EXPERIENCE OF CONTINUOUS AMBULATORY PERITONEAL DIALYSIS IN REMOTE AREA OF SOUTHEAST BANGLADESH

HASAN R[1], ANWAR ASMT[2], KABIR MA[3], HAKIM MA[4], ALAM MU[5]

Abstract

Background: *Chronic kidney disease (CKD) is a major public health problem that continues to increase in prevalence globally. The prevalence of chronic kidney disease is increasing day by day in low to middle income countries (LMICs). People living in LMICs have the highest need for renal replacement therapy (RRT) despite they have lowest access to various modalities of treatment. As continuous ambulatory peritoneal dialysis (CAPD) does not require advanced technologies, very much infrastructure, dialysis staff support, it should be an ideal form of RRT in LMICs, particularly for those living in remote areas. To authors knowledge there was scarcity of data regarding CAPD performance in remote area of Bangladesh. This study was aimed to report the characteristics and outcomes of CAPD in ESRD patients lived in least developed area of Bangladesh.*

Methods: *This prospective study was conducted in Cox'sbazar Medical College Hospital, Cox'sbazar and Parkview hospital Ltd, Chattogram, Bangladesh. Data were collected by questionnaire from the patients of any age with end-stage renal disease (ESRD) who underwent CAPD in 2018–2021. The baseline characteristics, PD-related complication as well as patient and technique survivals were analyzed.*

Results: *Out of 31 patients who underwent CAPD, 18 (58%) were male on the age range of 15–79 years. The mean follow-up duration was 18 months. Mortality was inversely related with the EF of echocardiography. The peritonitis rate was 0.48 episodes per patient per year. The 1, 3 and 4-year patient survival rates were 64.34% (95% CI = 52.5–81.5), 23.79% (95% CI = 17.9 – 57.4) and 3.22% (95% CI = 31.2–77.5) respectively.*

Conclusions: *In this study, CAPD performance was poorer than usual reference. Cardiac compromised patient and inappropriate dwell might be the main contributing factors behind this scenario. The peritonitis rate was nearly similar to that of developed countries. CAPD was cost effective than HD in remote area. Some accessible measures may be taken to make CAPD a more acceptable RRT modality with improved outcomes in poor socioeconomic backgrounds area.*

Keywords: *Dialysis cost, Peritoneal dialysis, Peritonitis, CAPD, Least developed area, Remote area, Bangladesh.*

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Introduction

Chronic kidney disease (CKD) is an important public health problem which is increasing day by day in incidence as well as in prevalence. End-stage renal disease (ESRD) is a serious complication of CKD and requires renal replacement therapy (RRT).RRT may be haemodialysis (HD), peritoneal dialysis (PD) or renal transplantation. Patients requiring renal replacement therapy have a reduced health perception since they are chronically dependent on a life-saving procedure. An estimated 3.8 million people worldwide currently rely on some form of dialysis for treatment of end-stage kidney disease (ESKD).[1] Although the prevalence of peritoneal dialysis varies from

1. Dr. Rafiqul Hasan, Associate Professor (Nephrology), Chittagong Medical College
2. Dr. ASM Tanim Anwar, Assistant Professor (Nephrology), Dhaka Medical College
3. Dr. Muhammad Anwarul Kabir, Assistant Professor (Medicine), Comilla Medical College
4. Dr. Mohammad Azizul Hakim, Dhaka Medical College
5. Dr. Muntasir Ul Alam, Medical Officer, Chittagong Medical College, Chittagong

Correspondence: Dr. Rafiqul Hasan, Associte Professor, Department of Nephrology, Chittagong Medical College, Chattogram.Cell Phone: +8801712116155, Email: rafiquek54@yhoo.com

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country to country, it accounts for approximately 11% of patients undergoing dialysis overall.[2] In developed countries, peritoneal dialysis is less expensive to deliver than hemodialysis.[3] Therefore, some national health care systems have implemented a "PD first" policy, with peritoneal dialysis as the preferred approach unless a medical contraindication is present.[4]There is no formal PD-first policy in the United States, although Medicare favors home dialysis over in-center dialysis.[5] The efficiency of CAPD is equal to to, and in many aspects supersedes that of haemodialysis (HD). CAPD compares very closely to HD in dialysis adequacy as measured by urea kinetic modeling (Kt/V per week) and creatinine clearances per week.[5] The long-term nutritional status of CAPD patients is comparable to HD patients.[6]One should remember that with CAPD there is a constant removal of waste products from the body which is the most physiological way of dialyzing. Many clinicians lack knowledge and experience regarding peritoneal dialysis and may not feel comfortable in managing the care of patients who are using PD.

The first apparatus conceived for PD delivery was first used in human by Boen et al. in Seattle and subsequently by Lasker et al. to treat patients with acute kidney injury (AKI).[7,8] Further improvement of those devices subsequently allowed treatment of ESRD patients, and promoted a relative diffusion of intermittent automated peritoneal dialysis (APD). Peritoneal dialysis (PD) gained worldwide acceptance as a renal replacement therapy because of ease of performance and patient independence from frequent hospital visits. The use of PD varies worldwide, with the highest prevalence of use being reported for Mexico and Hong Kong (70.5% and 81.3% of all dialysis patients respectively) and with prevalence of 19.3%, 23%, 12%, and 5.3% being reported for the United Kingdom, the Netherlands, France, and Germany respectively.[9] As compared with HD, PD requires less technological support, electricity, and medical staff; thus it can be scaled up more efficiently as the need for RRT grows. Further, PD can better reach patients living in remote, rural regions.[10] However, CAPD is limitedly available in many LMICs, and even where available, there are several constrains to be confronted regarding patient selection for this modality. High cost of CAPD due to unavailability of fluids, low patient education and motivation, low remuneration for nephrologists, lack of expertise/experience for catheter insertion and management of complications, presence of associated comorbid diseases and poor socio-economic status contribute significantly toward reduced patient selection for CAPD. Cost of CAPD fluids is a major constraint and many countries do not have the capacity to manufacture fluids but instead rely heavily on fluids imported from developed countries. It is an important factor to invest in fluid manufacturing (either nationally or regionally) in LMICs to improve uptake of patients treated with CAPD. Workforce training and retraining is necessary to ensure that there is coordination of CAPD programs and improve CAPD outcomes such as insertion of catheters, treatment of peritonitis and treatment of complications associated with CAPD. Training of nephrology workforce in CAPD will increase workforce capabilities and make CAPD a more acceptable modality with improved outcomes. To authors knowledge very few studies have been conducted regarding PD patients in Bangladesh. In this study we discussed the characteristics and outcomes of continuous ambulatory peritoneal dialysis (CAPD) in ESRD patients of remote area in Bangladesh.

Methods

A 48 months prospective study carried out on 31 patients who had participated in our study and followed up from January 2018 to December 2021. It was conducted in Coxsbazar medical college Hospital, coxsbazar and Parkview hospital, chattogram, Bangladesh. Study population was selected as patients of any age with end-stage renal disease who underwent CAPD at Cox'sbazar Medical college hospital and Parkview hospital Ltd from January 2018 to December 2021.The patients with CAPD who were not catheterized at the mentioned Hospital or was seen for CAPD follow-up in other centers were excluded, to

avoid variety of clinical evaluation between different centers. Data were collected by questionnaire from routine and emergency visits at the clinics and hospital. Detailed histories and physical examination were carried out when necessary. Laboratory investigations were done when indicated and as per management protocol. Double -cuff coiled Tenckhoff catheters were used. Flushing of the catheter was done on the third day. CAPD were initiated by manual exchanges on the 15th day using twin-bag system. These catheters were cared by skilled and educated nephrologists to ascertain proper functioning of catheters and to detect early complications. The PD patients were trained to survey and examine their catheters to keep them functional. Patients were considered to have peritonitis if cloudy drain fluid and/or abdominal pain associated with a WBC>100 (with >50% neutrophils). Ultrafiltration failure (UFF) was defined as net UF volume <400 ml after 4 hours of fluid dwell with 2 litres of 4.25% dextrose dialysis solution. Severe heart failure was recognized when EF was <30% in echocardiography. Cost of HD was determined from patients on MHD in Parkview hospital, chattogram. Least developed/ remote area was considered as area from which nearest HD centre distance were equal or more than 50 km.The baseline characteristics, PD-related infection rate, as well as patient survivals were analyzed. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as mean + standard deviation, whereas categorical data were expressed as a number and percentage.

Result

This was a prospective study which was conducted in the period of 2018- 2021. Table I reflects the characteristics of study population. This study included all patients (31 patients) undergoing CAPD, 13 of who were female (41.93%) and 18 were male (58.06%). The age of the study patients ranged from 15 to 79 years, with the mean age of 51.07 ± 13.44 years.

Table-I

Demographic variables

Variable	Data	Frequency	Percentage
Age	Below 35 yrs	02	06.45
	35-55 yrs	17	54.84
	Above 55 yrs	12	38.71
Sex	Male	18	58.06
	Female	13	41.93
Residence	Rural	27	87.10
	Urban	04	12.90
Marital status	Single	01	03.22
	Married	24	77.42
	Widowed	06	19.35
	Divorced	00	00.00
Religion	Islam	28	90.32
	Hinduism	03	09.68
	Buddhism	00	00.00
	Christianity	00	00.00
Monthly family income (Taka)	<10,000	00	00.00
	10,000 – 20,000	02	06.45
	>20,000	29	93.55
Distance of residence from nearest H/D centre (Km)	50-100	05	16.13
	>100	26	83.87
Education	Primary School	03	09.68
	High School	21	67.74
	College & above	07	22.58

Table I shows some basic demographic variables of the patients in this study. Majority of the patients aged between 35 and 55 years, from rural areas, were male, Muslim and married, educated upto high school level with monthly family income of Taka 20,000 or more. Most of the study population lived in > 100 km away from nearest H/D centre.

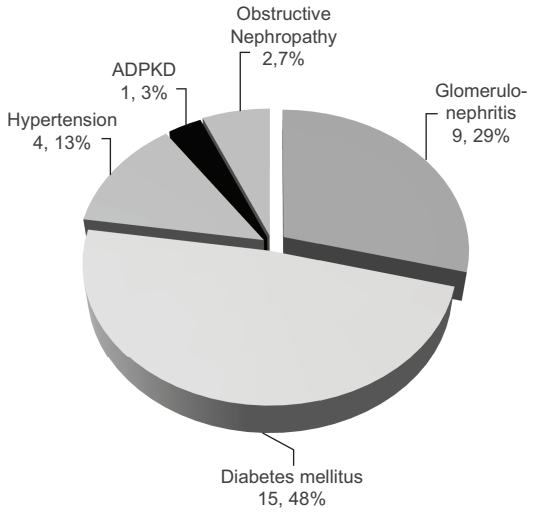

Figure 1: *Etiology of CKD in study population.*

Diabetes mellitus (15, 48 percent) was the most prevalent cause of ESRD in study population, followed by Glomerular disease (9, 29 percent) and hypertension (4, 13 percent).

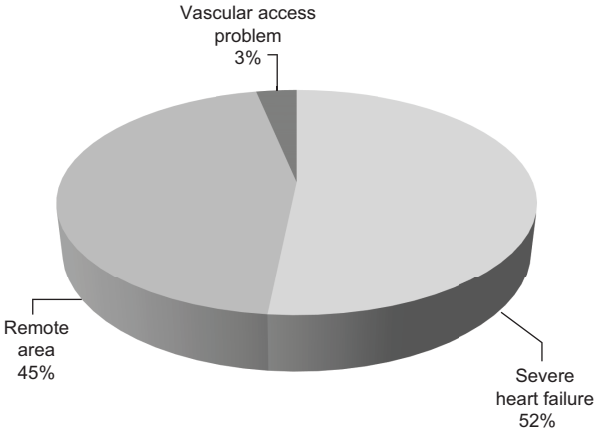

Figure 2: *Causes of CAPD selection as RRT.Poor cardiac function and patient's residence in remote area were the most important issue in selection of CAPD as RRT.*

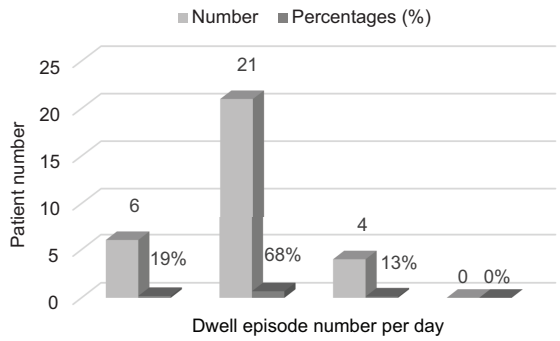

Figure 3: *Dwell episode received by patient per day.*

Patient compliance was very poor. Figure 3 showed the dwell episode received by the patient per day in maximum time of study period. No patient took 4 dwell in a day.3 dwell/day was taken by only 4(13%) patients. Maximum number 21(68%) of patient took 2 dwell/day. Others 6(19%) took single dwell in a day.

Most of the study population (68%) took 2 dwell/day and spent nearly 2920$ per year for CAPD purpose. In our HD center patient who took 2 session per week had to spent 4160$ - 4888$ per year. Value of working hours of accompany person with H/D patients were not included in this expenditure.

The average duration on CAPD was 12.04 ± 0.95 months. Maximum number (52%) of patients took 7-12 months of CAPD.

Abdominal pain 23 (74%) was the main complication. There were 10 (32%) episodes of peritonitis including 3 recurrence of peritonitis in 7 patients, 2 (6%) exit site infections, 5 (16%) failure of drainage, 1 (3%) catheter displacement, 1 (3%) omental wrapping, 13 (41%) mortality. There was no case of pericatheter leakage and catheter removal.

The I, 3 and 4-year patient survival rates were 64.34%, 23.79% and 3.22% respectively.

Table-II

Costs of dialysis (taka).

Dialysis type	Dialysis itself cost/ session	Transportation session		Food cost/ session	Total cost/ session	Total cost/year	
HD	3000	50-100 km	700	300	4000	608400 (6084$) [3session/week]	416000 (4160$) [2session/ week]
		>100 km	1400	300	4700	733200 (7332$) [3session/week]	488800 (4888$) [2session/ week]
CAPD	370	30	—	400		584000 (5840$)	[4 dwel/day]
						438000 (4380$)	[3 dwel/day]
						292000 (2920$)	[2 dwel/day]

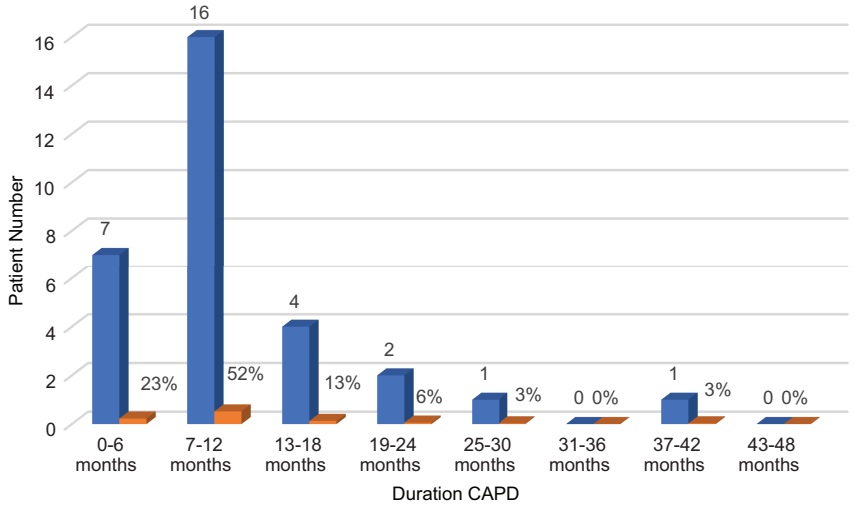

Figure 4: *Duration of CAPD taken by the study subject.*

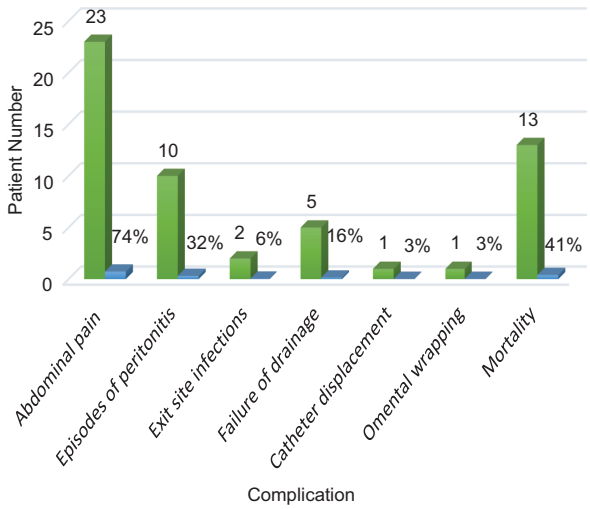

Figure 5: *Complication of CAPD.*

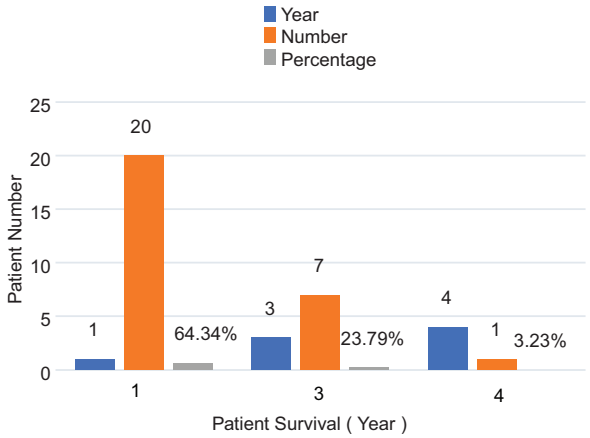

Figure 6: *Survival of the patient with CAPD.*

Discussion

In the present study, the characteristics and outcomes of CAPD in remote area of Bangladesh were evaluated. PD is considered as an important modality of RRT as it can be easily performed by the patient at his/her home without the need for frequent hospital visits. However, it is still underutilized as the first option of RRT worldwide. Patients preferred PD over HD because PD could avoid the complications of HD as well as distance of HD service.[11] Moreover, CAPD patients had more flexible diet and less fluid restriction compared with HD patients.[12] They also had greater full-time workplace attendance rate compared to those on HD.[13]

PD may have certain favorable features over HD in the developing nations, including ease of performing the treatment, decreased requirement of trained staff, and insignificant prerequisite for specialized support and electricity. Furthermore, it is more suitable to patients living in remote and rustic areas to use this modality of treatment as a home therapy, carries cost savings (especially if PD solutions are manufactured locally or in a neighboring country), superior rehabilitation, satisfaction with care, and better quality of life.[14, 15] In addition, it results in preservation of residual kidney function, [16] superior patient survivals in the first two years of RRT, [17] and protection of peripheral vessels for the future

access to HD. Thus, it is advised to perform CAPD before HD since it has many advantages over HD.

In our study 58% were male, 48% were diabetic. These characteristics were similar to the same type of study done in Bangladesh previously.[18]The age of the study patients ranged from 15 to 79 years, as there was no age bar in our study.

The main issues behind of CAPD selection as RRT were poor cardiac status (51.61%) and remote area (45.16%). Arefin MSU et al. found that the main reason of CAPD selection was patient choice (53%) followed by poor cardiac status (25%).[18]Difference of study area may be responsible for this type of discrimination.

Typically patients manually infuse and drain 2 to 3 L of PD fluid three to four times a day.[19] The PD fluid is allowed to dwell in the peritoneal cavity for a period of 4 to 6 hours in every daytime exchange and 8 to 10 hours in overnight exchange. Patients usually carry PD fluid in peritoneal cavity *continuously,* 24 hours in a day. In our study most of the patients (68%) received only 2 dwell per day and no one took ideal 4 dwell. Financial constrain and sometimes unavailability of PD fluid were responsible for this poor performance.

Apart from the technical simplicity and tolerability, an economic factor likely drove in the selection of PD uptake in remote area of Bangladesh. The increasing burden of HD therapy in our unit urged the healthcare service providers to implement a more cost- and time-efficient dialysis modality for this group of patients. In Hong Kong and Thailand, PD first policy has been implemented since it was known to be cost-effective.[20,21]Although Bangladesh has not applied PD first policy yet and as per authors knowledge no study was done regarding cost-effectiveness ratio associated with HD and CAPD.In this study we found that a patient have to expend 2920 $ - 5840 $ per year in remote area including 730-1460 bags Dianeal with minicap (Baxter Healthcare SA, Singapore), which was sufficient for one PD patient requirements per year. Our HD unit experienced that annual HD cost of a patent in remote area in Bangladesh was 4160 $ - 7332 $ depends on patients location and frequency of H/D session. Value of working hours of accompany person with H/D patients were not included in this expenditure. At private facilities, patients have to spend Tk12,000 to Tk15,000 per week for dialysis in Dhaka, Bangladesh.[22]This is little bit lower than that of our finding as associated transport and food cost were included in our study. In Thailand, the cost burden of PD which is 7,300 USD/year, and that of HD is 12,100 USD/year.[23] An analysis on budget impact of PD compared with conventional in-center HD in Malaysia suggested that there has been an increase of PD population from 8% in 2014 to 38% in 2018 resulted in 5-year cumulative savings 23.93 million RM for the Malaysian government.[24] The cost ratio of HD to CAPD is much lower in LMICs.[25] It was 1.6 for UK, 1.9 for Canada and .4 for Sri Lanka.[26] In our study the cost ratio of HD to CAPD was 1.6.High price of HD with its associated cost (transport and food) might be responsible for this disparity. Overall, reimbursement policies and government initiatives have been identified to successfully increase the PD uptake in Asia.[27]

This study showed that average duration on CAPD was 1.02 ± 0.95 years. Maximum number of patients took 7-12 months of CAPD. There was no positive losses (regaining renal function or renal transplantation).The negative losses are those patients who were unable to continue CAPD for the reason of death or refusal of CAPD or abstinence from follow up. The number of total negative losses was 11(35%).Improper dwell intake, poor cardiac status might be responsible for the large number of negative losses.

The common complications of CAPD are abdominal pain, exit site leak, exit site infection, tunnel infection, catheter malposition, omental wrapping, hemoperitoneum, hydrothorax, peritonitis, ultrafiltration failure (UFF),abdominal hernia, scrotal swelling, and catheter cuff protrusion.[28] Metabolic complication were not considered in this study. In our study abdominal pain (74%) was the main complication. It was followed by peritonitis (32%), failure of drainage (16%), exit site

infections (6%), catheter displacement (3%), omental wrapping (3%). Abdominal pain (30.8%), ultrafiltration failure , (4.7%), peritonitis (32.7%), exit site infection (9.3%), malfunction of catheter (1.9%) were the main complication found in a study in Dhaka.[18]In our study 10 events of peritonitis occurred in a total of 07 patients, with a peritonitis risk rate of 0.48 episodes per year. International Society of Peritoneal Dialysis (ISPD) recommends every CAPD program to reduce the peritonitis incidence to be lower than 0.4 episodes per year at risk.[29]The peritonitis rate of our study was close to the target set by ISPD. Arefin MSU et al. found 37% peritonitis rate in a similar study done in Dhaka, Bangladesh.[18] We experienced a better result (32%). Moreover, our peritonitis rate is comparable with that of high-income countries, which is approximately 0.47 episodes per year at risk.[30] Total mortality was 35% in study period and main cause of death was congestive cardiac failure. Our patient survival was relatively low. The 1, 3 and 4-year patient survival rates were 64.34%, 23.79% and 3.22% respectively. The 1, 3 and 5-year patient survival rate of our patients were lower than that of developed countries. The 1- and 3-year survival in the USA were 97.8% and 95.9%, while in Italy were 96.5% and 91.6%, respectively.[31]In India, the one-year patient survival rate is higher than our center (94% versus 64.34%).[32] High rate of patients with poor cardiac status and irrational dwell intake might be responsible for such a mortality rate.

Conclusion

CAPD is an important means of providing dialysis. The complication rate was nearly similar to that of the developed world. Patient selection is an important factor in outcomes of CAPD. It was cost effective than HD in remote area. This study was especially important in the context of poverty and limited access to medical resources like Bangladesh and other developing countries. Further research in large scale is necessary to recommend CAPD as the first option of dialysis in remote area.

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