



## Paediatric Renal Dialysis at the End of the 20<sup>th</sup> Century in Ibadan Nigeria

A. O. Asinobi<sup>1\*</sup> and O. O. Ogunkunle<sup>1</sup>

<sup>1</sup>Department of Paediatrics, College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria.

### Authors' contributions

This work was carried out by both authors. Author AOA conceptualized the study. Both authors generated and interpreted the data and also prepared the manuscript. Both authors read and approved the final manuscript.

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### ABSTRACT

**Aim:** To document the conditions requiring dialysis in children at the University College Hospital, Ibadan Nigeria, at the end of the 20<sup>th</sup> century, as well as the available dialytic modalities and short-term outcomes of dialysis for future comparisons.

**Patients and Methods:** The data of all children aged 15 years and below who underwent peritoneal dialysis or haemodialysis in the Dialysis Unit between January 1990 and December 1999 were reviewed. A descriptive analysis of patients' demography, aetiology of kidney failure, dialytic modalities and short-term outcome in these patients was performed. The primary outcome measure was mortality.

**Results:** Sixty-six children comprising 14 (21%) boys and 52 (79%) girls underwent dialysis. The mean age was 11.9 (SD 3.9) years. Fifty-eight (88%) underwent peritoneal dialysis and 8 (12%) haemodialysis. A definitive diagnosis of Stage 5 chronic kidney Disease was made in 25 (38%), acute kidney injury in 23(35%) and acute kidney injury-on-chronic kidney disease in 6 (8%). The major underlying conditions were the nephrotic syndrome, acute glomerulonephritis and chronic glomerulonephritis. Others were diethylene glycol poisoning, malignancies and sepsis. Only acute

\*Corresponding author: Email: [adasinobi@yahoo.com](mailto:adasinobi@yahoo.com);

dialysis was offered because of limited resources.

Overall 25 died, giving a mortality rate of 37.9% with 12 (48%) and 22 (88%) patients dying within 3 days and 2 weeks of presentation respectively. Thirteen of the 25 (52%) patients in Stage 5 CKD, and 9 (39.1%) of the 23 with AKI, died and the mortalities were related more to the aetiologies.

**Conclusion:** Acute glomerulonephritis and Nephrotic syndrome were the major causes of AKI while chronic glomerulonephritis was the major identified cause of Stage 5 CKD. The available dialytic modalities were peritoneal dialysis and the then newly introduced haemodialysis. Patients had no insurance cover and paid out of pocket for treatment thereby limiting the duration of dialysis. The short-term outcome compared favourably with outcomes in centres with similar predicaments.

*Keywords: Paediatric dialysis; peritoneal dialysis; haemodialysis; acute kidney injury; chronic kidney disease; Ibadan; Nigeria.*

## 1. INTRODUCTION

Acute kidney injury (AKI) and Stage 5 chronic kidney disease (Stage 5 CKD) previously referred to as acute renal failure (ARF) and chronic renal failure (CRF) respectively, are conditions frequently encountered in Paediatric Nephrology practice world-wide [1,2]. They often require urgent and well-organized interventions to prevent unfavourable outcomes. In many developing countries such as Nigeria, the provision of dialysis, one of the basic modalities of treatment for these conditions, is hampered by many factors, particularly socio-economic, thereby limiting experience with it. This is more so in the pediatric age group, where additional constraints such as non-availability of appropriately-sized consumables and expertise exist [3,4,5].

Peritoneal dialysis (PD) was first performed in adults at the University College Hospital (UCH), Ibadan Nigeria, by Akinkugbe in 1967 to be followed soon after in children with AKI [6]. However, the down-turn in the nation's economic fortune in the early 1980s led to very distressing challenges in the management of children with AKI [7-11]. Dialysis access in some institutions in Nigeria in later years was reported as 10.9% at Ife [10] and 24.1% in Port-Harcourt [11]. The story was not very different for adults either [12-14]. Haemodialysis centres eventually became established at the Lagos University Teaching Hospital, Lagos in 1981 [15,16] and at the UCH Ibadan in 1990 [17].

The choice of dialysis therapy is usually guided by the clinical circumstance, location of the patient, available expertise and resources [18-21]. Whereas continuous renal replacement therapy (CRRT) is being more increasingly used in AKI to save critically ill patients [22-24], the

easiest mode of therapy, peritoneal dialysis, requiring minimal equipment and infrastructure is not easily accessible to children in developing countries, such as ours, even in the tertiary hospitals [5]. In spite of Nigeria's vast oil wealth, over 50% of Nigerian population were extremely poor, living on less than 1.25 US dollars a day [25]. Unfortunately, the newly introduced National Health Insurance programme does not cover for dialysis, in contrast to what obtains in the developed countries such as USA and Japan [26,27]. Individuals therefore pay out of their pockets for such facility.

The period under review at our Centre was characterized by shortage of manpower and material resources resulting in inability to render services routinely offered in the 1960s and failure to keep pace with newer technological advancements. The findings in children who underwent dialysis in the last decade of the 20<sup>th</sup> century are hereby documented for future comparisons.

### 1.1 Aims and Objectives

To document the conditions requiring dialysis in children at the University College Hospital, Ibadan Nigeria, at the end of the 20<sup>th</sup> century, as well as the available dialytic modalities and short-term outcomes of dialysis, for future comparisons.

## 2. PATIENTS AND METHODS

The data of all patients aged 15 years and below who underwent peritoneal dialysis (PD) or haemodialysis (HD) in the Dialysis Unit of the University College Hospital, Ibadan between January 1990 and December 1999 were reviewed. The final diagnosis of the patients in terms of AKI (KDIGO Stage 3), Stage 5 CKD (Chronic Kidney failure/CKF) or AKI-on-chronic

kidney disease was based on clinical, biochemical, radiological and/or histopathological parameters and is in keeping with the KDIGO and KDOQI criteria [1,2]. The associated conditions were diagnosed based on their standard clinical and laboratory definitions [28,29].

The indications for dialysis were clinical features of severe uraemia and circulatory overload that failed to respond to medical management with or without markedly deranged biochemical parameters such as hyperkalaemia.

Only acute dialysis was offered and PD was the only option available till 1996 when HD became available for children aged 15 years and below at our Centre. Centry-2 Cobe machines were initially provided but paediatric dialyzers and blood lines were not immediately available.

For the PD, disposable semi-rigid peritoneal catheters with stylets were used. The catheter was inserted after preparing and draping in an aseptic manner, and anaesthetizing the planned site with 1% xylocaine without adrenaline. In all cases, an infra-umbilical midline stab incision was used. Following catheter insertion into the peritoneal cavity, the stylet was removed and the catheter was advanced into the pelvic fossa. The catheter was usually secured with a purse-string suture to avoid peri-catheter leak and dislodgement.

The usual exchange volume was 30-50 ml/kg body weight per exchange after an initial evaluation with 10-20 ml/kg cycles. One-hourly cycles were mostly used at commencement and indwelling time increased as patient's condition improved. The exchanges were carried out manually by the nursing staff. Heparin (500 u/L of dialysis fluid) was used for the 1<sup>st</sup> few exchanges, or until the dialysis fluid was clear to prevent the formation of fibrin clots.

The standard dialysis solution (1.5% glucose solution) was alternated with a more hypertonic solution (4.25% glucose solution) as indicated for circulatory overload. Potassium was added to the bag of peritoneal dialysis solution to obtain 3 mmol/litre when the serum potassium was less than 4 mmol/litre. Antibiotics were not routinely added to the dialysis fluid. Each patient's weight, vital signs, fluid intake and output, were strictly monitored and charted.

A few older patients (10-15 years) underwent haemodialysis. The procedure was carried out

with hollow-fibre dialyzers and femoral venous cannulations were carried out with non-cuffed temporary single lumen catheters. A second venous access was usually created in the upper limb. Appropriate dialyzers based on patients' body surface areas and appropriate blood lines based on patients' circulating blood volumes were used.

## 2.1 Data Analysis

Simple descriptive statistics such as mean  $\pm$  SD were used for variables such as age and percentages were used for categorical data.

## 2.2 Ethical Statement

Ethical approval for this study was obtained from the University of Ibadan/University College Hospital, Ibadan Joint Ethical Committee. The study analyzed the outcome of our routine work in the Paediatric Nephrology Unit normally carried out with signed informed consent. The patients' individual data are not traceable to them.

## 3. RESULTS

Sixty-six children comprising 14 (21%) boys and 52 (79%) girls, with a male: female ratio of 0.27:1, underwent dialysis. The mean age was 11.9 (SD 3.9) years. Fifty-eight (88%) underwent peritoneal dialysis and 8 (12%) haemodialysis. Table 1 shows the gender and age of patients that underwent dialysis. Table 2 shows the type of Kidney failure in terms of chronicity. Table 3 shows the conditions associated with kidney failure requiring dialysis and the short-term mortality. Malignancy-related AKI was seen in 4 patients {Burkitt Lymphoma (3) and Rhabdomyosarcoma(1)}. Some cases involved multiple features such as sepsis, gastroenteritis and hepatitis but the final diagnosis was based on the primary diagnosis. The cause of CKF could not be ascertained in 65% of the cases as they presented in very late stages but 11 cases of chronic glomerulonephritis were identified.

Pertaining to treatment, there was a delay of over 24 hours before the commencement of dialysis in over 80% of the patients, either because of lack of funds for purchasing needed items, or non-availability of the needed items in the hospital. In most instances, the dialysis was to rescue them from death; conservative management was then continued due to limited funds. Only 8(12%) children had HD between 1996 and 1999.

**Table 1. Sex and age of patients with kidney failure who underwent dialysis**

Sex	Number	%	
Male	14	21	Male: Female 0.27: 1
Female	52	79	
<b>Age (Years)</b>			
0-5	6	9.1	
6-10	6	9.1	
11-15	54	81.8	

The average number of days for the PD was 3 days while none had more than 3 sessions of HD. Complications were minimal as the procedures were not prolonged and patients were closely monitored under strict asepsis.

Overall, 25 died, giving a mortality rate of 37.9% with 12 (48%) and 22 (88%) patients dying within 3 days and 2 weeks of presentation respectively. 13 out of the 25 (52%) patients in CKF and 9 (39.1%) out of the 23 with AKI, died. The mortalities were more related to the aetiologies. Concerning AKI, all 4 cases of diethylene glycol poisoning died; 2 of the children with malignant disease, one case of sepsis, 1 HUS and another in whom a definitive diagnosis was not made, died. Excluding the unusual mortalities from diethylene glycol poisoning epidemic, the overall mortality rate would have been 33.9% and AKI mortality rate 26.3%.

#### 4. DISCUSSION

This study has described the state of paediatric renal dialysis in the University College Hospital, Ibadan at the close of the 20<sup>th</sup> Century. Dialysis is a life-saving procedure which if commenced early and appropriately delivered could sustain life till the underlying cause of kidney failure is handled or sorted out. This is not readily available in developing countries. At the beginning of the study period, PD was the only dialytic modality available to children in Ibadan, but its effectiveness was limited by non-availability of consumables, namely dialysates and PD catheters. Haemodialysis subsequently commenced in 1990, but was restricted to adults, only being extended to adolescents in 1996 - only 8 children benefitted from it over a 4-year period. HD was a rarity for children in Nigeria then. Of the 10 patients dialyzed at Ile-Ife, South-west Nigeria by Olowu and Adelusola [30] between 1994 and 2003, 7 underwent PD and 3 HD.

The short-term mortality in patients undergoing dialysis was high. The reasons for the high

mortality rates in our environment as seen in this study and as highlighted by other workers [7,10,11] include: poor clinical state at presentation, delay in instituting therapy as management was given on a "Cash and Carry" basis, inadequate facilities, problems of vascular access in young children and financial constraints on the part of the parents/care-givers. Additionally, at that time, there was no Centre offering renal transplantation in the whole of Nigeria for those with chronic kidney failure. That almost 50% of the patients died within 72 hours of presentation was a testament to how ill and how late they presented. Early presentation makes for better planning and better outcome. Preemptive renal transplant is the preferred treatment modality for children in end-stage renal disease and this involves early detection and follow-up [31].

Dialysis is quite expensive in our setting when compared with the average income of workers. Excluding the cost of laboratory investigations, other admission requirements, and indirect costs on the care givers, the minimum cost of 3 sessions of haemodialysis (the average weekly requirement) then was N18,000.00 ≈ \$150.00 (it is presently N60,000≈ \$300.00), whereas the minimum monthly wage for public servants then was N7,500.00 ≈ \$54.00 and presently N18,000.00 ≈ \$100. These costs were and are not easily affordable by the majority of Nigerians. The initial 3 dialysis sessions carried out in our patients, most of who required dialysis at first presentation was termed "sorting out dialysis" as described by Arije [32] which enabled determination of the type of failure. The maximum number of dialysis sessions patients with Stage 5 CKD received was 3 sessions and no other patient did because of cost. Unfortunately, peritoneal dialysis also costs as much as, if not more than haemodialysis. The only fluid available for PD in Nigeria is the continuous ambulatory peritoneal dialysis (CAPD) fluid, imported at high costs. The present minimum cost of a 2-litre bag of the CAPD fluid is N3, 500 (≈ \$17). A child with AKI requiring 10 cycles of PD in 24 hours at 1litre per cycle would utilize five 2-litre bags at a cost of ≈\$85 (N17,000) per day for fluids only, which is almost the monthly salary of some Nigerians. Sadly also, the National Health Insurance Scheme, which recently took off for employees in certain sectors of our economy does not cover dialysis costs.

**Table 2. Types of kidney failure and the short-term mortality rates**

Diagnosis	Total (n)	% of total	Mortality (n)	Case fatality rate (%)
Stage 5 CKD (CKF)	25	38	13	52
AKI on Chronic kidney Disease	6	8	1	16.7
AKI (pRIFLE-Failure)	23	35	9	39.1
Indeterminate	12	19	2	16.7
	66	100	25	100

**Table 3. Clinical conditions associated with AKI (pRIFLE-failure)**

Diagnosis	No of patients	Total (%)
Acute glomerulonephritis	10	43.5
Diethylene glycol poisoning	4	17.4
Malignancies	4	17.4
Haemoglobinuria	2	8.7
Sepsis	2	8.7
Haemolytic uraemic Syndrome	1	4.3
	23	100

That most of the patients were in the 11-15 years age bracket is not surprising, as in this age group it was easier to use adult catheters and dialyzers which were more readily available. The female preponderance among the patients in this study is difficult to explain. Concerning the associated conditions, acute glomerulonephritis (AGN) is usually more common in males than females and as regards the nephrotic syndrome in our environment; there is either male preponderance or no sex predilection [33-35].

That nephrotic syndrome (NS) and acute glomerulonephritis (AGN) were the most common conditions associated with renal failure in the patients is a reflection of the most common renal disorders seen in Paediatric Nephrology Units in Nigeria [36].

With regards to AKI in children, the frequency of specific antecedent diseases differs amongst different age groups and geographical areas [8,9,37] and the antecedent disease also affects the prognosis as shown in this study. In the Western world, the most common primary renal cause of AKI in infants and young children is the haemolytic uraemic syndrome (HUS)[38]; which is contrary to our findings in this environment [30,39]. In spite of our high index of suspicion for HUS, it remained rare in our experience. Only 2 cases of HUS were seen in our unit during the 10-year study period, with only one receiving

dialysis. Seriki [6] also saw only one case among the 23 patients he had earlier studied in our centre.

The finding that AGN was the most common cause of ARF necessitating dialysis in the present study is in keeping with that of Seriki [6] working in the same unit about 2 decades previously and also in keeping with the recent findings from Lagos [39]. Whereas the incidence of AGN has markedly reduced in technologically developed countries of the world [40,41], it is still an important cause of morbidity and mortality in Nigeria [42,43]. As the long-term prognosis of AGN is generally good, parents/care-givers are encouraged to do all in their capacity to save their children; even if it entails borrowing funds or selling property.

Also notable in Ibadan Nigeria, the place of this study, is that even though we encounter many children with gastroenteritis, most do not develop intrinsic renal failure requiring dialysis. This observation was also made by Seriki (6) several decades ago and it is plausible to conclude that health education concerning the use of Oral Rehydration Therapy (ORT) has been embraced by care-givers resulting in improved outcome. The features of gastroenteritis seen in some critically ill children are associated with other features of sepsis and may therefore be secondary or confounding factors. The report from our Centre that included part of the first decade of the new century saw 3 cases of gastroenteritis among 27 patients requiring dialysis [4]. Esezobor et al. [39] have recently shown that gastroenteritis and malaria are declining in their contribution to AKI in Lagos, Nigeria.

In 1990, 23 children presented in ARF, having ingested paracetamol (acetaminophen) syrup which had been inadvertently constituted with diethylene glycol. Only 4 of these children with the diethylene glycol toxicity could be dialyzed, the only available dialytic modality being PD, which was inappropriate; all 4 died. More importantly the patients presented very late and

the offending toxin was not initially known thus contributing to the high mortality rate. The details of their clinical presentation, management, course and outcome have been presented elsewhere [44].

With regards to the malignant conditions associated with AKI in this study, they are similar to the findings by other workers in our environment [30]. The rhabdomyosarcoma occurred in the bladder and caused an obstructive uropathy while the Burkitt Lymphoma resulted from kidney infiltration. Prophylaxis for Acute tumour lysis syndrome was religiously followed in our practice and was a rare cause of AKI requiring dialysis.

The case fatality rate of 39.1% in cases of AKI in this study was surprisingly the same as that documented by Seriki [6] from our Centre over 2 decades previously; however, excluding the mortalities from the epidemic of diethylene glycol poisoning, it reduces to 26.3%. Olowu and Adelusola [30] at about the same period of the present study, recorded a mortality of 46.2% and in a later report by Anochie and Eke [37], the overall mortality rate in their cases of ARF was 40.5%. Esezobor and his colleagues [39] more recently reported a mortality rate of 28.4%. In spite of advances in technology and improved outcome in the management of children in AKI in developed countries, even manually performed PD exchanges cannot be offered with ease to children in our setting. It is therefore no wonder that our mortalities are high.

The experience with PD at our Centre in the management of AKI from 2004 to 2011 was reported by Ademola et al. [4] and comparatively showed an increase in the average annual dialysis rate for AKI. If however, deaths from diethylene glycol poisoning were excluded, the mortality rate did not differ much. Never-the-less, improvisation to save lives was intensified, namely, the use of fenestrated nasogastric tubes as PD catheters and seeking for alternative means of obtaining PD fluids, which ensured that this important therapeutic procedure was not stopped. The aetiological pattern has however changed somewhat in recent times with haemoglobinuria associated with intravascular haemolysis and sepsis being the most common causes of AKI requiring dialysis. Most, however, were still secondary to infections.

In the developed countries of the world, factors associated with poor outcome in AKI are those

that are unavoidable in most instances, such as patients with AKI as part of multi-organ failure, especially in neonates who had cardiac surgery [45]. Otherwise, for intrinsic renal disorders such as haemolytic uraemic syndrome (HUS), the mortality rates in AKI range from 3 to 5% [38].

Concerning Stage 5 CKD, the short-term mortality remains uniformly high in our environment, ranging from 46.7% in Port-Harcourt [46], to 52% in the present study to 88% in Enugu, Nigeria [9]. In the long run, without chronic renal replacement therapy (RRT), it is almost certain that the mortality rate would be 100%.

Chronic dialysis without prospects for renal transplantation in a young child is generally not encouraged in our setting, as families become impoverished within a few weeks of its commencement. In the period under review, there was no Centre equipped for end-stage renal disease (ESRD) management in Nigeria. Up to the present time, only a few kidney transplants have been carried out in a private hospital, St. Nicholas Hospital, Lagos and at the Lagos University Teaching Hospital recently. For over 99.9% of Nigerian children who may need kidney transplant for end-stage renal disease (ESRD), and cannot afford the cost of over N5million Naira, ( $\approx$  \$25,0000.00), here or abroad, ESRD is a death sentence.

This study has not addressed the challenges from cases of AKI in neonates, patients with severe burns, some cases of poisoning and post-operative patients with multiple organ dysfunction syndrome. Many of these special cases had indications for dialysis but could not be dialyzed either for technical reasons or due to non-availability of required items.

It is gladdening to note that in recent years, the International Nephrology Associations such as ISN, IPNA, ASN and ISPD are assisting in building up manpower in developing countries [47] and hopefully, in the near future, more viable centres will be set up for both acute and chronic renal replacement therapy.

It is sad to note that the conditions responsible for the lamentations of Abdurrahman et al. [7] over a decade ago, concerning the depressing and distressing clinical problems posed by ARF and CRF in Nigeria persisted in the last decade of the 20<sup>th</sup> century. The same challenges are still present in our practice today. Children presenting

with AKI whose conditions are potentially reversible still die because of lack of appropriate facilities for treatment. A country with a population of over 150 million, where over 50% are aged below 19 years, that has negligible facilities for the management of AKI in children and no facilities for childhood ESRD management, sends many to their graves prematurely. Whereas measures geared towards preventing the common causes of kidney failure should be put in place, the issue of inadequate facilities for managing kidney failure, particularly AKI (which is potentially reversible and still exists in the 21<sup>st</sup> century) needs to be seriously addressed by all stakeholders.

## 5. CONCLUSION

In conclusion, acute glomerulonephritis and Nephrotic syndrome were the major causes of AKI, while chronic glomerulonephritis was the major identified cause of Stage 5 CKD. The available dialytic modalities were peritoneal dialysis and the then newly introduced haemodialysis. Patients had no insurance cover and paid out-of-pocket for treatment, thereby limiting the duration of dialysis. The short-term outcome compared favourably with outcomes in centres with similar predicaments.

## 6. LIMITATIONS

- i. The study included only patients that received dialysis but should have included all who needed dialysis but could not be dialyzed.
- ii. It would have been ideal to have followed up these patients for longer to address the issue of AKI being complicated by CKD, most especially when treatment was not optimal in some and the outcome in those with chronic kidney failure diagnosis.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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