

Clinical and Etiological Profile of Renal Failure in Children

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Abstract

Introduction: Acute renal failure (ARF) is a syndrome characterized by acute decline in glomerular filtration rate leading to the retention of nitrogenous wastes such as urea and creatinine.

Materials and Methods: 59 patients who fulfilled the diagnostic criteria were studied between the age group of 3 months and 18 years during the study period, i.e., March 2011 to October 2012.

Results: The results are well explained in the article using various tables and sufficient explanation.

Conclusion: The most common cause for ARF is acute glomerulonephritis (GN), in which post-streptococcal GN is common. Increased awareness about gastroenteritis, oral rehydration salts, and early referral to tertiary hospital by effective management at tertiary level leading to decreased incidence of RF with acute gastroenteritis.

Key words: Acute renal failure, Chronic glomerulonephritis, Chronic kidney disease, End-stage renal disease, Pediatrics

INTRODUCTION

Acute renal failure (ARF) remains an important clinical problem with little progress made in the therapeutic approach over the past 20–30 years. Data on the epidemiology of chronic kidney disease (CKD), which is a serious health problem and refers to a condition related to irreversible kidney damage that further progress to end-stage renal disease in children, are insufficient and data that are available were based on hospital records.^[1-8] The aim of this study is to study the Clinical and Etiological profile of Renal Failure Outcome of patients with RF.

MATERIALS AND METHODS

1. Cases from Pediatric Department, it is a prospective study.
2. Children who fulfilled diagnostic criteria for RF from March 2011 to August 2012.

3. 59 patients satisfying the diagnostic criteria were studied. Each patient was assessed with the help of detailed pro forma which included.

- i. History
- ii. Physical examination
- iii. Investigations.

Inclusion Criteria

3 months to 18 years children were included in this study.

Exclusion Criteria

The exclusion criteria were as follows:

- <3 months and >18 years children
- Trauma cases
- Post-operative cases.

Diagnostic Criteria

ARF: Doubling of serum creatinine level for that age [Table 1].

Chronic Renal Failure (CRF)

Creatinine clearance (glomerular filtration rate [GFR]) below 50 ml/1, 73 m²/minute. Persisting for more than 3 months, using Schwartz formula 2.

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Schwartz formula:

Creatinine clearance = $k \times \text{length in cm} / \text{Sr.creatinine mg/dl}$

For infants $k = 0.45$; children up to 13 years $k = 0.55$; Adolescent male children $k = 0.7$.

RESULTS

59 patients who fulfilled the diagnostic criteria were studied between the age group of 3 months and 18 years during the study period, i.e. March 2011 to October 2012.

During the study period, 4973 cases were admitted in pediatric department, out of these 59 patients presented with renal insufficiency that accounts for 1.2%.

Out of these, 49 cases were ARF and the remaining 10 cases were due to CKD [Table 2].

Table 1: Normal serum creatinine levels for different age groups

Age in years	Girls	Boys
1	0.35±0.05	0.41±0.12
2	0.45±0.07	0.43±0.12
3	0.42±0.08	0.46±0.11
4	0.47±0.12	0.45±0.11
5	0.46±0.11	0.50±0.12
6	0.48±0.11	0.52±0.12
7	0.53±0.12	0.54±0.14
8	0.53±0.11	0.57±0.16
9	0.55±0.11	0.59±0.16
10	0.55±0.13	0.61±0.22
11	0.60±0.13	0.62±0.14
12	0.59±0.13	0.65±0.16
13	0.62±0.14	0.68±0.21
14	0.65±0.13	0.72±0.24
15	0.67±0.22	0.76±0.22
16	0.65±0.15	0.74±0.23
17	0.70±0.20	0.80±0.18
18–20	0.72±0.19	0.91±0.17

Table 2: Number of cases

Total no. of cases	59	%
ARF	49	83.1
CKD	10	16.9

ARF: Acute renal failure, CKD: Chronic kidney disease

Table 3: Age distribution

Age group	No. of patients	ARF (%)	CKD (%)	Total
3 months – 5 years	14	12 (20.3)	2 (3.4)	23.7%
6 years – 10 years	16	13 (22)	3 (5.1)	27.1
11 years – 18 years	29	24 (40.6)	5 (8.6)	49.2

The maximum percentage of patients was between the age of 11 and 18 years, i.e., 29 (49.2%).

The maximum percentage of patients with ARF were inbetween the age group of 11 and 18 years, i.e., 24 (40.6%). The maximum percentage of patients with CKD were inbetween the age group of 11 and 18 years, i.e., 5 (8.6%).

The minimum percentage of patients with ARF were inbetween the age group of 3 months and 5 years, i.e., 12 (20.3%). The minimum percentage of CRF were in the age group of 3 months to 5 years, i.e., 2 (3.4%).

The mean age at a presentation of CRF is 11 years [Table 3].

Overall male:female ratio 1:3:1.

The male:female ratio in ARF is 1:3:1.

The male:female ratio in CKD is 2:3:1 [Table 4].

The most common cause for ARF is acute glomerulonephritis (GN), 15 (30.6%). In these, post-streptococcal GN cases were 5, membranoproliferative GN cases were 4, focal segmental glomerulosclerosis cases were 3, IgA nephropathy cases were 2, and 1 case of minimal change disease.

Next in order are 6 cases of nephrotic syndrome, 5 cases of hemolytic uremic syndrome, 5 cases of dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS), 4 cases each of septicemia and systemic lupus erythematosus, and 1 case each for snake bite, renal amyloidosis, complicated urinary tract infection, and chronic rheumatic heart disease with congestive cardiac failure with ARF [Tables 5 and 6].

In this study out of 28 cases, acute GN is the leading cause of primary renal disease for ARF contributing 10 cases. Obstructive uropathy is the primary leading cause for CRF contributing 3 cases [Table 7].

RF due to secondary causes for RF 31, i.e., which is slightly more than the primary renal disease 28 going to RF.

DHF/DSS and hemolytic uremic syndrome are the leading secondary causes for RF contributing about 11 cases out of 31 cases. The increased incidence of DHF/DSS probably due to mixed strain infections with its fulminate course, and the decreased incidence of RF due to acute gastroenteritis is due to increased awareness and early referral to tertiary hospital and timely intervention and better outcome [Table 8].

Symptom Analysis

The most common symptom in ARF is decreased urine output in about 35 cases.

Table 4: Sex distribution

Sex	Age groups			No. patients ARF	No. of patients CKD	Percentage
	3 months–5 years	5–10 years	11–18 years			
Male	12	7	29	29	7	66.1%
Female	2	9	20	20	3	33.9%

Table 5: Etiology of CRF

Etiology	No. of cases	Percentage
Obstructive uropathy		
Posterior urethral valves	2	30
Anterior urethral narrowing	1	
Vesicoureteric reflex	1	10
DKA, DI with neurogenic bladder with CKD	1	10
Exstrophy of bladder with VACTERL assoc	1	10
Chronic glomerulonephritis	2	20
Renal artery stenosis with hypertension	1	10
Undiagnosed CKD	1	10

CRF: Chronic renal failure, DKA: Diabetic ketoacidosis, CKD: Chronic kidney disease

The other common symptoms are high-colored urine, fever, shortness of breath in 21 cases, vomiting in 7 cases, loose motions in 6 cases, altered sensorium seen in 6 cases, and convulsions in about 6 cases and passing excessive urine.

The most common symptoms in CRF are swelling of face in 18 cases.

The other common symptoms in CRF are shortness of breath in 6 cases, vomitings in 4 cases, convulsions in 4 cases, fever in 4 cases, decreased urine output 6 cases, and dribbling of urine in 3 cases.

The most common sign in ARF is oliguria in about 35 (71.5%) cases.

Other common signs are periorbital edema (44.88%), altered sensorium (38.76), polyuria (8.16%), pedal edema (24.48%), hematuria (26.52%), dehydration (12.24%), hypertension (16.32%), shifting dullness (32.64%), seizures (12.24%), hepatomegaly (20.4%), and basal crepitations (18.36%) cases.

The most common sign in CRF is puffy face and hypertension seen in 8 cases, i.e., seen in 80% of the CKD cases.

70% of the cases are short statured in CKD patients; pallor and breathlessness are seen in 50% of cases, i.e., in 5 cases; oliguria is seen in 6 cases (60%); seizures in 3 cases (30%); failure to thrive, bony abnormalities, and polyuria are seen in 20% of cases; pedal edema is seen in 6 cases

(60%); dehydration is seen in 3 cases (30%); and altered sensorium is seen in 4 cases (40%) [Table 9].

Out of 59 cases of RF, 26 cases were cured by treatment and 21 were relieved from their symptoms. Of these 59 cases, dialysis was done in 9 cases and 2 cases were dependent on dialysis even after discharge.

The overall mortality due to RF is 12 cases (20.34%)

Total mortality during the study period is 249, among these 12 cases expired due to RF which accounts to about 4.8% [Table 10].

RF due to secondary causes such as hemolytic uremic syndrome (24.12%), septicemia (16.6%), and DSS/DHF (16.6%) are the leading causes for mortality RF due to primary renal disease like the glomerular disease that is acute GN has less mortality, i.e., 8.3% [Table 11].

Among the CKDs, chronic GN has contributed to 16.6%, i.e., 2 cases and 1 case due to obstructive uropathy out of 3 cases.

With different etiological factors for RF, the number of cases expired was 12 cases and the total number of survived cases were 47 cases.

Survival is more in the primary glomerular diseases like in acute GN, that is, 14 out of 15 cases survived (93.3%). The survival is low in cases of RF due to secondary causes, that is, 2 out of 5 (40%) among the cases of hemolytic uremic syndrome.

DISCUSSION

59 cases who fulfilled the diagnostic criteria for the RF were studied, in which the 49 cases were ARF and 10 cases were CRF.

ARF Group

In ARF, the group consisted of 29 boys and 20 girls, ranging in the age from 6 months to 16 years.

Shah *et al.* reviewed the symptoms and signs and etiological factors in 51 cases, of whom the youngest case is 6 months old and the oldest case is 12 years old, the mean age being 7.1.

Table 6: Primary renal disease for renal failure versus secondary causes for renal failure

Renal failure due to primary renal disease (%)	Renal failure due to secondary cause (%)	Total no. of cases of renal failure
28 (47.4)	31 (52.6)	59

Table 7: Primary renal diseases contributing to RF

Disease	No. of cases with RF	No. of cases without RF	Total no. of cases
Acute GN	10	64	74
Post-streptococcal GN	5	23	28
Nephrotic syndrome	6	60	66
Obstructive uropathy	3	0	3
Vesicoureteric reflex	1	0	1
Chronic GN	2	0	2
Exstrophy of bladder with VACTERL association	1	0	1

RF: Renal failure, GN: Glomerulonephritis

Table 8: Renal failure due to secondary causes

Diseases	No. of cases with RF	No. of cases without RF	Total no. of cases
Septicemia	4	48	52
Lupus nephritis with ARF	3	11	14
Acute gastroenteritis	4	287	291
Diabetic ketoacidosis	3	35	38
Hemolytic uremic syndrome	5	0	5
Snakebite	1	16	17
DHF/DSS	6	147	153
Complicated malaria	3	27	30
CRHD with CCF with ARF	1	16	17
Renal amyloidosis	1	0	1

RF: Renal failure, ARF: Acute renal failure, DHF: Dengue hemorrhagic fever, DSS: Dengue shock syndrome, CRHD: Chronic rheumatic heart disease, CRF: Congestive cardiac failure

The mean age group in our study being 7.1 years, 36 and that of other study group being 6.25 years, 37. The male:female ratio is 1.5:1 in our study.

The male:female ratio is 1.5:1 in our study.

The decreased urine output is the most common symptom in our study being 71.8% is comparable with Hari *et al.* being 94.1%.

Passing of excessive urine being 4 (8.16%) in this study. In Shah *et al.* study, it is 5.9%. In this study, this symptom is mainly attributed to diabetic ketoacidosis (DKI).

In this study, convulsions are being 12.24%, whereas in Shah *et al.*, it is 29.4% and this symptom is mainly attributed to acute GN.

Other symptoms in this study high-colored urine being 26.52%, shortness of breath 42.84%, vomiting being 14.28%, loose motions being 12.24%, rash all over body 22.44%, and high colored urine in 36.72% of cases.

Table 9: Outcome in renal failure

Outcome	Total no. of cases	Percentage
Cured by treatment	26	44.06
Relieved by treatment	21	35.59
Overall mortality	12	20.03
Dialysis	9	15.25
Hemodialysis	7	
Peritoneal dialysis	2	
Dialysis dependant	2	3.3
LAMA cases	6	

LAMA: Leaving against medical advice

Table 10: Mortality due to renal failure

Total no. of admissions	Total no. of cases expired	Total no. of cases expired due to renal failure	Percentage
4973	249	12	4.8

Table 11: Independent risk factors for mortality

Disease	No. of cases with RF	No. of cases expired	Percentage
Septicemia	4	2	16.66
Hemolytic uremic syndrome	5	3	24.12
Acute glomerulonephritis	15	1	8.33
Dengue shock syndrome	6	2	16.66
SLE nephritis	3	1	8.33
Chronic glomerulonephritis	3	2	16.66
Obstructive uropathy	3	1	8.33

RF: Renal failure, SLE: Systemic lupus erythematosus

Polyuria was present in 8.16% in our study and is comparable to 5.9% in Shah *et al.* study. In this study, this sign is mainly attributed to DKI.

The most common sign in our study being oliguria is 71.8% similar observation was noted by Hari *et al.* study that is 73.84%.

The other signs are dehydration - 12.24%, periorbital edema - 44.89%, pedal edema - 24.48% hypertension - 16.32%, hematuria - 26.52%, altered sensorium - 38.76%; these are comparable with Shah *et al.* study except convulsion 29.4%, altered sensorium 60.8% in Shah *et al.* at study.

The incidence of these symptoms in our study is low which may be because of early referral and improved modality of treatment at the tertiary level of hospital.

In this study, the mean blood urea and serum creatinine levels are 80.7 mg/dl and 2.38 mg/dl, respectively, which is comparatively low when compared to Hari *et al.* study were 132.6 mg/dl and 3.05 mg/dl, respectively.

Acute GN is the most common cause for ARF accounting for 15 cases (30.6%).

The next common cause are septicemia 8.16%, HUS 10.20%, DKA 6.12%, complicated malaria 6.12%, acute gastroenteritis 8.16%, and SLE nephritis 6.12%.

In Shah *et al.* study, acute gastroenteritis is the most common cause. The next common causes are acute GN and HUS.

The incidence of acute gastroenteritis causing RF is low in this study which may be because of increased awareness about gastroenteritis, oral rehydration salts (ORS) therapy, and early referral to tertiary level hospital and early treatment with fluid replacement.

The DKA causing RF is one among the causes in our study which may be because in Jaffe method of measuring serum creatinine the estimated serum creatinine levels in DKA cases may be falsely elevated because of the presence of ketone bodies and hyperglycemia.

In Counhan *et al.* study, renal hypoperfusion is the most common cause for RF being 43% which is mostly due to nephritic syndrome 10 cases out of 31 cases of hypoperfusion. Next common causes are HUS 12 (16.6%), acute GN 9 (12.5%), and septicemia 6 (6.94%)

In Uchino *et al.* study, the most common cause for ARF was septic shock 47.5%.

The survival is better with primary glomerular diseases like acute GN in our study out of 15 cases (88.8%) is comparable with Hari *et al.* study, in which acute GN better survival 88.8%, this is probably causes the primary glomerular disease is more common in older children than in younger children in whom RF is usually secondary to some other causes such as septicemia, HUS, and gastroenteritis.

The survival is poor with 40% and septicemia is 50% comparable with gastroenteritis and HUS 33.3% in Shah *et al.* study.

The survival is better in children above 5 years of age and poor in children below 5 years of age in our study is comparable with Hari *et al.* and Shah *et al.* study in that survivals better in children above 3 years of age and poor in children below 3 years of age, which may be due to

secondary causes for RF such as septicemia, HUS, and gastroenteritis are most common in younger children.

The overall mortality in our study is 18.36%, which is comparable with Counahan *et al.* study, in which mortality is 20%. In Hari *et al.* study, it is 33.3%.

Comparatively low mortality in our study may be because of early referral to tertiary level hospital and availability of dialysis facility and early intervention.

In Uchino *et al.* study, the overall mortality was 60.3%.

The most common cause for mortality in our study was HUS (60%) and septicemia (50%).

In our study, 26 cases (44.06%) with RF were cured of the disease and 21 (35.5%) cases were relieved of symptoms by treatment. Dialysis was done in 9 cases (15.2%) which is comparable with Counahan study, in which full recovery of renal function occurred in 53% and relief symptoms and discharge from hospital occurred in 14% patients. Dialysis was done in 6 cases (11.3%).

CRF

In our study, 10 cases out of 56 cases were CRF cases.

In CRF, the group consisted of 7 boys (70%) and 3 girls (30%) ranging in the age group of 3 years to 17 years.

In our study, the secondary causes causing RF is statistically highly significant age from 6 months to 18 years.

In our study, the number of case below 5 years was 1 (10%). Between 6 and 10 years of age group, the number of cases with CRF was 4 (40%). Between 11 and 18 years of age group the number of cases with CRF was 5 (50%).

In Pankaj *et al.* study, the number of cases below 5 years of age was 96 (31.4%). Between 6 and 10 years of age group, the number of cases was 105 (34.4%). Between 11 and 18 years of age group, the number of cases was 104 (34%).

The age at presentation in our study with features of CRF was higher as compared to Pankaj *et al.* study, suggesting delayed detection and referral of patients.

In our study, the lower age at presentation is 3 years and the upper age at presentation is 17 years. The mean age at presentation is 11½ years. This is comparatively in elderly with Hari *et al.* study, in which the mean age of presentation was 8 years.

In our study, the male cases are 70 % and female cases are 30%; the male-to-female ratio 2.3:1 which is comparable

with Gianluigi *et al.* study 67% male cases and female cases are 33%. The M:F ratio is 2.03:1 in Hari *et al.* study, in which 73.77% cases are male and 26.33% cases are female and M: F ratio is 2.8:1. In Gianluigi *et al.* study, 67% were male and 33% were female. The M: F ratio is 2.03:1. This male predominance is because of posterior urethral valve cases (obstructive uropathy) are most common cause for CRF, presenting in males.

Swelling of face 80% is a most common symptom and puffy face is the most common sign (80%) in our study.

The other common presenting features are pedal edema 60%, pallor 50%, short stature 70%, shortness of breath 50%, hypertension 80%, dribbling of urine 30%, convulsions 30%, bony abnormalities 20%, and failure to thrive 20%.

The mean blood urea and serum creatinine levels in our study in CRF cases are 148 mg/dl and 6.1 mg/dl, respectively. This is almost comparable with the Hari *et al.* study in which mean blood urea and serum creatinine levels are 150 mg/dl and 4.6 mg/dl, respectively.

The mean GFR at presentation in our study is 18.8 ml/1.73 m²/min, is comparable to Hari *et al.* study, in which the GFR is 18.5 ml/1.73 m²/min. In Gianluigi *et al.* study, the mean GFR at presentation is 41 ml/1.73 m²/min.

This also indicates delayed detection and referred to tertiary level hospitals.

In our study, creatinine clearance between 50 and 25 ml/1.73 m²/min 20% of cases, 25–10 ml/1.73 m²/min are 40%, and 10 ml/1.73 m²/min are 40 cases.

In Gianluigi *et al.* study, creatinine clearance between 25 and 50 ml/min/1.73 m² cases were 35% and <25 ml/min 1.73 m² cases were 26%.

This also indicates in our study that severe CRF and end-stage renal disease are common because of delayed detection of the cases.

The mean hemoglobin in our study is 7.9 g/dl is comparable with Hari *et al.* study, in which the mean HB level at presentation was 7.6 g/dl, the range of HB levels in our study are 5.8–11 g/dl. In Hari *et al.* study, it was 5–10 g/dl.

In our study, osteodystrophy is present in 20% which is comparable with Hari *et al.* study, in which osteodystrophy was present in 20.8%.

The most common cause for CRF in our study was obstructive uropathy 30%. The next common cause was

chronic GN is 30% and vesicoureteral reflex 10%, vascular malformation (Rt. Renal artery stenosis with hypertensive encephalopathy) is 10%. This is comparable with other studies, Hari *et al.* study obstructive uropathy cases were 31%, vesicoureteral reflux (VUR) 16.7%, chronic GN 27.5%.

In Gulati *et al.* study, combined obstructive uropathy and VUR contribute 52% of cases and chronic GN cases contribute to 37.5%. In Gianluigi *et al.* study, hypodysplasia with urinary tract malformations contribute 67.1%, chronic GN 2.8%, In Lagomarsiano study, obstructive uropathy contributes 16.7% and GN contributes 16.3% of cases.

It is observed that congenital malformation of the urinary tract is the major cause for development of RF. So if detect these condition early by antenatal scanning and intervene early, the prognosis will be good.^[9-15]

In our study, 3 cases out of 10 of CRF are expired. The independent risk factors for mortality is obstructive uropathy 1 cases and chronic GN 2 cases. 7 cases were relieved of symptom and discharged from the hospital. Dialysis was done in 4 cases of CRF.

CONCLUSION

1. The most common cause for ARF is acute GN, in which post-streptococcal GN is common.
2. Increased awareness about gastroenteritis, ORS, and early referral to tertiary hospital by effective management at the tertiary level leading to decreased incidence of RF with acute gastroenteritis.
3. The male:female ratio is 4:3 in ARF.
4. Decreased urinary output is the most common symptom in ARF.
5. Oliguria is the most common sign in ARF.
6. The DKA is one of the most common cause for ARF in our study which may be because of in Jaffe method, measuring serum creatinine, the estimated serum creatinine levels in DKA cases may be falsely elevated because of the presence of ketone bodies and hyperglycemia.
7. Survival is better in older children than younger children. This is because of primary glomerular diseases more common in older children, in which survival is good and the secondary causes are for ARF is more common in younger age group, in which survival is poor.
8. The most common cause for mortality HUS.
9. Early and frequent dialysis leads to improvement in patient survival.
10. The most common cause for CRF is obstructive uropathy.

11. More number of cases of CRF is presented in older age groups, that is, above 10 years.
12. Male predominance of CRF is due to post-urethral valve cases are seen in male is most common contributing factors for CRF.
13. Puffy face swelling is most common presenting features in CRF.
14. Stunted growth, malnutrition, and anemia are present in the majority of cases, indicates delayed detection of cases and referral to the tertiary hospital in our study.
15. Sever CRF and end-stage renal disease (ESRD) case are more in our study indicating late referral to the tertiary hospital.
16. The most common cause for CRF is obstructive uropathy in that post-urethral valve are most common.
17. Since congenital urinary tract malformation are common cause for CRF, early identification of urinary tract anomalies by antenatal scanning and early intervention lead to better prognosis.
18. With the availability of dialysis most of the cases with RF are improving, so the cases with the RF an early referral to specialized center with dialysis facility can improve the outcome.
19. The mortality due to CRF is comparatively low may be because of these cases are cannot followed up due to majority of the cases progressed to ESRD beyond the pediatric age group.

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