Non-oliguric ARF is usually diagnosed by index of suspicion and by periodic biochemical monitoring. The mortality in non-oliguric ARF is usually due to basic precipitating cause like septicemia. In oliguric ARF, if the duration of Oliguria is more than 7 days the prognosis is poor. So early referral to major centres even with 1-2 days oliguria and early treatment will improve the prognosis. Peritoneal dialysis in severe ARF with associated complications really helped the children. Peritoneal dialysis was given when ARF was severe and not by simple categorization into PD group and non-PD group by random allotments. High serum creatinine at the time of admission to the hospital and hyperkalaemia were associated with bad prognosis. Associated systemic complications and background sepsis play a major negative role in the prognosis.

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