Tropical Journal of Nephrology Vol.12 No 2, December, 2017 45 - 52

Acute Peritoneal Dialysis Experience in a Public Tertiary Hospital in Nigeria: Challenges and Limitations of a Resource Poor Nation

Solarin AU, Aremu EO, Gbelee HO, Salisu M and Animashaun BA

Lagos State University Teaching Hospital, Ikeja

ABSTRACT

Peritoneal Dialysis is well known treatment option for Acute Kidney Injury. It is thought to be less expensive and more frequently used in the developing countries. We report our experience in the practice of peritoneal dialysis in a resource constrained environment. We acknowledge that it is indeed a simple procedure. The challenges of availability of catheters, commercially produced peritoneal dialysis fluid and cost of standard peritoneal dialysis fluid have limited its widespread use and focused PD and improvised fluids have evolved as our adaptation.

Method: Intentional prospective cohort study of children who had peritoneal dialysis between October 2015 and December 2016 at the Lagos State University Teaching Hospital, Ikeja. Information such as Age, gender, cause of Acute kidney injury, indication for dialysis, duration, type of catheter used, complication and outcome were documented.

Result: A total number of 17 cases of AKI had peritoneal dialysis over a period of fifteen month. Their age ranges between 10days to 12years with a mean age of 3.24± 3.76 (in years). Fifty-three percent (9) of them were males while 47% (8) were females with male to female ratio of 1.1:1. Sepsis 9(52.9%) and primary kidney diseases 6(35.3%) were the most common causes of AKI requiring dialysis. Indications for dialysis include fluid overload (60.0%), severe metabolic acidosis (53%), anuria (40.0%), Hyperkalemia (40.0%) and oliguria (33.0%). Majority of them (14/17; 82.4%) had standard peritoneal dialysis fluid while 3(17.6%) had improvised fluid using 470 mls of ringer's lactate and 25 mls of 50% dextrose water and 5mls of 8.4% sodium bicarbonate. The duration of PD ranged between <1 to 16days with a mean duration of 7.31±4.61(in days). Catheter blockage (17.6%), leakage and slip out (17.6%) were the most common complications experienced. Peritonitis as a complication was seen in 2(11.8%) subjects.11 (64.7%) of the children were discharged from the hospital following resolution of AKI. 5(29%) of them died.

Conclusion: PD remains a good option in treatment of AKI requiring renal replacement therapy with good outcome and few complications.

Keywords: *acute kidney injury, dialysis, paediatric, peritoneal, focused peritoneal dialysis*

INTRODUCTION

Peritoneal dialysis (PD) is a recognized treatment option for acute and chronic renal failure. Globally, the use of PD has been reported to contribute in recent times at 11% of world's dialysis population [1]. Peritoneal dialysis was the first renal replacement treatment (RRT) modality and is preferred in the management of AKI in children especially the younger children [2]. Interestingly, the use of PD is declining especially in the developed nations because of availability of the newer extracorporeal blood purifying technologies [2]. However, its practice has declined in favor of the new extracorporeal blood purifying technologies especially in the developed countries [2]. The choice of RRT in any country is affected by factors such as socioeconomic status. PD offers several advantages over extracorporeal

Corresponding Author: **Solarin AU,** Lagos State University Teaching Hospital, Ikeja *E-mail:* asolar234@gmail.com

blood purifying techniques that are widely acknowledged. PD requires minimal equipment and technically simple to practice. Secondly, it is a better option when there is difficulty with vascular access and for those at risk of bleeding since it requires no anticoagulation. Thirdly, PD offers a gradual removal of solutes and complications of extracorporeal circulations such as disequilibrium syndrome are absent. Additional advantage for PD is good hemodynamic tolerance since it requires no extracorporeal circulation and local renal hemodynamics may be preserved. It has also been postulated that PD may be more physiologic and less inflammatory than extracorporeal therapies in which blood is exposed to synthetic materials [2]. Peritoneal dialysis procedure requires expertise in catheter insertion [2]. ISPD recommendation for paediatric acute dialysis is that flexible tenchkoff catheters be inserted surgically [2]. Alternatively, Paediatricians can insert catheters by the bedside using the Seldinger technique without the backup of theatre facilities and must be performed in the most sterile environment [2]. Studies on bedside catheter placement found it to be safe and cost effective [3]. Recommended catheters include the tenchkoff catheter for older children and the Cook catheters for infants and small babies [2]. The rigid catheter is an alternative especially in older children but associated with increased frequency of leakage compared to tenchkoff catheters [2]. When the standard catheters are unavailable, alternatives such as nasogastric tubes, chest tube drains, double lumen adult dialysis catheter can be used and have been lifesaving in many instances [2] but routine use is not recommended [2]. Peritoneal dialysis fluids are commercially available in different strengths depending on glucose concentration [2].

Despite the many glaring advantages of PD, there is no uniform and consistent access to it in our country. Expertise, availability of catheters and fluids were major challenges to the establishment and continuous PD program in our facility. Prior to the 2008 outbreak of diethylene glycol poisoning with associated AKI from a teething mixture "My Pikin" across the nation, PD was not a common practice. The sudden upsurge in the incidence of AKI with nearly 100% mortality stimulated the lead author to go for subspecialty nephrology training. The incidence brought government participation however brief in procuring the initial rigid catheters used. The use of PD as a modality of management of AKI in our facility has however evolved over the years with availability of expertise, procedure friendly catheters and other materials. Where necessary, unavailability of standard materials have no longer hampered our practice of PD as we have readily adapted for use commercially available intravenous fluid like Ringers lactate to constitute 2.5% PD and 1.5%PD like the reports by Obiagwu et al in Kano [4]. We have also been able to reuse some of our catheters after sterilization in hypochlorite with no added infection risk. Antwi in Ghana [5] and Fedrick in Tanzania [6] described their use of improvised PD fluid using constitution from 500ml of Norma saline, 250ml of 5% dextrose, 40mls of 8.4% sodium bicarbonate, 7.5mls of 10% calcium gluconate, 1000iu of heparin and 250mg of ceftriaxone in case reports.

We have described our experience using the tenchkoff and Cook catheters as well as our adaptation when overall cost was out of patients' reach, improvising materials and focusing PD to the neonates and younger infants.

The various advantages of PD outlined above have been well explored among children with AKI in our center with a good (successful) outcome. Hence, the need to report our experience.

METHODS

Intentional prospective cohort of children with acute kidney injury requiring dialysis, who had peritoneal dialysis for AKI between October 2015 to December 2016, in Lagos State University Teaching Hospital (LASUTH), were recruited. Lagos State is the most densely inhabited metropolitan city in Nigeria with a population close to 20 million [7] with three tertiary hospitals, two of which is owned by the Federal Government. LASUTH is a Lagos State Government owned Tertiary hospital located in Ikeja, the capital city of Lagos State in South-West Nigeria. It is a multi-specialist hospital with a bed complement of 770. It receives patients from private and public hospital within the state and occasionally from neighboring Ogun State. Children are usually admitted for about 48-72hours in children emergency room (CHER) and transferred to general ward if they have not fully recovered. CHER in LASUTH has a capacity of 37 beds while the general ward and neonatal unit have 58beds in total. Paediatric department of LASUTH attends to children from birth

to 13years. Critically ill children are often managed at the CHER or general ward instead of intensive care unit due to financial constraints and lack of paediatric ventilator support.

Information such as, age, gender, cause of AKI, and indications for dialysis were recorded in a proforma and subsequently transferred into an excel spreadsheet. Type of catheter used, duration of PD, complications as well as outcome of hospitalization were also recorded into the proforma. Documentation of the cost expenditure for the consumables were documented and compared with hemodialysis at our center. Ethical approval was obtained from the Health Research and Ethics Committee of the hospital prior to commencement of the study.

The procedure for PD catheter insertion for each patient was done by one of the authors in a designated room for such procedures and sometimes by patient's bedside. Kimal peel away tenchkoff and cook catheters were used and procedure done using the seldinger technique and standard recommended procedure was adhered to. The catheters were secured with pulse string after insertion. A close system utilizing buretrols to measure fill and drainage volumes was often the practice. However, sometimes, infusion giving burette (soluset) was connected to the PD fluid at one end while the other end was attached to the catheter via a catheter extension (connector) which is connected to the outlet via a three-way tap. A 2ml size syringe is improvised and attached to the tubing of a urine bag serving as drainage bag. Filling was performed via the soluset through the connector while PD effluent drainage was done through the connector via the improvised syringe into the urine bag. Fill volume at the commencement of dialysis was often at 20mls/kg per cycle, which may be increased to 30mls/kg when the need arises. Dwelling time for each cycle was 30 – 45minutes. The strength of PD fluid often used varied between 1.5% and 2.3%. Heparin at a dose of 500u/L was added to the PD fluid. Antibiotics are not routinely added to PD fluids, however when indicated in treatment of peritonitis, Ciprofloxacin and vancomycin were added into PD fluid at the dose of 20mg/L and 15mg/L respectively. Potassium was also added to the PD fluid at a dose of 4mmol/L when serum potassium drops to d"4mmol. Commercially prepared fluid (Fresenius) often used. Locally constituted fluid using ringer's lactate and 50% dextrose water was employed in some instances [4].

Records of dialysis cycles/events of every patient were documented in a designed PD chart. The events recorded on the chart include; time and volume of fluid in and out of the peritoneal cavity, ultrafiltrate and vital signs of patient during each cycle. Individual PD dialysis lasted till urine output was more than 0.5mls/kg/hour with resolution of the initial indications of peritoneal dialysis.

RESULTS

A total number of 17 cases of AKI had peritoneal dialysis over a period of one year. Their age ranges between 10days to12years with a mean age of 3.24± 3.76 (in years). Age groups of children dialyzed is shown in fig 1. Fifty-three percent (9) of them were males while 47%(8) were females with male to female ratio of 1.1:1. Sepsis 9 out of 17(52.9%) and primary kidney diseases 6 (35.3%) were the most common causes of AKI requiring dialysis. Indications for dialysis include fluid overload (60.0%), severe metabolic acidosis (53%), anuria (40.0%), Hyperkalemia (40.0%) and oliguria (33.0%). All the subjects however had multiple indications for peritoneal dialysis (Figure 2). Ten (58.8%) of them had Cook catheter while Kimal catheter was used for the remaining 7 (41.2%) subjects.

Majority of them (14; 82.4%) had standard peritoneal dialysis fluid while 3(17.6%) had improvised concocted fluid using ringers lactate and 50% dextrose water. The duration of PD ranged between <1 to 16days with a mean duration of 7.31±4.61days. Catheter blockage (17.6%), leakage and slip out (17.6%) were the most common complications experienced. Peritonitis as a complication was seen in 2(11.8%) subjects. Other complications seen were exit site infection 1(6%), catheter malfunction 1(6%). 11 (64.7%) of the children were discharged from the hospital following resolution of AKI. 5(29%) of them died, while 1(6%) discharged against medical advice. When the outcome of PD was compared with the duration of PD, it showed that longer duration results in good outcome, the finding was however not statistically significant (p=0.06) [figure 3].

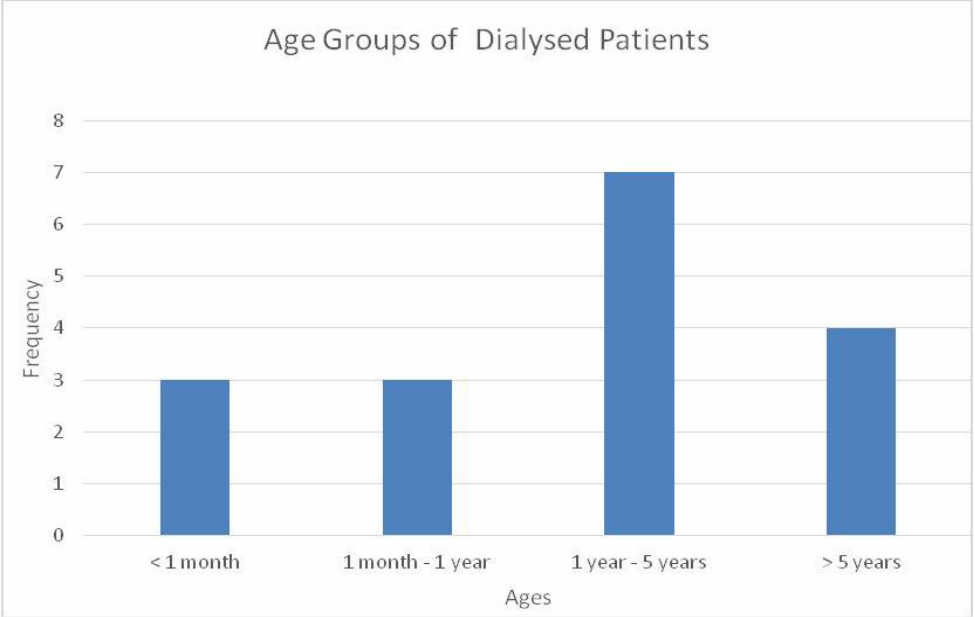

Figure 1: **Age groups of Dialysed Patients**

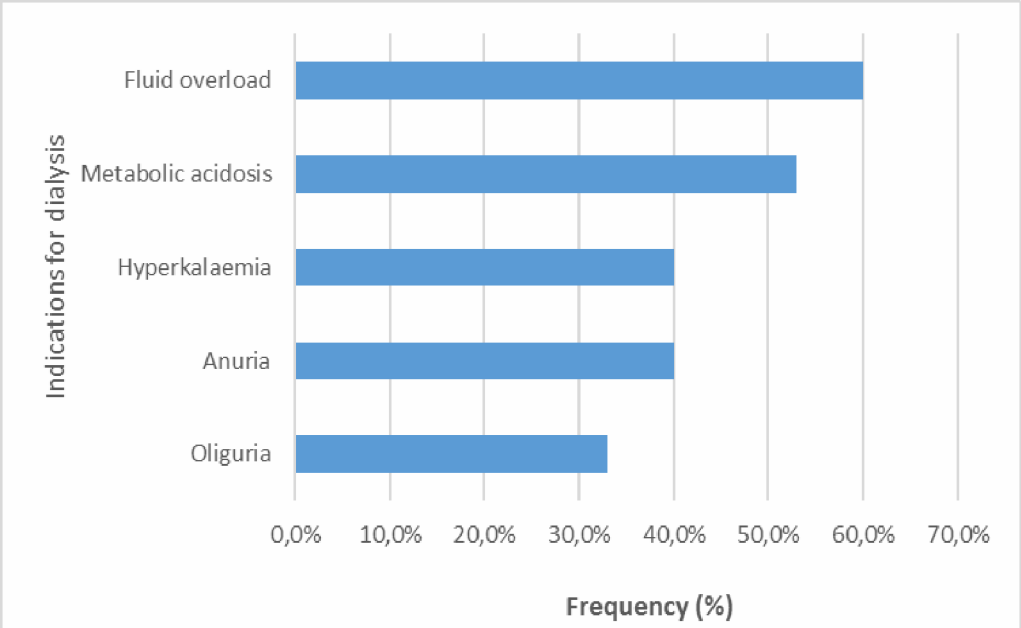

Figure 2: **Indications for Dialysis**

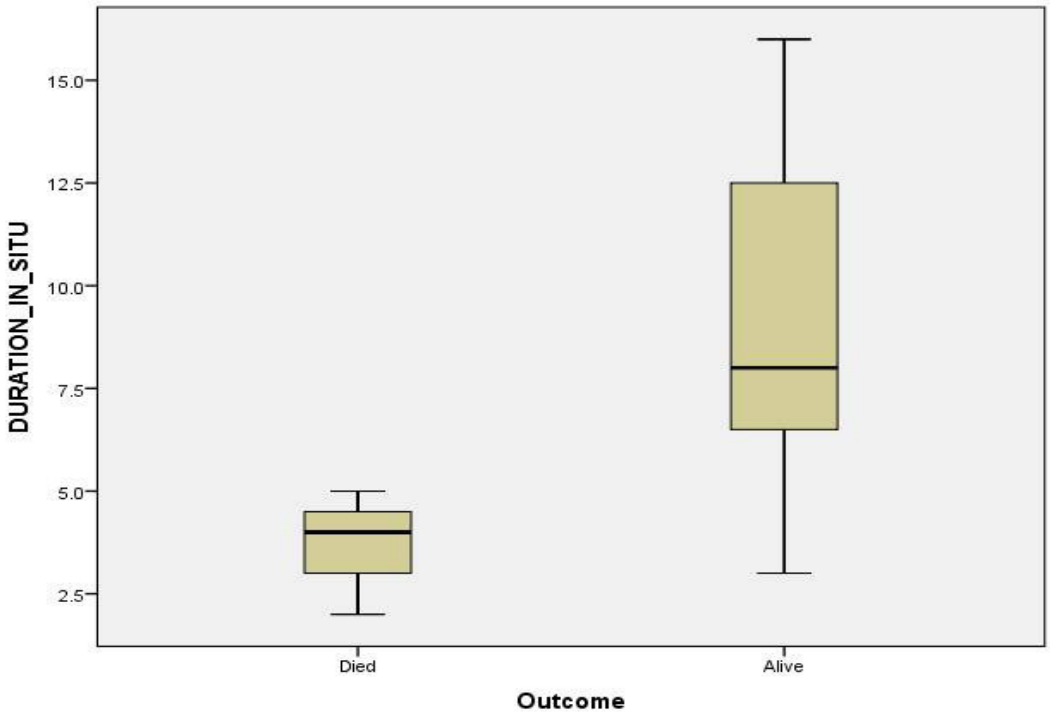

Figure 3: **Box Plot Showing Comapring Duration of PD with Outcome (p=0.06)**

Table 1: Cost analysis for children weighing up to 10kg for three days PD

Weight	30mls/kg	Total vol for 24 cycles	Number of 2 L bags	Cost per day at N2,200 per bag	cost per day	cost for 3 days	cost of catheter(Cook/Kimal)	cost of connector	cost of fresinus set	total cost for 3 day(Naira)
2	60	1440	1	2200		6600	15000	10000	25000	56600
3	90	2160	2	4400		13200	15000	10000	25000	63200
4	120	2880	2	4400		13200	15000	10000	25000	63200
5	150	3600	2	4400		13200	15000	10000	25000	63200
6	180	4320	3	6600		19800	15000	10000	25000	69800
7	210	5040	3	6600		19800	15000	10000	25000	69800
8	240	5760	3	6600		19800	15000	10000	25000	69800
9	270	6480	4	8800		26400	15000	10000	25000	76400
10	300	7200	4	8800		26400	15000	10000	25000	76400

Standard cost for Peritoneal dialysis for three days using soft catheters and closed system of Fresenius. For adaptation, use of three- way tap (N1000), soluset (N2000), fluid giving set (N200), urine bag (N500)

DISCUSSION

Peritoneal dialysis experience in our Centre in the last one year showed a great improvement in the frequency of dialysis with a better outcome over our past practice. Previously, many of the patients with AKI in our Centre requiring RRT were offered more of extracorporeal therapy if they were ten years and above. The neonates and younger children were often either managed with single volume exchange transfusion as many the AKI were secondary to septicaemia or on few occasions PD with variable outcome. In this report, eleven (64.7%) of the children with AKI managed using PD were discharged home following resolution of AKI while a low (29%) mortality was recorded. This tremendous improvement documented in the outcome within this one-year review can be attributed to availability of expertise, materials and better knowledge of PD. Esezobor et al [8] in a similar study recorded a higher mortality among the studied subjects, this may be due to the use of improvised materials and PD fluids among many of their subjects.

All the children in our report had soft PD catheters either Cook catheter or the Tenckhoff catheter which is the optimal recommendation by the International Society of Peritoneal Dialysis [2]. The Tenckhoff catheter remains the gold standard for PD access and is the most widely used in chronic dialysis [2]. These catheters are preferable to the rigid or improvised they have a larger diameter lumen and side holes resulting in better dialysate flow rates and less obstruction which is imperative in acute PD to achieve adequate clearances. They are also less prone to leakage and have a lower incidence of peritonitis [2]. Our experience previously with rigid catheters was good as we had no recorded case of bowel or bladder perforations. However, leakage of dialysate and obstruction probably due to the small side holes were some of the complications we encountered. The incidence of peritonitis is said to increase with the time the catheter is left in the abdomen [2].

Fluid overload, anuria and severe metabolic acidosis were the commonest indications for PD among our patients. This is similar to the findings reported by Esezobor et al [8]. Anochie et al [9] from Port Harcourt in a similar study however reported uraemic encephalopathy as the commonest indication for PD among their study subjects while Olowu et al [10] in their study among children with AKI reported severe hypertension and congestive cardiac failure as the commonest indications for dialysis among the children studied. Thus, common indications for PD vary from place to place and among patients depending on the severity of AKI, time of presentation and underlining aetiology.

Peritoneal dialysis is occasionally associated with some complications. A few complications were recorded among our study subjects, commonest of which were catheter blockage and leak out. Review of several literatures has also shown catheter blockage/leakage and peritonitis as common PD complications [11, 12, 13]. Majority of the catheter blockage experienced in our study was mainly among children who used cook catheter, this is perhaps due to small caliber of the catheter and the tiny fenestrations. Similar experience with cook catheter has been documented even in developed world [14]. Peritonitis occurred in two (11.8%) of our subjects unlike the reports from some other similar studies with higher occurrence [11, 12]. The low incidence of peritonitis as a complication in our study, despite our routine of non-use of antibiotics in PD fluid is commendable. This can be attributed to strict adherence of asepsis and meticulous management of the whole process starting from insertion of catheter to manual performance of the PD itself. Parents of the subjects were counseled and taught severally on the need for good hygiene around the children while on dialysis.

Common factors identified among the subject that died included delayed presentation, severity of AKI and aetiology of the AKI. Primary renal disease accounted for all the mortality documented in our patients.

The use of PD in our facility is not without some challenges which were also reported to be common to most facilities in developing countries [11, 15, 16, 17]. Lack of fund is a major challenge we often encounter in the management of our patients with AKI. Possible explanations we readily can adduce include: Most parents/caregivers are from very low socioeconomic class, No comprehensive insurance cover, poor supply of PD consumables like PD fluids, connectors and catheter, inadequate trained personnel, and lack of seamless/good laboratory support as well as limited support at the government level.

Adaptation such as focused PD in view of cost burden on the parents/caregivers is now a more constant practice. The cost of PD for a neonate or younger child was cheaper in relative terms compared to an older child (Table 1). Extracorporeal therapy in form of Hemodialysis is cheaper at N25,000 (less than $100) for older children. Interestingly Obiagwu and Aliyu Abdul in their article performed a cost analysis between PD and HD and found PD was cheaper [18]. We, however, only evaluated the cost of consumables for three days PD and compared it with the cost of HD. We acknowledge our institution's reduction of fees paid for HD to N25000 (this includes a single lumen catheter for femoral cannulation) and subsequent session of N20000 and did not put a cost to nursing and nephrologist fee, we can only infer that there may be cost differences based on location.

Other adaptations include mixing fluids using lactated ringers and 50% dextrose which is acceptable when the circumstance permits.

Outlook of PD in our facility is however bright, in view of the good outcome recorded in this report despite our limitations. Therefore, the future is more promising, if the earlier outlined challenges can be surmounted. Capacity building in terms of training and retraining personnel, availability of standard PD fluids and catheters at affordable costs via collaboration with local and international agencies are vital areas that are currently being explored in our facility, towards a more excellent outcome with the use of acute PD.

CONCLUSION

Acute PD as one of the modalities of managing paediatric AKI is a lifesaving intervention in our developing world, with associated good outcome. Availability and affordability of standard PD fluids, catheters and expertise will further brighten the outlook and outcome of this important intervention among children with AKI in our resource constrained country, and ultimately reduce childhood mortality.

Funding: None

Conflict of Interest: *None declared*

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