

## Challenges of Peritoneal Dialysis in the Management of Acute Kidney Injury in South-South Nigeria

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### Abstract

**Background:** Peritoneal dialysis (PD) remains a more practical modality for renal replacement therapy (RRT) in young children with Acute Kidney Injury (AKI) especially in resource poor settings. However, its utilization is limited by challenges such as low number of qualified health workers, cost of PD fluid and socio-demographic issues like poor housing, electricity and water supply.

**Methods:** In a retrospective study, the case notes of all children that had prescription for PD as a RRT for AKI over a 10-year period from February 2009 to March 2019 were reviewed.

**Results:** Peritoneal dialysis was prescribed for 16 patients, 11 males and 5 females who were diagnosed with AKI. The main causes of AKI were gastroenteritis, malaria, sepsis and posterior urethral valve (PUV). The ages of these patients ranged from 3 days to 5 years (mean  $3.00 \pm 1.59$  years). However, PD was performed in 7 (44%) of these patients. Three (19%) patients had contraindications to PD such as peritonitis, recent abdominal surgery and intra-abdominal mass. Peritoneal Dialysis was performed manually with PD

catheters inserted in the operating theatre by a paediatric surgeon. Size 16 urinary silicon catheter was used as an improvised PD catheter in 6 patients (86%). PD was delayed for more than 24 hours after prescription in all patients. Time before onset of PD ranged from 2 to 7 days with a mean time before PD as  $1.78 \pm 0.85$  days. Duration of PD ranged from 2 hours to 10 days (mean  $4.15 \pm 1.00$  days). Four (57%) of patients had full recovery of renal function while the remaining three (43%) patients died. All mortalities occurred within 48 hours of commencement of PD. The main challenges were unavailability of dialysis fluid in 100%, delay in obtaining parental consent for PD due to ignorance in 81%, financial constraint in 75% and cultural beliefs in 56% of patients.

**Conclusion:** The utilization of PD was found to be low in resource poor settings like ours. Contributory factors were financial constraints, non-availability of PD catheters and dialysis fluid, delay in obtaining parental consent and cultural beliefs.

**Keywords:** Acute Kidney Injury, Peritoneal dialysis, Challenges, poor resource setting.

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### Introduction

Acute Kidney Injury (AKI) is increasingly prevalent in developing countries with increasing morbidity and mortality.<sup>1,2,3</sup> The exact prevalence of AKI in children in sub-Saharan Africa is not known.<sup>4</sup> Callegari *et al*<sup>4</sup> opines that this could be because it is often ignored and under diagnosed. Susantitaphong *et al*<sup>5</sup> in a global meta-analysis spanning four continents (America, Europe, Asia and Africa) stated

that the pooled incidence of AKI in children was 33.7%. In sub-Saharan Africa, researchers have reported varying numbers of paediatric AKI cases over varied time periods in countries such as Congo-Brazzaville with 106 cases over a 6 year period,<sup>6</sup> Cameroon with 87 cases over 9 years<sup>7</sup> and Ghana with 68 cases in a year.<sup>8</sup> Paediatric AKI reportage in Nigeria follows a similar pattern of varying incidence.<sup>9,10,11</sup>

Renal replacement therapy (RRT) is a form of therapy which replaces non endocrine kidney functions in patients with renal failure. In developed countries, continuous RRT and intermittent haemodialysis are the modalities commonly used.<sup>12,13</sup>

A systematic review in sub-Saharan Africa indicated that 66% of paediatric AKI patients needed dialysis.<sup>3</sup> The choice of RRT in childhood AKI is however limited in developing countries.<sup>14</sup> In Nigeria for example, where 70-90% of health care financing is “out of the pocket spending”<sup>15</sup> a dialysis modality that is cost effective and eliminates the need for clean water, machinery, electricity and maintenance is ideal. Peritoneal dialysis (PD) has been shown to fit into this ideal as a RRT for young children.<sup>4</sup>

Peritoneal Dialysis has been shown to be as effective as hemodialysis (HD) in the treatment of AKI.<sup>4</sup> It is advantageous in patients with risk of bleeding or hemodynamic instability and in patients with technical challenges such as vascular access.<sup>16</sup> It is more physiologic and less inflammatory than HD because of the absence of contact between blood and synthetic membrane, and reduced risk of transmission of blood borne infections.<sup>17</sup> It is frequently used in developing countries because of its lower cost and minimal infrastructural requirements.<sup>18,19</sup> However, developing countries still struggle to provide minimal amount of PD for patients with AKI.<sup>4</sup> In 2007, Abu-Aisha *et al*<sup>20</sup> reported that the prevalence of PD was 2.2 pmp compared to a global prevalence of 27 pmp with bulk of African PD patients residing in South Africa.<sup>20</sup> This was attributed to South Africa having one of the largest dialysis programmes in the African continent.<sup>20, 21</sup> Some studies in Nigeria highlighted challenges to regular usage of PD as lack of standard PD catheter or dialysis fluid, poor access to health facilities for rural dwellers, late presentation to health facilities and poverty.<sup>9,14,22</sup> Even with these challenges, PD appears to be the most practical modality for RRT in young children with AKI in resource poor countries.<sup>23</sup>

In our centre, we aimed to determine the utility of PD

over a ten-year period in the treatment of our AKI patients and highlight the challenges encountered as a tertiary centre in a resource poor country.

## Methods

In a retrospective study, the case notes of all paediatric patients admitted into the nephrology unit of University of Uyo teaching hospital (UUTH), Uyo, Nigeria that had prescription for PD for AKI over a 10-year period from February 2009 to March 2019 were reviewed. AKI was defined according to the modified paediatric RIFLE (risk, injury, failure, loss, ESRD) criteria.<sup>24</sup> Data extracted were entered into a proforma designed for this study.

Sociodemographic characteristics, symptoms, signs at presentation and clinical diagnosis of the patients were noted. Indication for dialysis, dialysis fluid used, catheter used and method of catheter insertion, duration before commencement of PD and duration of the PD were also noted. Outcome of PD and reasons for delay in commencement of PD were documented.

Ethical clearance was obtained from Health Research and Ethics Committee of University of Uyo Teaching Hospital.

Data generated from this study was entered into Microsoft Excel spread sheet from the completed proforma. Data was analysed using Microsoft Excel, and results were presented on pie charts and tables.

## Results

The focus of the study was to highlight the challenges of PD, all patients that has PD prescription for AKI were reviewed. The results of those reviews are presented in this section.

Over the study period, PD was prescribed for 16 patients with AKI with a male to female ratio of 2:1. The ages of these patients ranged from 3 days to 5 years (mean  $3.00 \pm 1.59$  years). Causes of AKI in these patients varied from sepsis to malaria and gastroenteritis as shown in Table I. The abnormal biochemical findings were increased serum urea and

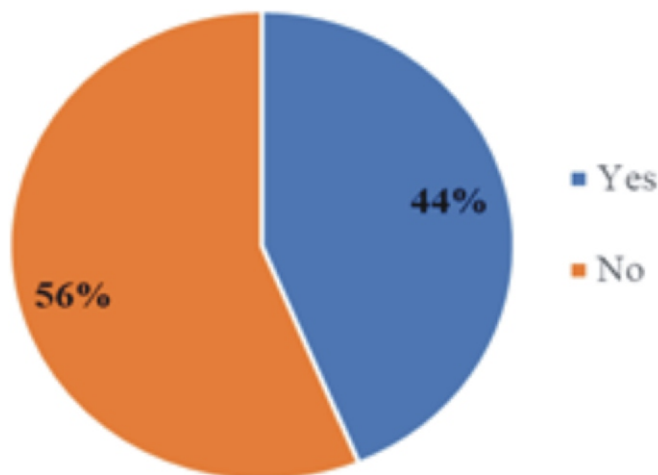
creatinine and metabolic acidosis.

**Table I:** Causes of AKI

| Causes of AKI   | Number of Patients(%) |
|-----------------|-----------------------|
| AGN             | 1(6.25)               |
| Gastroenteritis | 3(18.75)              |
| HIVAN           | 1(6.25)               |
| Malaria         | 4(25.0)               |
| PUV             | 2(12.5)               |
| SBA             | 1(6.25)               |
| Sepsis          | 4(25.0)               |
| Total           | 16(100)               |

Legend: AGN- Acute Glomerulonephritis, HIVAN- HIV Associated Nephropathy, PUV-Posterior urethral valve, SBA- Severe Birth Asphyxia.

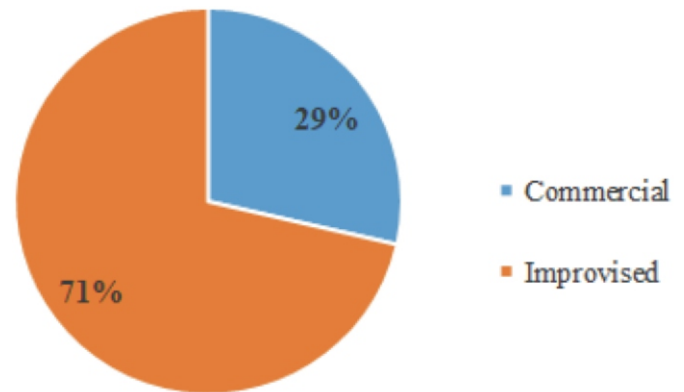
PD was performed in 7 (44%) patients as shown in Figure 1. Furthermore, PD was delayed for more than 24 hours in all patients. Delay in commencement of PD ranged from 2 to 7 days with a mean time before PD of  $1.78 \pm 0.85$  days.



**Figure 1:** Number of Patients on whom Peritoneal Dialysis was performed.

All PD were performed manually with catheter inserted in the operating theatre by a paediatric surgeon via a subumbilical incision into the pelvic peritoneal cavity using the Seldinger technique.<sup>23</sup>

The financial cost of the procedure was increased due to the use of an operating theatre. Improvised catheter (size 16 silicon urinary catheter) was used in 6 (86%) patients. One (14%) patient used a tenckhoff catheter which was purchased from a neighbouring State because of its unavailability in our centre. Due to unavailability and financial constraints, commercial PD fluid (DIANEAL 2.5 mEq/L) was used for only 2 (29%) patients as shown in Figure 2. Improvised PD fluid was used for the remaining 5 (71%) patients. The improvised fluid used was made up of 1000mls of normal saline, 440mls of 10% dextrose, 60mls of 8.4% sodium bicarbonate, 10mg/L of ceftazidime, 30mg/L of vancomycin, 500iu of heparin,  $\pm 4$ mmol/L of potassium chloride.



**Figure 2:** Types of Peritoneal Dialysis Fluid Used.

Duration of PD ranged from 2hours to 10 days (mean  $4.15 \pm 1.00$  days). Four (57%) patients had full recovery of renal function while the remaining three (43%) patients died. All mortalities occurred within 48 hours of commencement of PD.

The main challenges encountered were unavailability of commercial dialysis fluid due to logistic constraints, financial constraints on the part of the care givers and delay in obtaining parental consent due to ignorance, fear and cultural bias as shown in Table II.

**Table II:** Challenges to Peritoneal Dialysis in a resource poor setting.

| Challenges                                 | Frequency of occurrence |
|--------------------------------------------|-------------------------|
| Financial constraints                      | 75                      |
| Availability of PD Fluid                   | 100                     |
| Availability of PD Catheter                | 94                      |
| Delay in obtaining Parental consent for PD | 81                      |
| Cultural beliefs                           | 56                      |

## Discussion

In this study, PD was performed in 44% of the patients for which it was prescribed. The low number of PD performed in our study mirrors that reported in a tertiary hospital in South-South Nigeria with 27% of PD performance.<sup>25</sup> A systematic review by Olowu *et al*<sup>3</sup> reported a dialysis access rate of 64%. They maintained that it was due to financial difficulties and lack of dialysis materials. However, a tertiary hospital located in Abuja (the Federal Capital Territory of Nigeria), reported a 100% dialysis access rate, which they attributed to better socioeconomic conditions when compared with other Nigerian regions.<sup>10</sup> Although PD has gained wider acceptance in recent years based on reports, the proportion of AKI patients who have accessed PD in developing countries remains unchanged.<sup>26</sup> North African Countries account for 0-3% of total peritoneal dialysis carried out in Africa.<sup>20</sup> South Africa however accounts for a greater proportion of total PD performed in Africa, while some African countries account for no peritoneal dialysis.<sup>20</sup> Data from sub-Saharan Africa on the use of PD in children with AKI is however few.<sup>14</sup>

A South African study outlined limiting factors to PD to include cost, low number of qualified health care workers, socio-demographic issues (poor housing, electricity and water supply) and the availability of dialysis fluid.<sup>21</sup> Availability of standard PD catheter and dialysis fluid remain a challenge in resource poor countries.<sup>23</sup> These have led to exploring some cheaper but widely available options as materials used for PD in these settings. Improvised catheters such as nasogastric tubes, urinary catheters, rubber catheters, intercostal drainage catheters, haemodialysis

catheters have been used for PD in some of these countries.<sup>9, 14, 23</sup> These improvised catheters are however not without disadvantages which include a higher risk for dialysate leakage, infection and blockage.<sup>22</sup>

A major constraint to RRT in sub-Saharan African has been the low number of qualified health workers, nephrologists, trained renal nurses, social workers and technologists.<sup>21</sup> In this study, all our patients had catheters inserted in the theatre by a paediatric surgeon increasing the cost of the procedure. Patients have to bear the cost of theatre fees, anaesthesia fees and theatre consumables. This cost could be reduced as inserting a PD catheter can be done at the bedside by a trained nephrologist without the need of a surgeon or theatre, thus making the cost cheaper. Catheters are now available in complete kits providing all the components for a non-surgical insertion.<sup>4</sup>

Improvised dialysis fluid which can be lifesaving carry with it an increased risk of peritonitis compared to commercial dialysis fluid if not prepared under strict aseptic conditions.<sup>23</sup> In this study, 29% of the patients who had dialysis used improvised dialysis fluid. In many sub-Saharan countries where PD is practiced, there is total dependence on commercial PD fluids imported from developed countries which adds substantially to the cost of PD.<sup>21</sup> This in turn may lead to a delay in dialysis as well as inadequate dialysis.

None of the patients in this study had PD within 24 hours of its prescription. The reasons are multifactorial ranging from availability of PD fluid due to financial constraint, delay in parental consent due to ignorance, fear and cultural beliefs. Some of these challenges have also been reported in other studies in sub-Saharan Africa.<sup>3,9,21,23,25</sup> Financial constraint and unavailability of materials (PD, catheter and dialysis fluid) were the recurring challenges in our setting. In a study carried out in Kano, Nigeria on cost analysis of Peritoneal Dialysis versus Haemodialysis, the estimated cost of PD was 311.66 US dollars.<sup>27</sup> Majority of our patients had

difficulty providing the materials for PD, thus delaying the procedure. Culturally, it is believed in this region that children do not have “kidney problems”. If it does occur, it is usually attributed to “mystical” reasons, witchcraft or familial curses and such children are not expected to survive. This probably explains the delay in parental consent in some of our patients.

Sepsis, malaria and gastroenteritis were the leading causes of AKI among our patients. These are all preventable causes of AKI with prompt diagnosis and treatment of these conditions. This finding is in consonance with reports from other studies carried out in sub Saharan Africa.<sup>7,11</sup>

### Conclusion

The utilization of PD in our setting is low, mainly due to financial constraints, lack of materials like PD catheter, dialysis fluid and insufficient personnel to administer PD.

We therefore recommend increased training of personnel and availability of materials with subsidization of the cost of PD by the government to improve the utilisation of PD as an RRT for AKI. We further recommend intensified efforts in the control of gastroenteritis and prevention of dehydration as these were noted to be the leading causes of AKI in this study. Furthermore, prompt diagnosis and treatment of sepsis with appropriate antibiotics should not be overlooked.

### Authors' contributions

E.E.E conceived the idea of the study and a principal investigator. I.E E and D-U.O.T reviewed and provided critical feedback on the manuscript.

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