Clinical Research

Acute pediatric peritoneal dialysis: impact of an opt-out model and adaptable methods in a hospital in Nigeria

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ABSTRACT

BACKGROUND Despite efforts to scale peritoneal dialysis (PD) uptake, access is still limited in Sub-Saharan Africa, including Nigeria. Thus, this study evaluated access to PD, cost-effectiveness, complications, and in-hospital mortality rate following the adoption of a local opt-out model approach for all children with acute kidney injury (AKI) that required PD.

METHODS This work was a retrospective review of 33 children with AKI that required dialysis between December 2014 and November 2016. PD was carried out using locally adaptable consumables in place of commercially produced consumables. All patients that required renal replacement therapy (RRT) were offered an option to opt-out irrespective of their financial status. Patients' relevant data were retrieved from the case notes and analyzed.

RESULTS The median age was 7 years (range 3–12). 23 patients (70%) were males. Of the 33 patients that required RRT, 29 had PD. The children had an access rate of 88% (95% CI = 76.77–99.03). The access rate was not related to gender (p = 1.000), age group (p = 0.240), or socioeconomic status (p = 0.755). Complications were pericatheter leakage of fluid (n = 7, 24%), catheter malfunction (n = 5, 17%), abdominal wall edema (n = 3, 10%), scrotal edema (n = 2, 7%), and peritonitis (n = 1, 3%). In-hospital mortality was 3/29 (10%; 95% CI = 2.2–27.3). Cost analysis revealed that the cost of consumables was reduced by 88.5%.

CONCLUSIONS An opt-out model with the use of locally adaptable consumables improved PD access (88%) with a low in-hospital mortality rate.

KEYWORDS acute kidney injury, less developed countries, opt-out model, peritoneal dialysis

Acute kidney injury (AKI), previously known as acute renal failure, is a clinical condition characterized by a sudden decline in renal function, which may be reversible.[1] However, the reversibility of AKI mostly depends on timely presentation and prompt intervention.[2–4] Data on AKI among children in developing countries revealed a high incidence and risk of mortality.[4] A systematic review by Olowu et al[5] on AKI showed limited access to dialysis, which partly accounted for the high morbidity and mortality among children in Sub-Saharan Africa. The high burden of AKI with poor outcome among children in developing countries is also dependent on lack of access to care, unavailability of dialysis consumables, lack of expertise in renal care, and late presentation.[6,7]

Despite the high incidence of AKI and poor outcome, access to renal replacement therapy (RRT) has remained low in low- and middle-income countries (LMICs), including Nigeria.[5] Although many centers in Nigeria now offer acute peritoneal dialysis (PD) as a form of RRT, there is a need to develop a model of PD to improve access to all categories of children irrespective

of their socioeconomic status.[8–11] This model will ensure that the concept of universal access to health care is made available to children in Nigeria irrespective of their financial status.[12] The goal of zero deaths from AKI by the International Society of Nephrology by 2025 can only be achieved with methods for RRT that are locally available, affordable, and sustainable in the limited resource settings.[13] Thus, the nephrology unit proposed and designed an opt-out model approach that ensured all children that required PD were offered care through locally adaptable methods. The locally adaptable methods included a feeding tube as an improvised catheter connected to a burette for fluid delivery via a sterilizable reusable three-way tap. The adaptable methods also included the use of a sterilizable stylet of bicycle spokes and sterilizable set pack that contained a pair of scissors, sterile gauze, and artery forceps for the insertion of the feeding tube into the peritoneal cavity. Thus, this study aimed to evaluate the PD access rate, complications of the procedure, and in-hospital mortality rate following the introduction of an opt-out model approach to the provision of PD using locally adaptable methods and compare its cost with the commercially produced consumables.

METHODS

This study was a retrospective descriptive, cross-sectional study that involved children with AKI who had an indication(s) for RRT over a 2-year period (December 2014 and November 2016) at Bowen University Teaching Hospital, Ogbomosho, Southwestern Nigeria. The hospital is a 285-bed capacity that offers tertiary health care to children among others.

Opt-out model approach to PD

The health facility has trained personnel on PD; however, the procedure could hardly be carried out due to unavailability of consumables, which were usually procured from the manufacturer located about 100 km from the hospital. The Pediatric Nephrology Unit of the Hospital in December 2014 developed an adaptable PD program with an opt-out model that comprised a side room dedicated for the procedure; seedling PD fluid revolving funds ensured that PD fluids were readily available. A feeding tube was improvised as a catheter connected to a burette for fluid delivery via a sterilizable reusable three-way tap (Figure 1). The adaptable PD also included a sterilizable stylet of bicycle spokes and sterilizable set pack that contained a pair of scissors, sterile gauze, and artery forceps. A key component of the approach is an opt-out model, which ensured that all children with an indication for PD were offered treatment irrespective of their financial status except if the caregivers declined. The indications for PD were based on the 2012 guideline by the Kidney Disease: Improving Global Outcomes guidelines.[14] The indications for RRT were as follows: uremic syndrome, rapidly rising azotemia or a fall in estimation glomerular filtration of 75% or more within the time of admission, failure of medical treatment for severe hyperkalemia (K^+ ≥6.5 mmol/l), severe metabolic acidosis (HCO_3^+ ≤15 mmol/l), and fluid overload not responding to medical treatment. We

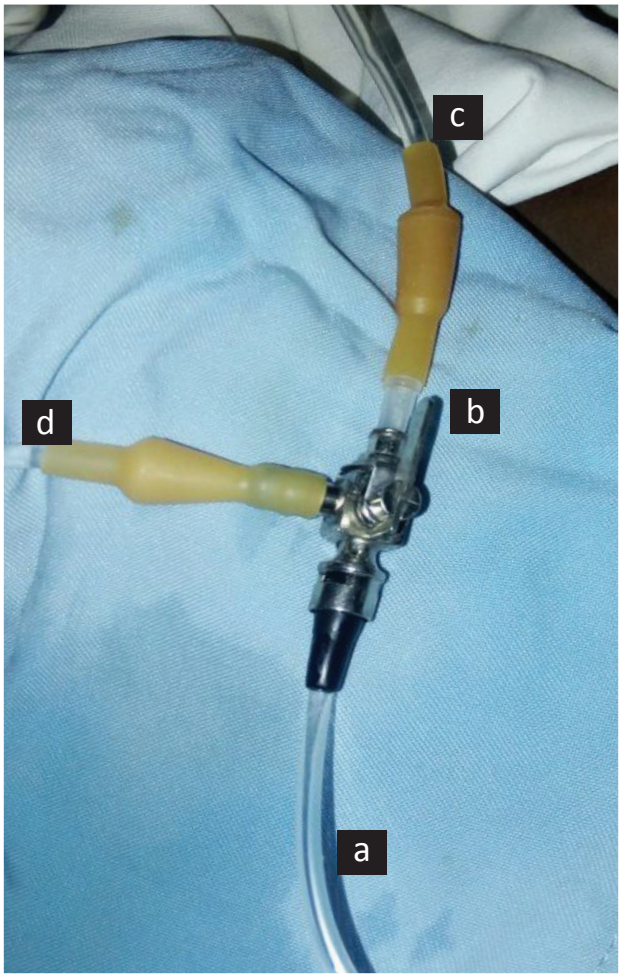

Figure 1. A patient undergoing peritoneal dialysis (PD) with adaptable methods with the tools consisting of (a) size 10 feeding tube, (b) a sterilizable reusable three-way tap, (c) connecting tube to burette to deliver the peritoneal fluids, and (d) connecting tube to urine bag to drain peritoneal fluids

explained the details of the procedure and nature of the adaptable consumables to the parents/caregivers before the intervention. Opting out of treatment was the only exclusion criteria for patients eligible for PD after informed consent by the caregivers.

A gravity-driven method was used to deliver PD fluid during dialysis. A cycle of PD comprised the infusion phase of PD fluids over 10–15 min at the rate of 20–30 ml/kg followed by a 30–45 min dwell time and drainage of the effluent through exit tubing into a sterile urine bag. PD access was defined as the number of children that had PD following AKI with an indication for RRT expressed per 100.[5]

Data collection and analysis

Patients' relevant clinical data were retrieved from the case note and renal unit database. The renal database is a comprehensive database containing biodata, social demographic history, detailed history, laboratory data, treatment modalities, complications, and patients' outcomes. The patients' case notes provided additional information where needed. The socioeconomic status of the caregivers was estimated from the mean of the sum of the maximum scores attainable from parents' educational level and occupational status based on Oyedeji classification of social class.[15] The mean of the 4 scores was rounded to the nearest whole number with scores of 1 and 2 classified as upper socioeconomic class, score of 3 classified as the middle socioeconomic class, and scores of 4 and 5 classified as lower socioeconomic class. The cost of the commercially manufactured consumables obtained from the manufacturer was compared with the list of prices of the adaptable consumables from the pharmacy department of the hospital.

The data were analyzed with SPSS software for Windows, version 20 (IBM Corp., USA). The variables (continuous) such as age were not normally distributed and summarized as median with interquartile range (IQR). The socio demographic variables were summarized as frequencies and proportions. The dialysis access rate was presented in percentage with 95% confidence interval (CI), while the chi-square was used to assess the possible relationship between the access to PD and socio demographic variables. The cost was estimated for both the commercially produced consumables and the adaptable ones and then compared. Statistical significance was set at $p<0.05$. This study obtained approval from the Research Ethics Committee of Bowen University Teaching Hospital (ethical approval number: NHERC/12/05/2012).

RESULTS

During the study period, 33 children and adolescents had AKI that required dialysis with a median age of 7 years (IQR 3–12), and the ratio of males to females was 2.3:1. Most of the children and adolescents were in the middle class and lower social class. Most of the parents/caregivers were educated. The PD access rate was 29/33 (88%; 95% CI = 76.8–99.0). The PD access rates in males and females were 87% (20/23) and 90% (9/10), respectively. Further details are shown in Table 1. Furthermore, retention of subjects from initiation to discontinuation of PD with the opt-out model was 28/29 (97%).

Table 1. Sociodemographic variables and access to peritoneal dialysis (PD)

Variables	n (%) (N = 29)
Age (years)	
<5	13 (45)
≥5	16 (55)
Male gender	20 (69)
Mothers' age group (years)	
25–35	15 (52)
36–45	13 (45)
>45	1 (3)
Fathers' age group (years)	
25–35	8 (28)
36–45	10 (34)
>45	11 (38)
Mothers' educational level	
Tertiary	8 (27)
Secondary	13 (45)
Primary	6 (21)
None	2 (7)
Fathers' educational level	
Tertiary	14 (48)
Secondary	10 (35)
Primary	3 (10)
None	2 (7)
Socioeconomic class	
Upper	3 (10)
Middle	15 (52)
Lower	11 (38)

Table 2. Complications of PD, duration of hospitalization, and in-hospital mortality

Variables	n (%) (N = 29)
Complications of acute peritoneal dialysis	
PD fluid leaks	7 (24)
Catheter malfunction	5 (17)
Abdominal wall edema	3 (10)
In-hospital mortality	3 (10)
Scrotal edema	2 (7)
Peritonitis	1 (3)
Number of sessions (sessions), median (IQR)	15 (9–27)
Duration of hospitalization (days), median (IQR)	10 (6.5–13.5)

PD=peritoneal dialysis; IQR=interquartile range

Table 3. Comparative cost of consumables

Commercially produced consumables	Cost per unit (USD)*	Adaptable consumables	Cost per unit (USD)*
Acute PD catheter (straight) set	29	Size 10 feeding tube	0.5
Drainage bags	5	Urine drainage bag	0.6
PD sterile cap	3.5	Fluid giving set	0.5
		Burette	2.7
Total†	37.5‡		4.3‡

PD=peritoneal dialysis
*Exchange rate was calculated at N360 to 1 USD; †percentage reduction in cost is 88.5%; ‡exclude the cost of PD fluid dialysate, which was 9 USD per liter

The range of PD sessions was 2–82 sessions. The range of hospitalization duration was 1–20 days. The most frequently observed complication during PD was pericatheter leakage of fluid. The least observed complication was peritonitis (Table 2). Only one patient with the most prolonged PD (82 sessions with a typical session lasting 30–45 min for acute intermittent PD) had peritonitis. Of the 29 that had acute PD, 3 died during hospitalization with a case fatality rate of 10% (95% CI = 2.2–27.3). The total cost of the locally adaptable consumables excluding the PD fluids was 4.3 USD, which was 88.9% lower than the commercially produced consumables (37.5 USD) as shown in Table 3.

DISCUSSION

This study showed the effect of a focused pragmatic approach in addressing limiting factors to access PD as a form of RRT in LMICs. This work further confirmed the suggestions by Vasudevan et al[16] in India, who recommended that PD modalities in children with AKI should be based on available resources. The PD access rate of 88% was far higher than most reported access rates in Nigeria (10% reported in Ife,[6] Southwestern Nigeria; 24% reported in Port Harcourt,[17] Southern Nigeria; and 39.1% in Enugu,[10] Southeastern Nigeria). The high accessibility rate to PD obtained in this study may be due to the use of locally available consumables and availability of PD fluids through a revolving fund. The unavailability of PD fluids in LMICs has been identified as a major barrier to providing PD services as a form of RRT in pediatric practice.[18] Previous studies also identified other barriers to the provision of PD, which included poverty, and unavailability of dialysis consumables and equipment; these barriers were partly addressed by this model.[6,18,19]

Our study showed a low in-hospital mortality rate of 10%. The observed mortality rate in this study was lower than 30–41.2%, which was the previously documented in-hospital mortality rate among Nigerian children that had acute PD for AKI.[8,9] The in-hospital mortality rate was also lower than the observed mortality rate in Sudan (29.7%),[20] Baghdad (22.0%),[21] and South Africa (65.0%).[22] There are plausible reasons for the relatively low mortality rate observed in this study, which included a low infection rate in the study and early commencement of PD with a protocol that included a dedicated sideward for the procedure. Moreover, the complications of PD found in this study were similar to other previous studies except for the relatively low peritonitis (3%).[8,20] The observed low rate of peritonitis could be due to the use of prophylactic antibiotics during the procedure. Although we carried out manual PD fluid exchange, the use of a sterilizable three-way tap along with commercially produced dialysates possibly reduced the risk of contamination during the procedure. The low mortality rate obtained in this study may also be due to the small sample size (n = 29) because the number of patients was low.

The opt-out approach ensured that all children that developed AKI and required dialysis were offered

to opt-out irrespective of their socioeconomic status or financial status. The out-opt option requires the patients or caregivers to give an affirmative "no" to initiate PD; otherwise, all eligible patients are subjected to PD irrespective of the financial status. The initiative by the unit was observed to have a positive influence on the caregivers' attitude and the drive to look for funds to ensure sustainability of PD as only one patient opted out on initiation of the new model. On the backdrop of an effective PD revolving fund model with a token margin of profit (3%), the gains that accrued were added to the funds to take care of the needs from indigent patients. Thus, the PD fluid revolving fund model ensured that the opt-out approach for PD initiation was sustainable. This approach can be leveraged on given the global difficulty to attain universal health coverage for children with renal impairment that require dialysis in developing countries, where the causes of AKI are typically related to infections and are common in the low socioeconomic class.[22]

Besides PD fluids in dialysis, the costs of other consumables such as PD catheter have been an impediment to access to dialysis in developing countries. This study showed that the cost of consumables excluding PD fluids was reduced by 89% (from 37.5 USD to 4.3 USD), which may have also contributed to the high access rate. Thus, the cost factor may be overcome by the adoption of a local model built around commonly available resources. A pragmatic approach like this may be considered in developing countries where the poverty rate is high with limited access to PD.

The limitations of this study were its retrospective nature and small sample size. Moreover, we did not conduct detailed interviews in the four parents/caregivers that declined our opt-out model for PD, although few of them believed the illness was spiritual and resorted to unorthodox medicine despite adequate counseling. In conclusion, the use of adaptable locally available PD consumables and designating PD revolving funds are steps that can enhance PD uptake, reduce mortality, and improve outcome in children with AKI that require PD. If health facilities in LMICs adopt this model, then it may ultimately improve the health and outcome of children with AKI in LMICs.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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