PATTERN OF ACUTE RENAL FAILURE AT A REFERRAL HOSPITAL

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ABSTRACT

Fifty two children (upto 12 years age) with acute renal failure (ARF) admitted to the Nephrology services between January, 1989 to August, 1992 were studied to determine the cause and outcome. Of these, 39 were boys and 13 girls; 27 (51.9%) patients were below 4 years of age. Hemolytic uremic syndrome (HUS) was the commonest cause of ARF (30.8%) followed by acute tubular necrosis (ATN) in 28.84% and acute gloinerulonephritis in 19.23%. All patients had severe renal involvement with anuria in 53.6% and oliguria in 46.4% at presentation. HUS was the leading cause of anuria (53.6%), followed by obstructive uropathy (21.4%). Thirty five patients required dialytic support for a median duration of 18 days (2-90 days). The mortality was 34.6%. Seven patients of HUS, 4 patients of ARF following surgery, 3 patients each of ATN and glomerulonephritis and one patient of obstructive uropathy died. Anuria at onset, central nervous system or respiratory complications and delay in institution of dialytic support were bad prognostic factors. We conclude that early referral and prompt institution of dialytic support may be helpful in decreasing the mortality.

Key words: *Acute renal failure, Hemolytic uremic syndrome, Peritoneal dialysis.*

Acute renal failure (ARF) is one of the commonest life threatening conditions seen in childhood. Proper assessment, adequate and timely treatment is highly rewarding. Etiology of ARF varies in different parts of the world. Traditionally gastroenteritis and infections are amongst the common causes in developing countries including India, while in the developed world, complications of major surgery and hemolytic uremic syndrome (HUS) are important causes of ARF in the developing countries(2). The present study was undertaken to define the pattern, course and outcome of ARF as seen in a tertiary referral centre in Northern India.

Material and Methods

All patients of ARF up to the age of 12 years admitted or referred to Nephrology Unit during the period January 1989 to August 1992 were included in the study. ARF was clinically diagnosed when serum creatinine concentration rose to more than 2.0 mg/dl acutely with or without oliguria. Patients with chronic renal insufficiency or those initially considered to have ARF but subsequently found to be suffering from long standing renal disease were excluded from the study.

All patients were investigated to determine the cause of ARF. Investigations done included hematological profile, urine examination, urinary indices, blood urea nitrogen, serum creatinine, serum electrolytes

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ind ultrasonography of the kidneys. Complement (C_3) level, ASO titre, Widal test, serum amylase were done whenever indicated. Investigations for intravascular hemolysis included hematocrit, reticulocyte count, complete blood counts, urinary hemoglobin and serum bilirubin estimation. Blood, urine, throat swab and stool were cultured to isolate any microorganisms. Kidney biopsy was done in 14 patients. The indications of biopsy were presence of prolonged oligoanuria (more than 2 weeks) and the clinical suspicion of illness other than acute tubular necrosis (ATN). The diagnosis of HUS was based on presence of the thrombocytopenia and microangiopathic hemolytic anemia. Glomerulonephritis was suspected when patients presented with acute nephritic syndrome, urine examination showing red blood cells (RBC) and RBC casts, proteinuria of more than 1 g/24 h and suggestive immunological parameters like low levels of complement (C_3) and raised ASO filter. Diagnosis was confirmed by histopathological examination when considered necessary. Acute tubular necrosis was diagnosed based on the initial presentation of the disease and exclusion of other causes. Oliguria was defined by urine output less than 1.0 ml/kg/h. Management of patients included correction of electrolyte imbalance, anemia and control of hypertension. Dialysis was done whenever indicated. All but one patient underwent peritoneal dialysis. The interval between development of uremic symptoms and institution of peritoneal dialysis was defined as time lag. Indications of dialysis included encephalopathy, intractable fluid overload, acidosis, hypertension and azotemia in various combinations. Peritoneal dialysis was done by surgically placed Tenckhoff catheter using either closed manual delivery system or peritoneal dialysis cycler (JMS PDO2).

Attempt was made to find out the poor prognostic factors. Children of ARF who recovered or died were compared for age, presence of anuria, central nervous system (CNS) and respiratory complications, hyperkalemia, metabolic acidosis, peak serum creatinine and time lag. between need and institution of dialysis. Hyperkalemia was defined as serum potassium more than 5.5 mEq/L with suggestive electrocardiographic changes. Diagnosis of metabolic acidosis was based on presence of acidotic breathing without any evidence of pulmonary congestion on chest X-ray and/or improvement of acidotic breathing after dialysis. In few cases it was confirmed by arterial blood gases. CNS complications included convulsions or altered sensorium. Respiratory complications were taken as presence of bronchopneumonia or need for respiratory support.

Data not distributed normally was converted into log and checked for normality. Student's 't' test and Chi square test were used for statistical analysis.

Results

Children with ARF comprised 19.4% of all patients of ARF patients admitted or referred to nephrology services during this period. There were 39 boys and 13 girls. Twenty seven (51.9%) patients were below four years, 16 (30.8%) between 4 and 8 years and 9 (17.3%) above 8 years of age. No neonate was referred to us during this period of the study. The various causes of renal failure are listed in *Table I.* IIUS was the commonest cause of ARF (30.8%), followed by ATN (28.8%) and glomerulonephritis (19.2%). All patients of HUS in this study were postdystolic. All patients with HUS had leukocytosis (range 13500-62000 cu mm), anemia and thrombocytopenia. Ten

TABLE I-*Etiology of Acute Renal Failure*

Condition	No. of patients	Percentage
Hemolytic uremic syndrome	16	30.8
Acute tubular necrosis	15	28.8
Acute gastroenteritis	13	25.0
Acute pancreatitis	1	1.9
Nephrotic syndrome	1	1.9
Glomerulonephritis	10	19.2
Acute postinfectious glomerulonephritis	6	11.5
Crescentic glomerulonephritis	4	7.7
Obstructive	6	11.5
Posterior urethral valve	5	9.6
Rhabdomyosarcoma of bladder	1	1.9
Post-operative	5	9.6

patients with HUS had CNS manifestations in the form of convulsions (n=4), and altered sensorium (n=6). Computerized tomography of head done in 4 patients showed intracerebral bleed. Amongst the causes of ATN, gastroenteritis was the commonest. All the patients had received fluids at primary or secondary health care centres and had presented in established renal failure. One patient had ATN following acute pancreatitis. Five patients (9.61%) developed ARF following correction of complex congenital cardiac anomalies. Amongst the glomerulonephritis causing ARF, AGN accounted for 6 cases and crescentic nephritis was responsible for 4 cases (2 were postinfectious, 1 each membranoproliferative and idiopathic).

The causative factors of ARF were related to age. HUS was the commonest cause of ARF below 4 years of age, ATN between 4 to 8 years of age and glomerulonephritis above the age of 8 years *(Table II).*

All the patients were either oliguric (46.4%) or anuric (53.6%) at presentation. HUS was the leading cause of anuria in this study (53.6%), followed by obstructive uropathy (21.4%). Three patients (10.7%) of crescentic glomerulonephritis and ATN each and 1 patient of acute glomerulonephritis (AGN) had anuria at presentation.

Thirty five (67.3%) patients required dialytic support. The median duration of peritoneal dialysis was 18 days (range 2-90 days). Thirty (57.1%) of 52 patients recovered completely, 18 (34.6%) children died, and 4 could not continue treatment due to financial constraints and were lost to follow up. Seven patients of HUS, 4 patients of ARF following surgery, 3 patients each of ATN and glomerulonephritis and 1 patient of obstructive uropathy died. Clinical predictors of poor outcome are shown in *Table III.* Patients who presented with anuria, had CNS or respiratory complications at presentation or during the course of illness and in whom there was a delay in providing the dialytic support had a poor prognosis.

TABLE II-*Causes of Acute Renal Failure in Different Age Groups*

Etiology	0-4 years (n=27)	4-8 years (n=16)	8-12 years (n=9)
Hemolytic uremic syndrome	11 (40.74)	2 (12.5)	3 (33.34)
Acute tubular necrosis	6 (22.22)	9 (56.25)	
Glomerulonephritis	2 (7.41)	3 (18.75)	5 (55.55)
Obstructive	6 (22.22)		
Post -operative	2 (7.41)	2 (12.50)	1 (11.11)

Figures in parentheses indicate percentages.

TABLE III-*Prognostic Factors of Acute Renal Failure*

Parameters	Recovered (n=30)	Death/LAMA (n=22)	p value
Age in mo (range)	48 (4-144)	42 (16-120)	NS
Anuria (%)	40	72.7	0.05
Peak serum creatinine (range) (mg/dl)	6.4 (2.1-18.9)	6.1 (2.2-18.8)	NS
Complications			
CNS	1/30	13/22	0.001
Respiratory		7/22	0.001
Hyperkalemia	5/30	3/22	NS
Acidosis	4/30	4/22	NS
Time lag between need and institution of dialysis (days)	3 (1-8)	8 (5-11)	0.05

Values are as median and range.

Prognosis in HUS patients was particularly poor, only 5 of 16 patients recovered, 7 died and 4 left against medical advice because of non recovery of renal function after 4 weeks of dialytic support. Predictors of poor outcome in these patients were the presence of CNS complications and time lag between the need and institution of dialysis *(Table IV).*

Discussion

The etiology, course and outcome of ARF are closely linked to the socio-economic and environmental conditions in a given geographical location. Hemolytic uremic syndrome has been observed as a major cause of ARF in western countries, while diarrheal disease has been described as a

TABLE IV-*Prognostic Indicator of HUS*

Parameters	Recovered (n=5)	Dead/LAMA (n=11)	p value
Age in mo (range)	18(6-72)	30 (6-120)	NS
Total leucocyte count/cu mm (range)	17000 (13600-22600)	2500 (19800-62000)	
Peak serum creatinine (range) *(mg/dl)*	8.6 (5.4-10.2)	7.6 (4.3-10.3)	NS
Complications			
CNS	1/5	9/11	0.05
Respiratory	0/5	2/11	NS
Hyperkalemia	1/5	2/11	NS
Acidosis	1/5	1/11	NS
Time lag between need and institution of dialysis (days)	3 (2-3)	9 (5-11)	0.01

Values are as median and range.

cause of ARF in children in 35-50% of patients in developing countries including India(l,3)- The magnitude of this problem can be appreciated by the fact that in tropics 220 diarrheal episodes and 1.4 deaths occur per 1000 children every year(4). The poor socioeconomic condition, the lack of clean pipe borne water supply, ignorance about personal hygiene, overcrowding and inadequate medical facilities are some of the factors that are responsible for the high prevalence of diarrheal diseases in third world countries(5). Recently, there are reports showing change in etiology of ARF in developing countries also, Srivastava *et al.* had shown HUS to be most important cause of ARF(2). In this study also HUS was responsible for 30.8% of ARF patients, while gastroenteritis was the cause in 25% of patients. This could be due to general improvement in the standard of living, early use of oral rehydration therapy in primary health centres. Kandoth *et al*. have shown AGN to be the commonest cause of ARF in their study followed by gastroenteritis(6). Glomerulonephritis was an important cause of ARF in this study (19.25%) also. In western countries the incidence of post streptococcal acute glomerulonephritis has considerably declined due to better hygienic conditions but this still remains a common disorder in the developing countries(7). Choudhary *et al.* observed acute glomerulonephritis to be responsible for 27.4% of ARF patients(l). ARF following correction of complicated congenital cardiac anomalies is important cause in western countries, observed in 4.3-8% of children undergoing cardiopulmonary bypass (CPB) surgery(8). In this series, cardiopulmonary surgery was the cause of ARF in 9.6% of patients.

Thirty five (67.5%) patients required dialytic support. Peritoneal dialysis was done by using surgically placed Tenckhoff catheter. All patients were given one hourly

exchange till they stabilized and then 10 one hourly exchange/day. Mean duration of dialysis was 18 days, thus justifying the use of surgically placed catheter. Peritoneal dialysis using the modified method of 10 hourly exchanges/day decreased incidence of infection and made children more comfortable and mobile(9).

Mortality in this study was 34.6%, and 4 (7.6%) discontinued treatment due to financial constraints. This is a peculiar situation in the developing countries. Poor outcome in postdysenteric HUS may be due to more prolonged injury. However, other factors including late referral of patients, serious infections, protracted dysentery with resulting malnutrition and higher incidence of intestinal complications could be contributory. In our patients leucocytosis, presence of CNS complications and increased time lag between need and institution of dialysis were harbingers of poor prognosis. Similarly, high mortality has been shown by Srivastava *et al.* who found poor outcome in patients with prolonged anuria and total renal cortical necrosis(2). This high mortality of HUS could be related to the fact that milder cases of HUS may not be referred to tertiary care centre like ours. Mortality in patients who developed ARF following correction of complex congenital cardiac anomalies was very high (80%). Similar high mortality has been shown by others(10). The mortality is greatly influenced by underlying illness which was responsible for initial development of ARF. In our study, all 4 patients who died post CPB surgery died within 3 days signifying severe underlying cardiac disease. Similar high mortality in ARF children (43.5%) has been shown by Kandoth *et al.(6).* They found presence of neurological manifestions, hypotension and female sex to be indicators of poor outcome. In other studies, metabolic acidosis has been found to be a poor prognosticator(ll). A multivariate analysis of prognostic factors in children had found assisted ventilation and need for dialysis to carry a poor prognosis(12). In this study also, ventilatory support proved to be a poor prognostic marker.

To conclude, HUS was the commonest cause of ARF in children, followed by ATN due to gastroenteritis and glomerulonephritis. Mortality rate was 34.6%. Early referral of these patients may be helpful in decreasing the mortality.

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