ACUTE RENAL FAILURE IN CHILDREN REQUIRING DIALYSIS THERAPY

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ABSTRACT

A prospective study over two and a half years analysed 48 children of acute renal failure requiring dialysis therapy. The mean age was 3 years 9 months and M : F ratio was 1.8 : 1. Renal causes predominated, accounting for 65%, with prerenal andpostrenal causes responsible for 19% and 16%. Acute glomerulonephritis was seen in 13 cases, hypovolemia secondary to gastroenteritis in 9, tubular necrosis in 6, and hemolytic uremic syndrome in 5. A delay in seeking medical attention was present in as many as 48%, and was especially common with female children. All had oligo-anuria, with fluid overload present in 18.7%, hypertension in 23%, hypotension in 16.6%, neuropsychiatric manifestations in 20%, and infections in 47%. Peritoneal dialysis was carried out in 95%, and hemodialysis in 6.2%. Urine output and renal function returned to normal within 1.5 to 16 days (mean 5.9) in the survivors. Of the 28 who survived, 19 were followed up regularly for a mean of 4.25 months and all except one had normal renal function. Factors associated with a poor prognosis included female sex, age <1 year, neurological manifestations, and hypotension, though these were not statistically significant. Mortality in our series was 41.5%. While etiological factors have shown changing trends, mortality still remains high inspite of dialysis.

Keywords: *Renal failure, Acute, Dialysis.*

Acute renal failure (ARF) is the most important condition in pediatric nephrology seen in hospital practice(l). The causes of ARF and its outcome vary from place to place and have shown changes with time(l,2). Dialysis therapy has changed the outlook for ARF somewhat; however, dialysis, especially hemodialysis, is not as easy proposition in children at centres with limited resources and inadequate expertise. We wish to record our experience with ARF requiring dialysis in children in recent times.

Material and Methods

This prospective study conducted over a two and a half year period, comprised of 48 children undeMhe age of 12 years with ARF requiring dialysis therapy.

The diagnosis of ARF was Wased on rapidly progressing azotemia (rise of serum creatinine by at least 0.5 mg/dl/day and BUN by 10^mg/dl/day) and usually but not always associated with oliguria(3). Cases of acute on chronic renal failure were excluded. Each patient underwent detailed clinical, hematological and biochemical evaluation. Biochemical tests were repeated daily till they returned to normal. Urine analysis was carried out in all cases where the urine could be collected for examination. Fractional urinary clearance indices were not utilized. In relevant cases, coagulation profile and specialized investigations such as renal ultrasound, intravenous urography,

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micturating cystourethrography and kidney biopsy were carried out. The treatment modality used (hemo or peritoneal dialysis), the response to treatment, and ultimate outcome were also noted. Autopsy was carried out in all the children who died. Bad prognostic factors were evaluated and their statistical significance tested by the Chi-square test.

Results

Of the 48 children, 31 were male and 17 female, giving a M : F ratio- of 1.8 : 1. The mean age was 3 years 9 months, ranging from 3 days to 12 years, including 3 neonates. Infants comprised 43% of the total, followed by children in the 5-12 year age group (33%). Under 1 year of age, males and females were seen in almost equal proportion, whereas males dominated in the older age groups. All the cases of hemolytic uremic syndrome (HUS) were < 3 years of age. Almost all the prerenal cases (88%) occurred below 1 year of age, while 77% of the cases of acute glomerulonephritis (AGN) were between 5-12 years of age. Half the cases of post renal obstructive uropathy presented in the first year of life, but a quarter had a delayed presentation beyond 5 years.

Table I depicts the etiological causes of ARF in our patients and their correlation with mortality. Renal causes accounted for 65%, of which AGN was the commonest, followed by acute tubular necrosis (ATN) and HUS. All prerenal cases were due to hypovolemia secondary to acute gastroenteritis (AGE), and posterior urethral valves accounted for 75% of the cases of obstructive uropathy. The maximum mortality was with ATN and HUS.

Oligo-anuria was a presenting feature in all our children. Only 52% presented within 48 hours of the setting in of oligo-anuria, while 27% had oligo-anuria of 48-96 hours duration and 21% greater than 96 hours. A clear sex bias was seen here, with 67% of boys and only 23.5% of girls being brought within 48 hours of oligoanuria. Fluid overload was seen in 18.7% of the cases seen in our series. Hypertension was present in 23%, hypotension in 16.6%, neuropsychiatric manifestations in 20%, infections in 47%, and bleeding disorders in 4.2%. Hyperkalcmia was seen in 31%, hypokalemia in 16.6%, mild acidosis in 35%, and severe acidosis (pH<7.20) in 48%. BUN levels were between 60-120 mg/dl in the majority (62.5%). Urine samples for analysis could be collected in 36 of the 48 cases. Of these, 1/3 had pus cells and positive cultures indicative of infection. Proteinuria >2+ and casts were found in 5 cases, while 8 samples showed hematuria with RBC casts. Eleven patients had no specific find-

TABLE I–*Etiology of ARF and Mortality*

Etiology	n	Died
Prerenal	9	3
Renal		
AGN	13	3
ATN	6	5
HUS	5	4
Chronic GN	3	1
Others	4	2
Post Renal		
Posterior Urethral valves	6	2
Others	2	-
	48	20

ings on urinalysis. Renal biopsy, done very selectively in just 5 cases, was helpful in arriving at a diagnosis in all, revealing lupus nehpritis, recovering glomerulonephritis, focal proliferative glomerulonephritis, cortical necrosis, and adult type polycystic kidney in 1 case each. Ultrasound studies, carried out on 23 patients, corroborated the clinical diagnosis in 20. Cystourethrograms were done in all post renal cases, and revealed posterior urethral valves in 6, associated vesico ureteral reflux (VUR) in 4, isolated VUR in 1, and pelviureteric junction obstruction in 1.

All the patients were subjected to dialysis therapy. Peritoneal dialysis (PD) alone was used in 45 cases, hemodialysis (HD) alone in 2, and both PD and HD in 1 case. HD was used only in specific situations, such as poor response with PD or peritonitis. In 33 children, only 1 cycle of PD was required; 10 needed it twice and 3 patients thrice or more. The time taken for urine output and renal function to return to normal in survivors was 5.9 days on average, ranging from 1.5 to 16 days. Mean duration of stay was 13.7 days.

As already shown in *Table I*, 20 patients expired, giving a mortality rate of 41.5%. Certain factors were associated with a bad outcome in a high percentage of patients. These are listed in *Table II,* and included age <1 year, female sex, neurological involvement, hypotension, and a diagnosis of ATN or HUS. None, however, were statistically significant. Other potentially adverse factors such as prolonged anuria, severe azotemia, or hyperkalemia were associated with similar mortality in patients with or without these features. Nineteen of the 28 survivors could be followed up for a mean of 4.25 months; only one went into chronic renal failure (CRF) and all the others had normal renal function. Postmortems on children who died revealed normal histology in 3, ATN in 5, HUS in 4, tuberculosis and polycystic disease in 1 each, and others in 3.

TABLE II—*Factors Associated with High Mortality*

Parameter	n	Died	%
1. Age			
<1 year	21	12	57.1
>1 year	27	8	29.6
2. Sex			
Female	17	11	64.7
Male	31	7	22.5
3. Cause			
ATN/HUS	11	9	81.8
Others	37	11	29.7
4. Neuropsychiatric manifestations			
Present	10	8	80.0
Absent	38	12	31.5
5. Hypotension			
Present	8	7	87.5
Absent	40	13	32.5

Discussion

It is interesting to note that all studies in India have found a strong male preponderance(4,6) as opposed to foreign studies, which have in fact shown a slight female preponderance(7,8). Both sex bias against girl children in India as well as different etiologies leading to ARF abroad may account for this. Infants comprised a high percentage of our total (43%), higher than the 29% reported by Shah *et al.(4)* but similar to the 36% of Deb *et al.*(6). Studies

emanating from pediatric rather than nephrology or dialysis units probably report a greater number of young children.

Etiological causes of ARF in our series appear to be different from what has been previously reported in India(1,5) and from our own institute(4) a decade ago. This appears to hold true even when taking into account the fact that some series (including ours) were restricted to only dialysis treated patients. Thus, Srivastav *et al*.(l,5) and Shah *et al.(4)* reported that AGE was responsible for 27% and 48% of ARF, respectively, of which the latter was from a dialysis unit. Our figure of 18.3% is similar to the 19% recently reported by Deb *et al.(6)* in patients treated conservatively only. Conversely, renal causes of ARF were higher in our study (65%), than what was seen a decade ago (30-43%)(1,4,5). A recent study by Gulati *et al.* (9) combining patients of ARF treated conservatively or with dialysis or both also found that 74% of cases were renal in origin. This suggests that *(a)* patient characteristics are similar even when comparing the more severe dialysis group with cases treated conservatively; and *(b)* the largely preventable prerenal group of cases is on the decline. Postrenal and post operative cases of ARF remain comparatively rare in our country(l).

Clinical features and complications seen by us were within the previously reported ranges(4,9-ll), keeping in mind the wide variations between different series. We had an unusually higher number of patients with hypotension and hypokalemia. Since all of these were seen in patients developing ARF due to gastroenteritis, they appear to be manifestations of the primary disease itself rather than ARF. Singh *et al.* (12) found that patients with renal dysfunction in gastroenteritis had hypokalemia in 15%, very similar to our figure. Delays in treatment occurred in an abysmally high percentage (48%) of our study group; identical to what was seen by Shah *et al.* (13) a decade ago of our institute and still much higher than the figure of 20% reported by Counahan *et al*.(10) in the seventies. Even more regretable is the clear sex bias seen where males comprised 84% of those brought within 48 hours of oligo-anuria. It is evident that considerable education of parents and doctors is still needed to change these trends.

PD was the modality of treatment used in the overwhelming majority because of its clear advantages over HD in children(2). Good results were seen with PD in our study, similar to those obtained by Day *et al.* (14), and with a low incidence of complications. Mortality in ARF has varied from 10-60%(4,9), with a decline seen over the years, especially in western countries(15). Our mortality rate of 41.5%, though lower than the 60.8% reported previously from KEM Hospital is still quite high. Those who survived however, did better with 94.7% of those followed up having completely recovered and 5.3% going into CRF. These results are slightly better than those of other workers, who reported complete recovery in 51-90%(5,14), and CRF in 7-15%(5,7,10). From *Table II,* it can be seen that much higher mortality was present in girl children, infants, ARF due to HUS/ATN, and those with neuropsychiatric manifestations or hypotension. Both Shah *et al*. (13) and Deb *et al.(6)* have found young age to be an indicator of poor outcome, and both have implicated prolonged oligo-anuria as well. Hypotension correlated with high mortality in Deb's study(6) also, and neurological abnormalities and infections had a poor prognosis in the studies of Were *et al.(8)* and Shah *et al*.(13). Hodson's study,

however, found that no parameter could be used in indicating the prognosis for ARF(15).

To conclude, our study findings indicate that etiological factors for ARF have changed to a pattern more similar to that seen in western countries, but delay in instituting appropriate treatment is still frequent. Mortality remains high, which is regrettable as a good outcome is likely if the patient survives the acute phase.

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