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Complication and Outcome of Continuous Ambulatory Peritoneal Dialysis: A Single Centre Experience

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Abstract **Original Research Article**

Continuous ambulatory peritoneal dialysis (CAPD) is a globally accepted form of renal replacement therapy (RRT) and gaining popularity day by day. To evaluate the complications and outcome related to CAPD this study was carried out at a tertiary care hospital in Bangladesh on 36 patients of end stage renal disease (ESRD) underwent CAPD from January 2019 to December 2023. All study patients were followed-up routinely from first month to 24th month of CAPD. We observed different complications (infectious and mechanical) and outcomes of CAPD among 36 patients occurring during the course of study. Mean age of the study patients was 62.7±6.68 years, with a predominance of middle-aged males from urban areas. Diabetic nephropathy was the leading (56%) cause of ESRD followed by hypertension (17%), glomerulonephritis (14%), obstructive nephropathy (5%), sepsis (5%) and unknown etiologies (3%). Peritonitis was the most common complication in our study occurring in 41.64% of study patients. The most common organism responsible was Staphylococcus Aureus (11.11%) followed by E. coli (5.55%), Pseudomonas (5.55%), Fungi (2.77%) and Acinetobacter (2.77%). Exit-side infections were observed in 8.3% patients and severe malnutrition was observed in 5.6% patients. Mechanical complication like peri-catheter leaks (5.6%), catheter malposition (2.8%), hydrothorax (2.8%), umbilical hernia (5.6%), inguinal hernia (2.8%), and scrotal swelling (2.8%) were also seen. At the end of 24 months, 56% patients were continuing CAPD, 11% was shifted to hemodialysis (HD), 8% of study patients was improved from acute kidney injury (AKI), however 25% was died due to septicemia and cardiac causes.

Keywords: Continuous Ambulatory Peritoneal Dialysis (CAPD), Complications, End Stage Renal Disease (ESRD), Hemodialysis (HD), Outcomes.

1. INTRODUCTION

Prevalence of Chronic Kidney Disease (CKD) is increasing rapidly day by day and causes global health burden. It was reported that, more than 10% of global population suffering from CKD [1]. Continuous ambulatory peritoneal dialysis (CAPD) was primarily initiated in the 1960s as an alternative to hemodialysis (HD), which is one of the modes of renal replacement therapy (RRT) being utilized for the management of end stage renal disease (ESRD) [2]. The last few decades have seen several developments in the field of peritoneal dialysis (PD), including successful use of acute PD, increasing emphasis on home dialysis utilization [3]. Nowadays, CAPD is an established form of renal replacement therapy to treat end stage renal failure especially in critically ill patients and patients living in remote areas. Due to its better hemodynamic stability, flexibility and freedom to perform daily activities; CAPD now gaining popularity worldwide. Moreover, preservation of residual renal function contributes significantly to the overall health and wellbeing of CAPD patients [4]. Worldwide, peritoneal dialysis accounts for 9% of all renal replacement therapy (RRT) and 11% of all dialysis [5]. From 2009 to 2019, the percentage of incident dialysis patients performing peritoneal dialysis (PD) increased from 6.6% to 12.3% in

the United States [3]. Recently urgent CAPD has been started as a first line renal replacement modality if vascular access for hemodialysis (HD) is not available [6]. Catheter-related complications are the major causes of CAPD technique failure and account for approximately 20% of transitions to hemodialysis (HD) [7]. There are two types of complication observed among patients on CAPD: infectious complications like– peritonitis, tunnel infection, existing infection and mechanical complication which includes- dialysate leaks, abdominal wall hernias, infusion pain and inefficient flow, catheter tip malposition, hydrothorax, omental entrapment [3, 8]. According to the 2022 US renal data systems reports, peritonitis episodes accounted for 5-9 hospital admission per 100 CAPD patients each year [3]. Currently, there is controversy whether CAPD or HD is better modality of treatment; but in generally considered equivalent overall [9]. Considering patients characteristics and needs, current and future options for renal replacement therapy (RRT) and patient preference, appropriate dialysis modality should be made [10]. CAPD is an updated treatment option globally for the management of ESRD. In context of Bangladesh, due to lack of public awareness, trained workforces and financial constrain, CAPD is not widely acceptable till now. Moreover, very few studies had performed focused on its outcomes and complications. This study was aimed to evaluate the complication and outcome related to CAPD among patients on this mode of therapy.

2. METHODOLOGY

This prospective observational study was carried out on 36 patients of end stage renal disease underwent CAPD from January 2019 to December 2023 at a tertiary care hospital, Dhaka, Bangladesh. The study cohort consisted of patients regardless of age, who catheterized in our center and received CAPD between the study periods. CAPD patients who were not catheterized at our hospital or who were followed-up at other centers were excluded from the study. All relevant data were collected on a questionnaire from each routine and emergency visits. At each visit, a thorough clinical history, physical examination findings and investigations results were recorded. We studied both infectious and non-infectious (mechanical) complications with outcomes in those patients occurring during the course of therapy. Double-cuffed straight Tenckhoff catheter was inserted in all patients using the percutaneous technique. All patients were followed up at an interval of at least six weeks or earlier if they had any problem. The duration of follow-up ranged between one month to 24 months. Detailed case history, clinical examination findings and relevant laboratory investigations of all patients were taken into account. Both infectious and non-infectious (mechanical) complications occurring during the study period and outcomes in terms of technique survival were noted accordingly.

3. RESULTS AND OBSERVATION

This study was intended to evaluate the complications and outcomes related to CAPD. A total of 36 ESRD patients on CAPD were enrolled following selection criteria. Demographic characteristics of study population based on age**,** sex and residence. The age range of the participants was from 53 to 77 years, with a mean age of 62.7±6.68 years. Most participants (52.8%) were in the 50-60 years age group followed by 33.3% was in 61-70 years age group and 13.9% in 71-80 years age group. Of them, 24 (66.7%) were male and 12 (33.3%) were female. Over half (52.8%) of the study patients were from urban areas (Table- 1).

Table 1: Socio-demographic characteristics of the study patients (N= 36)

Variables	Frequency (n)	Percentage (%)
Age group (years)		
50-60	19	52.8
61-70	12	33.3
71-80	5	13.9
Mean±SD Range (min-max)	62.7±6.68 (53-77) years	
Sex		
Male	24	66.7
Female	12	33.3
Male: Female	2:1	
Residence		
Rural	17	47.2
Urban	19	52.8

It was observed that, the main reasons for CAPD selection as a renal replacement therapy (RRT) in our study were poor cardiac status (52%), residence in remote areas (30%) and patient choice (18%) (Figure- 1).

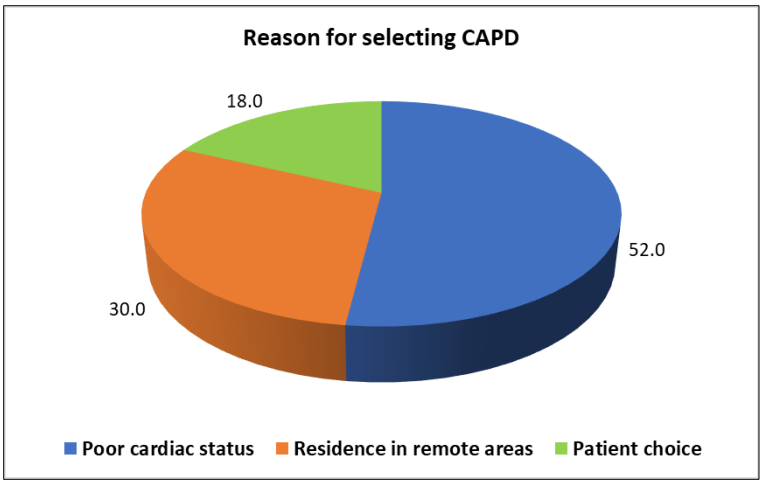


Figure 1: Different reasons for CAPD selection of the study population (N= 36)

The data highlighted that anemia (66.66%), edema (55.55%), and abdominal pain (47.22%) were the most common clinical issues; with other conditions occurring comparatively less frequently such as fever (38.88%), poor nutrition (36.11%), weight loss (27.77%), hypotension (22.22%) and sepsis (16.66%) respectively (Table- 2).

Table 2: Clinical characteristics of the study patients (N= 36)

Variables	Frequency (n)	Percentage (%)
Fever	14	38.9
Abdominal pain	17	47.2
Anemia	24	66.7
Sepsis	6	16.7
Weight loss	10	27.8
Edema	20	55.6
Poor nutrition	13	36.1
Hypotension	8	22.2
Hernia	3	8.3
Hydrothorax	1	2.8
Exist side discharge	3	8.3

Analyzing biochemical parameters revealed that; 50% patients had neutrophilic leukocytosis, 44.44% patients had high C- reactive protein (CRP) level, one-third (66.66%) study patients had metabolic acidosis where as 55.55% patients had hyperkalemia. Low serum albumin level was observed in 83.33% patients; increased level of pro-calcitonin (33.33%), D-dimer (13.88%), uric acid (61.11%) and parathyroid hormone (PTH) (50%) were also found (Table- 3).

Table 3: Biochemical parameters of the participants (N= 36)

Investigation	Number of Patients	Percentage %
Neutrophilic leukocytosis	18	50%
Raised CRP	16	44.44%
Hyperkalemia	20	55.55%
Metabolic acidosis	24	66.66%
Thrombocytopenia	6	16.66%
Low S. Albumin	30	83.33%
Raised uric acid	22	61.11%
Raised PTH	18	50%
Raised D-dimer	5	13.88%
Positive blood culture	15	41.66%
Low hemoglobin	22	61.11%
Raised pro-calcitonin	12	33.33%

Regarding etiologies of chronic kidney disease (CKD) among the study population; diabetes mellitus (DM- 56%) was the leading cause of CKD in our study population, followed by hypertension (HTN- 17%) and glomerulonephritis (GN- 14%), obstructive nephropathy and sepsis both was 5% but unknown cause of CKD was among 3% study patients (Figure- 2).

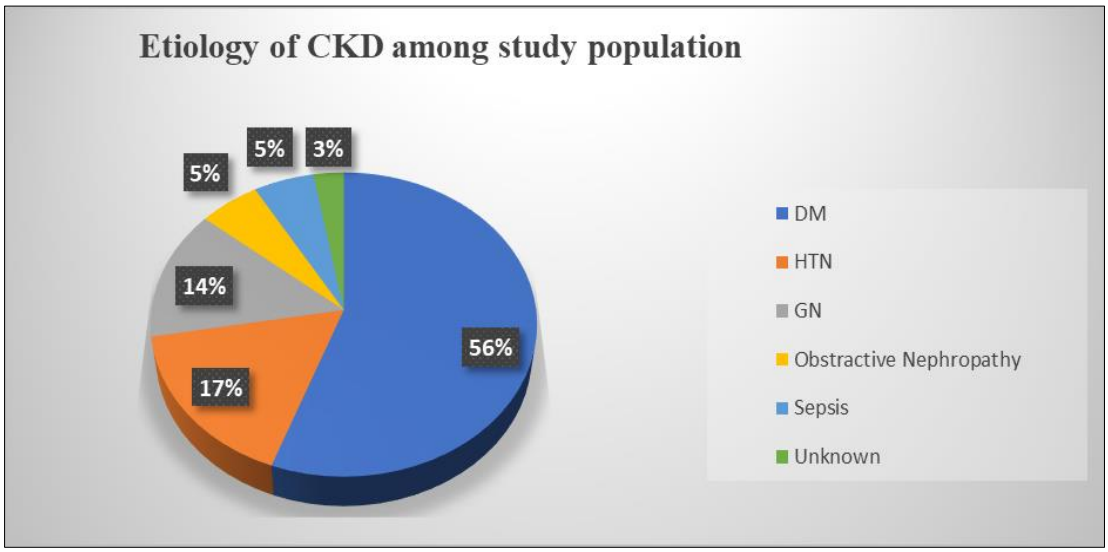


Figure 2: Etiology of CKD among study population (N= 36)

The duration of CAPD taken by the study population is depicted in figure- 3. It was observed that majority (88.88%) of the study patients received CAPD up to 6 months whereas 72.22% patients received up to 12 months; however, 63.88%, 55.55% and 27.77% patients have taken CAPD up to 18, 24 and 30 months respectively (Figure- 3).

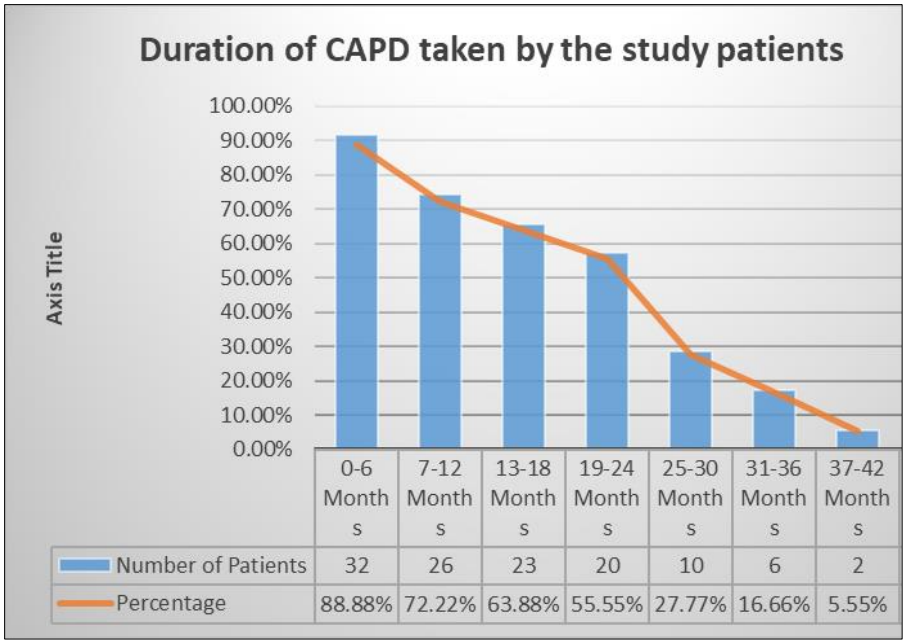
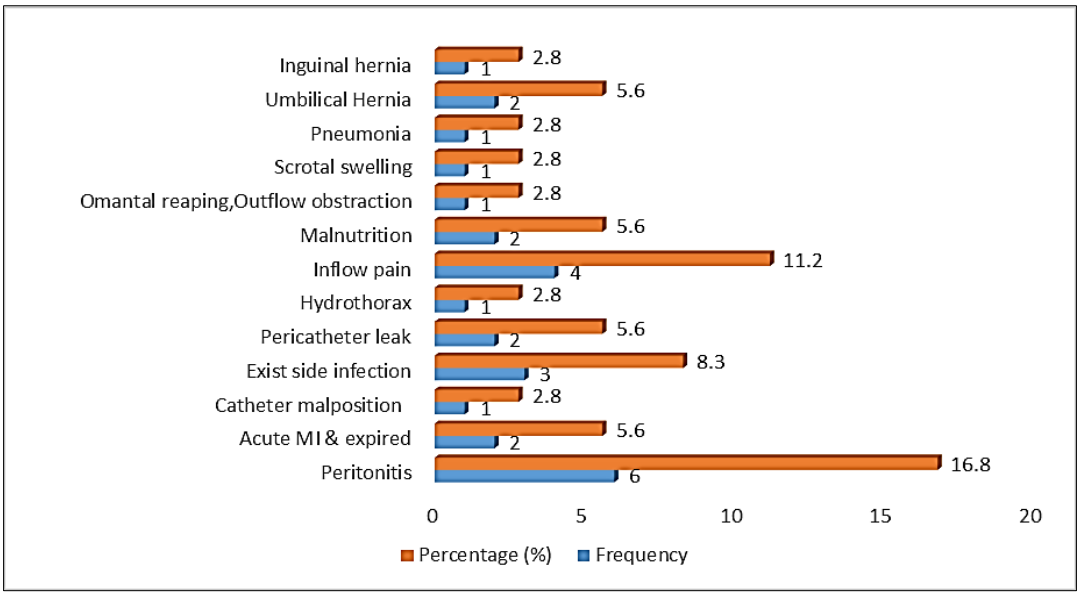


Figure 3: Duration of CAPD taken by the study patients

In this study, the major complication of CAPD was peritonitis 6 (16.8%) followed by inflow pain 4 (11.2%), exist side infection 3(8.3%), umbilical hernia 2(5.6%), malnutrition 2(5.6%) and peri-catheter leak 2(5.6%). While, hydrothorax, scrotal swelling and inguinal hernia were present in 1 (2.8%) episode each (Figure- 4).



*Multiple response

Figure 4: Complications of CAPD among the study population (N= 36)

In our study, major organisms responsible for peritonitis were caused by Coagulase negative Staphylococcus Aureus in 4 (11.11%) episodes, Staphylococcus Aureus in 4 (11.11%) episodes, E. coli, Klebsiella, Pseudomonas in 2 (5.55%) episodes whereas Fungal and Acinetobacter growth was seen in 1 (2.77%) episode each (Table- 4).

Table 4: Organism responsible for peritonitis in our study patients

Pathogens	Number of episodes (n)	Percentage (%)
Coagulase negative Staphylococcus Aureus	4	11.11
Staphylococcus Aureus	4	11.11
E. coli	2	5.55
Klebsiella	2	5.55
Pseudomonas	2	5.55
Fungal	1	2.77
Acinetobacter	1	2.77

We evaluate the outcomes of continuous ambulatory peritoneal dialysis (CAPD) after 24 months among the study population. We found that, 56% of the study patients successfully continued CAPD. However, 11% patients shifted to hemodialysis from CAPD, and 8% patients showed significant improvement from acute kidney injury (AKI) but 25% patients were died due to septicemia (14%) and cardiac causes (11%). (Figure- 5).

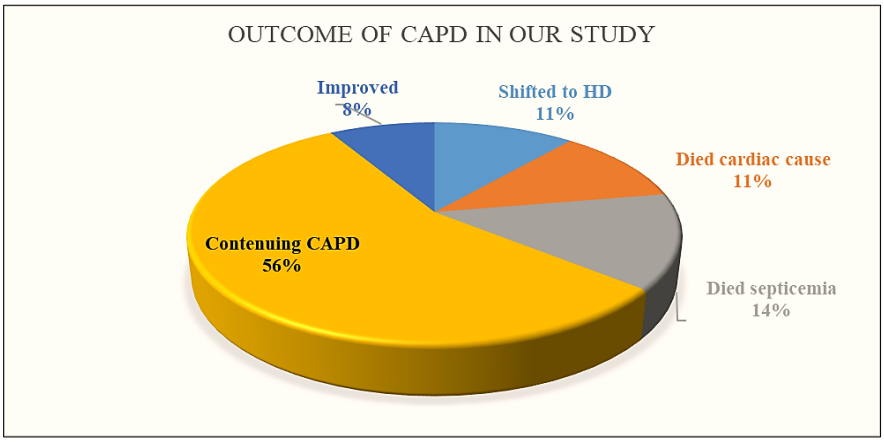


Figure 5: Outcome of CAPD among study patients after 24 months (N= 36)

4. DISCUSSION

Continuous ambulatory peritoneal dialysis (CAPD) is one type of renal replacement therapy used to treat end-stage renal failure. In recent years, a number of advancements have been seen in the field of CAPD; such as its effectiveness in acute cases, a greater focus on the use of home dialysis, and a better comprehension of models of peritoneal solute transfer [3]. However, CAPD can have a number of infectious and non-infectious (mechanical) complications [3, 8]. Besides, outcomes of CAPD also may vary on different clinical perspective [9]. The purpose of this study was to assess the complications and outcomes associated with CAPD in patients receiving this treatment between January 2019 to December 2023.

Baseline characteristics of our study population was comparable to those of other studies [2, 11]. The mean age of the study patients was 62.7±6.68 years the age was ranged from 15 to 79 years, as there was no age restriction in our study. The demographic trends suggest a predominance of middle-aged males of urban areas, which could have implications for health, social, or economic aspects specific to this group. In our study, poor cardiac status (52%), living in a remote location (30%), and patient preference (18%) were the primary reasons for choosing CAPD as renal replacement therapy (RRT). According to a prior study, patient preference accounted for 53% of CAPD selections with poor cardiac status coming in second (25%) [12]. This kind of discrimination may be caused by differences in study areas.

In this study anemia (66.66%), edema (55.55%), and abdominal pain (47.22%) were the most common clinical issues; other less frequent conditions were fever (38.88%), poor nutrition (36.11%), weight loss (27.77%), hypotension (22.22%) and sepsis (16.66%) respectively. These findings were reflected in similar studies [2, 13]. Diabetic nephropathy was the major cause of ESRD in our study (56%) followed by hypertension (17%), glomerulonephritis (14%), obstructive nephropathy (5%) and sepsis (5%); which were similar with previous studies [2, 15].

Peritonitis was the most common complication in our study population occurring in 41.64% of patients followed by inflow pain (11.2%) at the end of 24 months. The rate of peritonitis in our center was comparable with other studies [2, 13]. Inflow pain is usually observed in new patients initiating CAPD and is often transient in nature, spontaneously disappear within a few weeks. In our study, 11.2% of patients developed inflow pain, which was spontaneously disappeared, that was comparable to one related study [16]. In this study major organisms responsible for peritonitis were Coagulase negative Staphylococcus Aureus 11.11% and Staphylococcus Aureus 4 (11.11%) followed by E. coli, Klebsiella, Pseudomonas 5.55% each. Our findings were similar to a couple of previous studies [2, 16]. However, in the study by Abhisekh *et al*., Staphylococcus Aureus (22%) was the most common organism causing peritonitis [13]. Exit-side infections were observed 8.3% in our study. In our study 3 patients developed severe malnutrition and were expired due to pulmonary edema with left ventricular failure (LVF). It was seen that the commonest predisposing factor for peritonitis in our study population was poor aseptic measures and contamination during peritoneal dialysis exchanges. Patients and the caregivers were counseled regarding proper hygiene during the procedure and were treated with intraperitoneal, systemic antibiotics.

Mechanical complication like peri-catheter leaks (5.6%), catheter malposition (2.8%), hydrothorax (2.8%), umbilical hernia (5.6%), inguinal hernia (2.8%) and scrotal swelling (2.8%) was also seen in our study. These were managed accordingly. Re-insertion of CAPD catheter was done in one patient. These findings were supported by a related previous study [17]. Hydrothorax is a rare but potentially life-threatening complication that may occur usually on the right side and most commonly affects older females. In our study, one of our older females developed hydrothorax and the CAPD catheter was removed then patient was put on hemodialysis.

In our study at the end of 24 months, 56% patients were continuing CAPD, 11% was shifted to hemodialysis and 8% of study patients was improved from AKI, although 25% of study population were died due to septicemia and cardiac causes. These findings were supported by a couple previous studies [2, 18].

5. CONCLUSION

CAPD is an increasingly popular method of renal replacement therapy in patients with end-stage renal disease. Complications can be either immediate or delayed, and can also be categorized into infectious and non-infectious variety. Peritonitis is the most common complication caused by Staphylococcus Aureus, E. coli, Pseudomonas, Fungi and Acinetobacter. Mechanical complications like- peri-catheter leaks, catheter malposition, hydrothorax, umbilical hernia, inguinal hernia and scrotal swelling can also be seen. This study concluded that CAPD have an impressive outcome, although few patients may shift to hemodialysis and overall mortality rate among patients on CAPD is quite high. Techniques to prevent and minimize episodes of peritonitis, use of more biocompatible solutions in preserving the peritoneal membrane, and careful management of volume status can sustain the patient on CAPD.

Limitations of the Study: It was a single center study with a relatively small sample size.

Recommendation

Early recognition of complications is crucial in the management of CAPD in order to reduce treatment failure and limit patient morbidity and mortality. More

attention should be focused on preserving residual renal function, which was shown to have a significant impact on the survival of CAPD patients.

Conflicts of Interest: The authors declared that they have no conflict of interest.

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