The Outcome of Continuous Ambulatory Peritoneal Dialysis in Children: A Single Center Experience

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ABSTRACT

Background and Objectives: This is a retrospective study designed to determine the outcome of continuous ambulatory peritoneal dialysis (CAPD) in children.

Methodology: The medical record of the patients diagnosed with end-stage renal failure undergoing CAPD was reviewed for clinical and laboratory data. Children below 5 years of age or weighing less than 15 kg and older individuals up to 15 years of age who could not visit the hemodialysis centers due to socioeconomic reasons were included. The infants were excluded from the trial as the infantile CAPD catheter was not available in our country. The duration of CAPD and complications encountered during the treatment were also mentioned. Data analysis was done by using SPSS version 20.0 with p-value calculated for the statistical significance of results.

Results: A total of 45 children - 27 (60%) boys and 18 (40%) girls underwent peritoneal dialysis. The mean age at the initiation of CAPD was 37.5 months and the majority of patients had congenital anomalies of kidneys and urinary tract. Complications encountered in the subjects included occurrence of peritonitis seen in 100% followed by exit site infection in 20% participants while catheter replacement due to displacement was seen in one child. 37.7% children were shifted to hemodialysis permanently, 13.3% received renal transplantation from living related donors and 33.3% subjects died while 4.4% remained on peritoneal dialysis and 11.1% lost to follow-up.

Conclusion: Despite high rate of mortality CAPD still remains the treatment modality in small children with ESRF.

Keywords: Continuous ambulatory peritoneal dialysis; Chronic kidney disease; Complications; mortality.

INTRODUCTION

Chronic peritoneal dialysis is a home-based, widely used, safe and effective modality of renal replacement therapy (RRT) mostly used in infants and small children with chronic kidney disease (CKD) in developing countries due to vascular access problems for hemodialysis. Due to increasing number of patients with end stage renal failure (ESRF) over the past decade, RRT is being offered to a large number of children in the form of hemodialysis, chronic peritoneal dialysis and renal transplantation. The decision to choose CAPD for dialysis treatment depends on the patients' lifestyle, availability of service and clinical contraindications. Moreover, it is less commonly related to hemodynamic instability and has been found to be associated with improved health related quality of life.[1] Certain factors to be considered for the caregivers include (1) their capability to perform the dialysis at home (2) integration with work, school, hobbies, social and family activities (3) modifications of home if required (4) flexibility of daily treatment cycles (5) prescribed course of medication and diet and (6) alterations in body image and physical activities resulting from CAPD catheter access site. Unsuccessful CAPD is mostly the result of infections leading to death in some cases. Despite CAPD catheter related complications such as peritonitis, exit-site infection (ESI), tunnel infection, pericatheter leakage and mechanical dysfunction,[2-4] this treatment modality is still commonly utilized in infants and small children and can serve as a bridge between ESRF and renal transplantation.

The paucity of data in our country regarding outcome of CAPD in pediatric age group made us report our experience from a single tertiary care center.

METHODS

There were 45 patients diagnosed as ESRF who underwent CAPD between 2009 and 2018 and were selected for the study. This modality of treatment for CKD was recommended in participants below the age of 5 years or those weighing less than 15 kg and older individuals up to 15 years of age who could not visit the hemo-

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dialysis centers due to socioeconomic reasons. The children who survived for at least 6 months after initiation of CAPD were included in the study. The information was obtained from medical records of patients regarding clinical and laboratory data, duration of CAPD and complications encountered during the treatment. General anesthesia was administered for the surgical placement of Tenckhoff catheter in all subjects and the procedure was commenced electively after two weeks of catheter insertion. The dialysis was performed 5 – 6 times daily during the day with 40 ml/kg dialysate exchanges and dwell time being 3 – 4 hours. The follow-up visits were advised initially monthly, then quarterly and later on 6-monthly basis. The routine hematological and biochemical laboratory tests included blood counts, serum urea, creatinine, electrolytes, calcium and iron profiles on every follow-up visit while serum Vitamin D and intact parathyroid hormone levels were prescribed annually or earlier if treatment modification was required. The outcomes were observed in the form of number of episodes of peritonitis, ESI and tunnel infection, pericatheter leakage and mechanical dysfunction. Peritonitis was defined as presence of two of the following signs - abdominal pain, fever, hazy dialysate and/or total leucocyte count $\geq$ 100/mm^3 showing predominance of neutrophils.[5] ESI was diagnosed by occurrence of purulent discharge, edema, erythema, and/or tenderness at the catheter exit site. Tunnel infection was confirmed by ultrasonography showing signs of inflammation along the subcutaneous tunnel. Recurrence of peritonitis was defined to occur within 4 weeks of a previous episode due to a different organism while relapsing peritonitis was due to the same organism responsible for the episode occurring within the past 4 weeks. Repeat peritonitis occurred beyond 4 weeks of the previous episode and due to the same organism whereas refractory peritonitis showed no response to 5 days of antimicrobial therapy.

Assessment of adequate peritoneal dialysis was measured by Peritoneal Equilibration Test (PET) twice a year after commencement of CAPD in all children. Subjects who switched to hemodialysis, underwent renal transplantation and expired during the study period were also included in the outcome measures. Data analysis was done by using SPSS version 20.0.

RESULTS

CAPD was performed in 45 patients diagnosed with CKD Stage 5 with 27 (60%) boys and 18 (40%) girls (male to female ratio = 1.5:1.0). The mean age of subjects was *37.5 months* with 35 (78%) children below and 10 (22%) subjects above 5 years old. The majority of participants had congenital abnormalities of kidneys and urinary tract (CAKUT) (65%) (Figure 1) (Table 1). CAPD catheters were placed surgically in 46 children and one patient had replacement done following catheter dislodgement. Topical mupirocin application at the

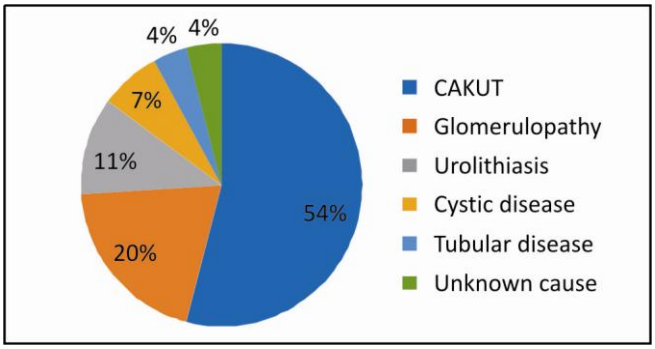

Fig. 1: *Etiology of Chronic Kidney Disease.*

Table 1: *Etiology of Chronic Kidney Disease.*

Condition	*Number*	*Percentage %*
CAKUT	*24*	*54%*
Posterior urethral valves	11	46
Vesicoureteral reflux	9	38
Congenital renal hypoplasia	1	4
Neurogenic bladder	1	4
Pelviureteric junction obstruction	1	4
Megaureter	1	4
Glomerular Diseases	*9*	*20%*
Congenital nephrotic syndrome	3	33.3
Focal segmental glomerulosclerosis	3	33.3
Mesangioproliferative glomerulonephritis	3	33.3
Urolithiasis	*5*	*11%*
Primary hyperoxaluria I		
Cystic Diseases	*3*	*7%*
Polycystic kidney disease	1	33.3
Juvenile nephronophthisis	1	33.3
Multicystic dysplastic kidney	1	33.3
Tubular Diseases	*2*	*4%*
Distal renal tubular acidosis		
Cause Unknown	*2*	*4%*

catheter exit site was not practiced in our center and dialysis in all cases was performed by the mothers/ caregivers at home with technical support and guidance provided by Fresenius Medical Care. The mean duration of treatment with CAPD was found to be *20.5 months*. The post-surgical complications seen were leakage and bleeding from the catheter site in 15 (33%) and incisional hernia in 3 (7%) children. The late complications included peritonitis occurring in all (100%) children followed by exit site infection in 9 (20%) participants, catheter blockade in 5 (11%) while tunnel infection developed in 2 (4.4%) subjects (Table 2). 31

(68.9%) cases experienced more than one episode of peritonitis with the first one occurring within the first

Table 2: *Complications of CAPD.*

Complications	*Number*	*Percentage %*
Early		
Leakage	15	33
Bleeding	15	33
Incisional hernia	3	7
Late		
Peritonitis episodes	72	
• Recurrent	20	28
• Relapsing	25	35
• Repeat	22	31
• Refractory	5	7
Exit site infection	9	20
Tunnel infection	2	4.4
Catheter blockade	5	11
Catheter displacement	1	2.2

6 months of initiation of CAPD in 28 (62%) children. The causative pathogens responsible for peritonitis episodes were mostly not isolated (41%) while Gram negative and positive organisms accounted for 33.3% and 25.7% respectively – Klebsiella, Pseudomonas and Coagulase-negative Staphylococcus being most common. The outcome measures analyzed are shown in Figure 2. The most common causes of death were infection (55%), volume overload (13%), and bowel perforation (5%) while cause was undetermined in 27%.

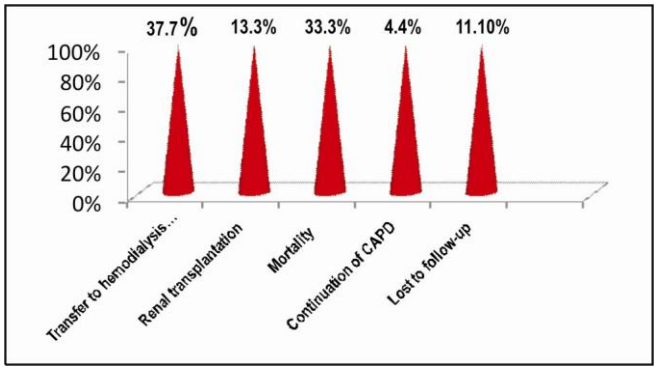

Fig. 2: *Outcome Measures of CAPD.*

DISCUSSION

The study performed on 45 children with ESRF in a single tertiary care center reports that in our country there is preference for CAPD over hemodialysis mostly in cases below 5 years of age/weighing less than 15 kg (78%) as also seen in other studies.[6-8] The common causes of ESRF in our patients were seen to be CAKUT (54%) followed by glomerular diseases (20%) which was similar to the results presented by Sinha and colleagues.[9] In contrast Lee K et al observed chronic glomerulonephritis in majority of patients (87.7%) followed by CAKUT (8.8%).[10] According to the annual report of North American Pediatric Renal Trials Collaborative Studies (2011)[11] and Gonzalez et al,[12] CAKUT was the leading cause of ESRF in 35.2% and 28.3% subjects respectively.

Peritonitis has been found to be more common in our setup as compared to the developed world which can be related to the poor socioeconomic status of our children. All our subjects experienced peritonitis with 68.9% cases having more than one episode with the first one occurring within the first 6 months of CAPD initiation in 62%. Although the number of episodes of peritonitis was observed to be low in older children, there was no difference in the incidence of peritonitis seen among children below and above 5 years of age ($p = 0.31$). The low incidence of peritonitis is associated with automated peritoneal dialysis (APD) as compared to CAPD.[13] The frequency of relapse in our study was more (35%) than the previously reported rates of relapsing peritonitis which was seen in up to 21% of patients.[14]

The etiology of peritonitis revealed no isolation of micro-organisms in majority of our participants (41%) followed by growth of Gram negative pathogens in 33.3% which was different from other data published in the literature which shows Gram positive organisms (58.2%) to be responsible for majority of episodes.[15,16]

Mekki et al concluded that the noninfectious complications of CAPD including catheter blockade were found to be significantly prevalent in children as compared to adults[17] (22.5% versus 9.3%; $P = 0.006$). Esposito et al also identified catheter obstruction in almost similar number of subjects (21%) which was confirmed by ultrasonography.[18] Comparatively, leakage and bleeding from the catheter site was seen in 33%, incisional hernia in 7% and catheter blockade in 11% of our patients.

Our mortality was found to be much higher (33.3%) in contrast to 17% pediatric patients receiving CAPD in a trial by Tsai HL et al[19] in whom hypoalbuminemia had a significant association with death. Our data revealed the high mortality to be associated with repeated episodes of peritonitis leading to septicemia. Honda M and his coworkers[20] determined the association of mortality with sclerosing encapsulating peritonitis following repeated episodes of peritonitis which was also observed by Maruyama Y[21] and Levy et al.[22] A study by Sethna CB et al revealed that poor conformity with follow-up of peritoneal dialysis care was associated with an elevated hazard of peritonitis.[23]

It is ***concluded*** that Congenital anomalies of kidney and urinary tract (CAKUT) was found to be the underlying etiology of chronic kidney disease in majority of our children who underwent CAPD. The out-

come depends on infectious and non-infectious complications associated with the dialysis modality and included peritonitis which was seen in more than 50% patients during the first six months of initiation of dialysis followed by leakage and hemorrhage occurring in about one-third cases. Despite the high rate of mortality CAPD still remains the treatment modality in small children with ESRF.

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Conflict of Interest
None.

Author's Contribution
NA: Conceived the idea, design and writing of manuscript. SI: Critical review and suggestions. AC: Data collection and statistical analysis.

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