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Experience of Continuous Ambulatory Peritoneal Dialysis in a Remote Area of Southeast Bangladesh

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Abstract **Original Research Article**

Background: Chronic kidney disease (CKD) is a major public health problem 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. This study was aimed to report the characteristics and outcomes of CAPD in end stage renal disease (ESRD) patients lived in a remote area of Bangladesh. ***Methods:*** This prospective study was conducted in Cox's bazar Medical College Hospital, Cox's bazar Bangladesh. Data were collected by questionnaire from the patients of any age with end-stage renal disease (ESRD) who underwent CAPD between 2018–2021. A total of 31 ESRD patients who underwent CAPD were enrolled. The baseline characteristics, CAPD-related complications, annual expenditure as well as patient survival rates were analyzed accordingly. ***Results****:* Out of 31 patients who underwent CAPD, 18 (58.1%) were male and 13 (41.9%) were female, the age ranged between 15–79 years. The poor cardiac function and patient's residence in remote area were the most important issue in selection of CAPD as RRT. Maximum patients (67.7%) took 2 dwell/day. Abdominal pain was the major (74.2%) complication. The peritonitis rate was 0.48 episodes per patient per year. The 1, 3 and 4-years patient survival rates were 64.5%, 22.6% and 12.9% respectively. The mortality rate was 41.9% and the main cause of death was congestive cardiac failure. ***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 hemodialysis (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 areas.

Keywords: Dialysis Cost, Hemodialysis (HD), Peritoneal Dialysis (PD), Peritonitis, Continuous Ambulatory Peritoneal Dialysis (CAPD), Remote Area.

1. INTRODUCTION

Chronic kidney disease (CKD) is an important public health problem which is increasingly prevalent day by day. End-stage renal disease (ESRD) is a serious complication of CKD and requires renal replacement therapy (RRT). The available RRT includes-hemodialysis (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 renal disease (ESRD) [1]. Although the prevalence of peritoneal dialysis (PD) varies from country to country, it accounts for approximately 11% of patients undergoing dialysis overall [2]. In developed countries, peritoneal dialysis (PD) 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 continuous ambulatory peritoneal dialysis (CAPD) is equal to, and in many aspects supersedes that of hemodialysis (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]. In CAPD there is a constant removal of waste products from the body which is the most physiological way of dialyzing [6].

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). Continuous ambulatory peritoneal dialysis (CAPD) gained worldwide acceptance as a renal replacement therapy because of ease of performance and patient independence from frequent hospital visits. The use of CAPD 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, Netherlands, France, and Germany respectively [9]. As compared with HD, CAPD requires less technological support, electricity, and medical staff; thus, it can be scaled up more efficiently as the need for RRT grows. In addition, CAPD can better reach patients living in remote, rural regions [10]. However, CAPD is limitedly available in many low to middle income countries (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, 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. In this background, current study was aimed to assess the characteristics and outcomes of continuous ambulatory peritoneal dialysis (CAPD) among ESRD patients in a remote area of Bangladesh.

3. METHODOLOGY

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 at Cox's bazar Medical College Hospital, Cox's bazar, Bangladesh. Study population was selected as patients of any age with end-stage renal disease who underwent CAPD from January 2018 to December 2021.The patients on 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 each routine and emergency visits at the hospital. Detailed clinical history and physical examination were carried out at every visits. Relevant 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 trained nephrologists to ascertain proper functioning of catheters and to detect early complications. All the study (CAPD) patients were trained to survey and examine their catheters to keep these functional properly. Patients were considered to have peritonitis if cloudy drain fluid and/or abdominal pain associated with a high white blood cell (WBC)>100 (with >50% neutrophils). Ultrafiltration failure (UFF) was defined as net UF volume <400 ml after 4 hours of fluid dwell with 2 liters of 4.25% dextrose dialysis solution. Severe heart failure was recognized when ejection fraction (EF) was <30% in echocardiography. Cost of HD was determined from patients on maintenance hemodialysis (MHD) in local hospitals. Remote area was considered as area from which nearest HD center distance were equal or more than 50 kilometers. The baseline characteristics, CAPD-related complications, annual expenditure as well as patient survival rates were recorded accordingly. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative data were expressed as mean with standard deviation (SD), whereas categorical data were expressed as a number and percentage.

3. RESULTS AND OBSERVATIONS

This prospective study was conducted in the period of 2018- 2021. This study included 31 patients underwent CAPD; of them 13 were female (41.94%) and 18 were male (58.06%). The age of the study patients ranged from 15 years to 79 years, with the mean (± SD) age of 51.07 ± 13.44 years. Majority of the patients aged between 35 and 55 years, most of them were from rural areas, maximum had monthly family income of BDT (Bangladeshi Taka/Bangladeshi currency) 20,000 or more. Most of the study population were lived in >100-

kilometer (Km) away from nearest hemodialysis (HD) center (Table-1).

Table-1: Socio-demographic data of the study population (N= 31)

Variables	Frequency (n)	Percentage (%)
Age		
Below 35 years	02	06.45
35-55 years	17	54.84
Above 55 years	12	38.71
Mean (±SD)	51.07 ± 13.44 years	
Range	15 – 79 years	
Sex		
Male	18	58.06
Female	13	41.94
Residence		
Rural	27	87.10
Urban	04	12.90
Monthly family income BDT*		
<10,000	00	00.00
10,000 – 20,000	02	06.45
>20,000	29	93.55
Distance of residence from nearest hemodialysis center (Kilometers)		
50-100	05	16.13
>100	26	83.87

*BDT= Bangladeshi Taka/ Bangladeshi currency

It was observed that, diabetes mellitus [15 (48%) was the most prevalent cause of ESRD among study population, followed by glomerular disease [9 (29%)] and hypertension [4 (13%)] (Figure- 1).

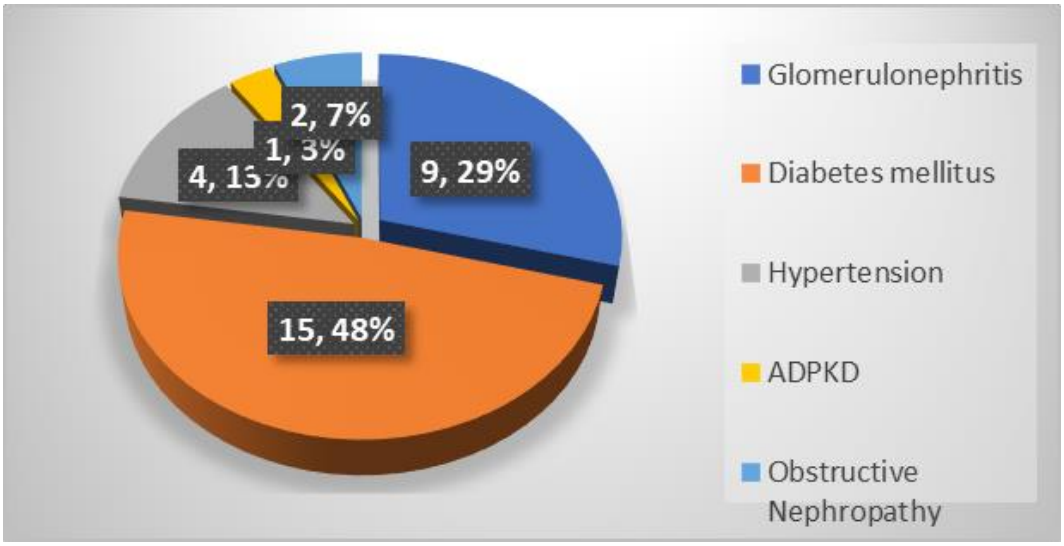

Figure 1: Etiology of CKD among study population

Regarding the preference of CAPD; poor cardiac function and patient's residence in remote area were the most important issue in selection of CAPD as RRT (Figure-2).

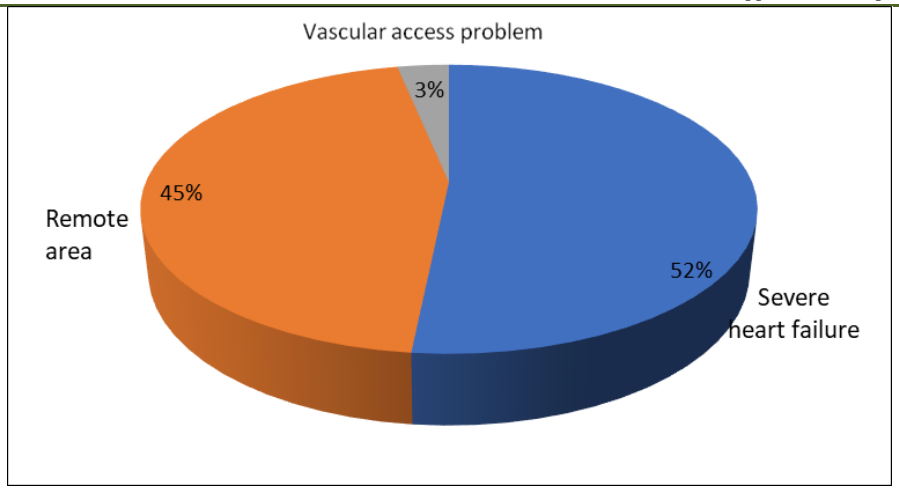

Figure- 2: Causes of CAPD selection as RRT

We found that patient compliance was very poor. Figure-3 showed the dwell episode received by the patients per day in maximum time of study period. No patient took 4 dwell per day, but 3 dwell/day was taken by only 4(12.9%) patients. Maximum [21(67.7%)] patients took 2 dwell/day. Rest 6(19.4%) patients took single dwell in a day (Figure-3).

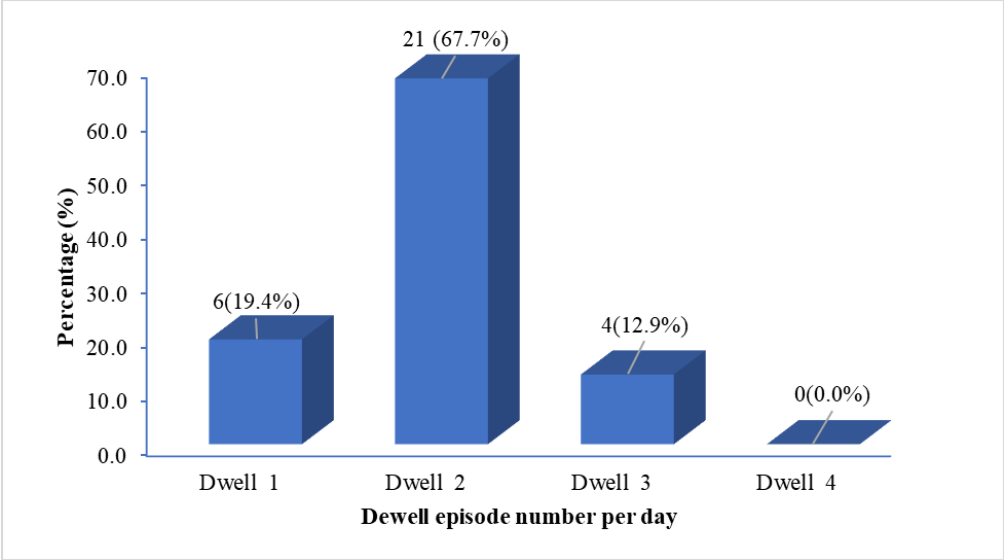

Figure-3: Dwell episode received by patient per day

Most of the study patients (67.7%) took 2 dwell/day and spent nearly 2920$ per year for CAPD purpose. In our HD center patients who took 2 session HD per week had to spent 4160$ - 4888$ per year. Value of working hours of accompany person with HD patients were not included in this expenditure (Table-2).

Table-2: Costs of dialysis (HD and CAPD)

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

*BDT (Bangladeshi Taka/ Bangladeshi currency)

In this study, the average duration of CAPD was 12.04 ± 0.95 months. Maximum number (51.6%) of patients took 7-12 months of CAPD (Figure-4).

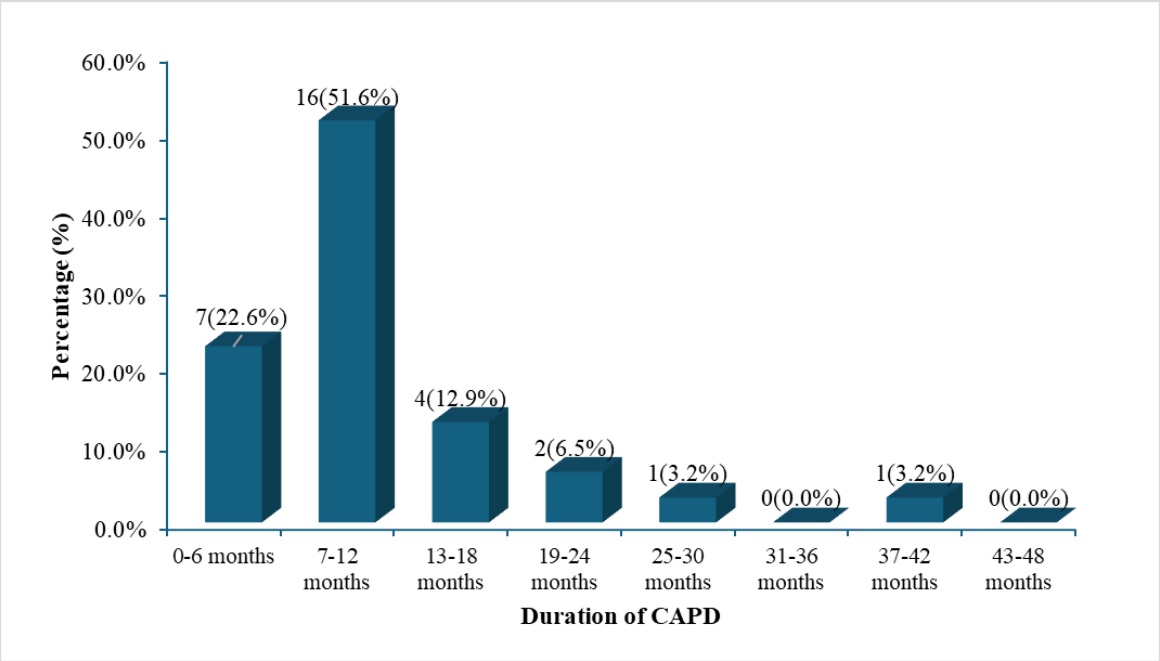

Figure- 4: Duration of CAPD taken by the study patients

Among the study population, abdominal pain 23 (74.2%) was the main complication. There were 10 (32.3%) episodes of peritonitis including 3 recurrences of peritonitis in 7 patients, 2 (6.5%) patients had exit site infections, 5 (16.1%) cases were failure of drainage, one patient (3.2%) had catheter displacement, another one (3.2%) had omental wrapping and mortality rate was 41.9%. There was no case of peri-catheter leakage and catheter removal (Figure- 5).

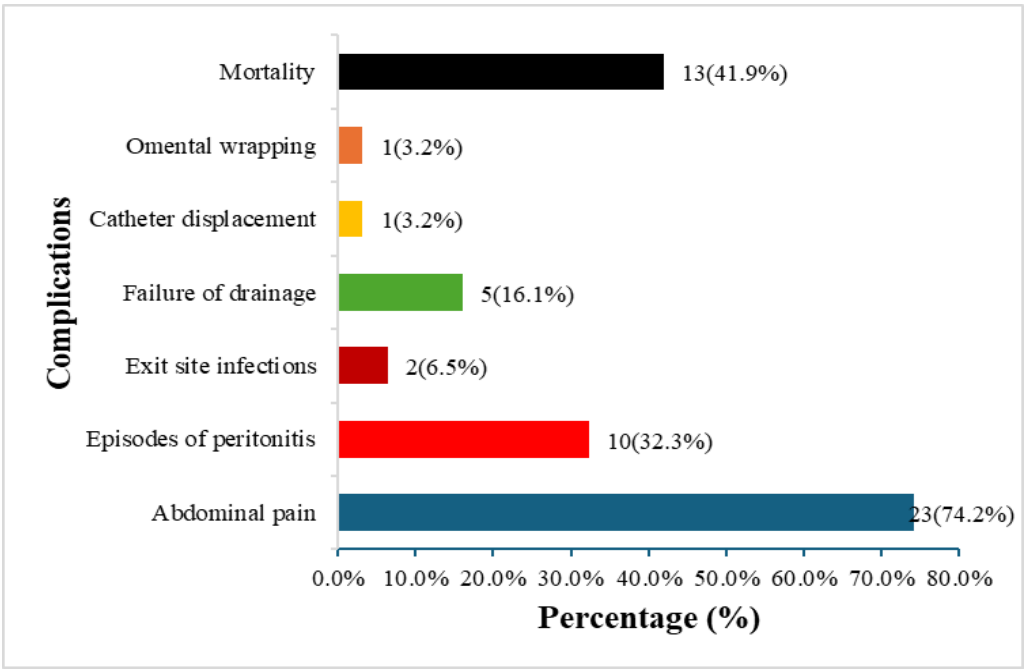

Figure- 5: Complications of CAPD

Data analysis revealed that; 1-year, 3-years and 4-years patient survival rates were 64.5%, 22.6% and 12.9% respectively (Figure-6).

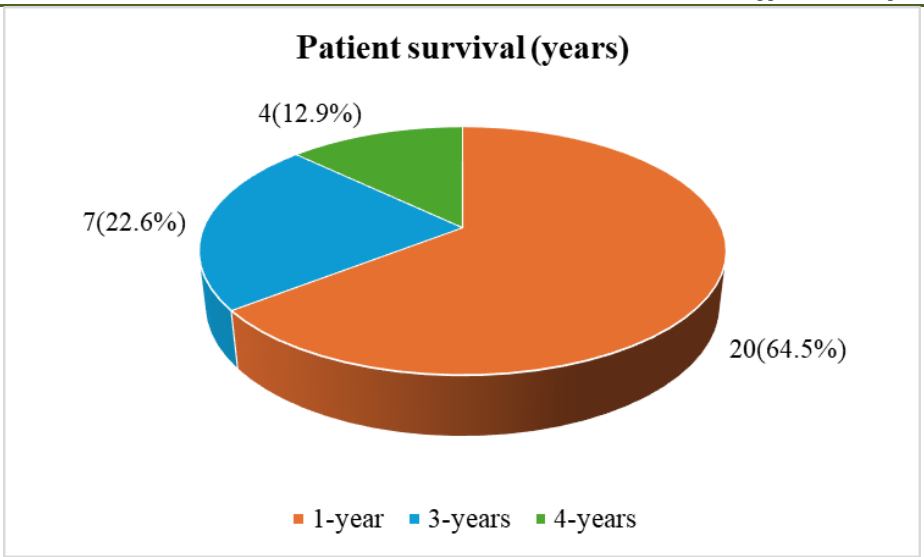

Figure- 6: Survival of the patient with CAPD

4. DISCUSSION

Renal replacement therapy (RRT) based on peritoneal dialysis (PD) has become widely accepted due to its convenience of use and ability to relieve patients from frequent hospital visits. Globally, there is variation in the use of PD. Mexico and Hong Kong have the highest prevalence of use, accounting for 70.5% and 81.3% of all dialysis patients, respectively; in contrast the United Kingdom, Netherlands, France, and Germany have the lowest prevalence, with 19.3%, 23%, 12%, and 5.3%, respectively [9].

In this present study, the characteristics and outcomes of CAPD in a 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), 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 population 58% were male and 48% were diabetic. These findings were similar to the related previously study [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 (52%) and remote area (45%). One previous study found that the main reason of CAPD selection was patient choice (53%) followed by poor cardiac status (25%) [18]. The difference of study area may be responsible for this type of discrimination.

Typically, patients manually infuse and drain 2 to 3 liters 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 day-time 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 (67.7%) received only 2 dwell per day and no one took ideal 4 dwell in a day. Financial constrain and sometimes unavailability of PD fluid could be 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 there is scarcity of data regarding cost-effectiveness ratio associated with HD and CAPD. This current study found that, one patient has 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 patient's location and frequency of HD session [22]. Value of working hours of accompany person with HD patients were not included in this expenditure. At private facilities, patients have to spend BDT- 12,000 to BDT- 15,000 per week for dialysis in the capital city (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 $/year, and that of HD is 12,100 $/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 (Malaysian currency) 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 0.4 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 of CAPD was 1.04 ± 0.95 years. Maximum number of patients took 7-12 months of CAPD. There were 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.

It was reported that, the common complications of CAPD are abdominal pain, exit site leak, exit site infections, tunnel infection, catheter malposition, omental wrapping, hemoperitoneum, hydrothorax, peritonitis, ultrafiltration failure (UFF), abdominal hernia, scrotal swelling, and catheter cuff protrusion [28]. Metabolic complications were not considered in this study. In our study population, abdominal pain (74.2%) was the main complication followed by peritonitis (32.3%), failure of drainage (16.1%), exit site infections (6.5%), catheter displacement (3.2%), omental wrapping (3.2%). In this context; abdominal pain (30.8%), ultrafiltration failure (4.7%), peritonitis (32.7%), exit site infections (9.3%), malfunction of catheter (1.9%) were the main complications found in a related previous study [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. Another previous study was documented 37% peritonitis rate [18]. We experienced a better result (32.3%). Moreover, our peritonitis rate was comparable with that of high-income countries, which was approximately 0.47 episodes per year at risk [30]. The mortality rate was 41.9% in our study period and the main cause of death was congestive cardiac failure. Our patient survival rate was relatively low. The 1-year, 3-years and 4-years patient survival rates were 64.5%, 22.6% and 12.9% respectively. The 1, 3 and 4-years survival rate of our patients were lower than that of developed countries [31]. The 1-year and 3-years survival rates in the USA were 97.8% and 95.9%, while in Italy these were 96.5% and 91.6%, respectively [31]. In India, the one-year patient survival rate was higher than our centre (94% versus 64.5%) [32]. High rate of patients with poor cardiac status and irrational dwell intake might be responsible for such a high mortality rate.

5. 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 areas. This study is 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 areas.

Conflicts of Interest: All authors declared that they have no conflict of interest regarding this publication.

REFERENCES

1. Liyanage, T., Ninomiya, T., Jha, V., Neal, B., Patrice, H. M., Okpechi, I., ... & Perkovic, V. (2015). Worldwide access to treatment for end-stage kidney disease: a systematic review. *The Lancet*, *385*(9981), 1975-1982.
2. Cho, Y., Bello, A. K., Levin, A., Lunney, M., Osman, M. A., Ye, F., ... & Johnson, D. W. (2021). Peritoneal dialysis use and practice patterns: an international survey study. *American Journal of Kidney Diseases*, *77*(3), 315-325.
3. Karopadi, A. N., Mason, G., Rettore, E., & Ronco, C. (2013). Cost of peritoneal dialysis and haemodialysis across the world. *Nephrology Dialysis Transplantation*, *28*(10), 2553-2569.
4. Li, P. K. T., Chow, K. M., Van de Luijtgaarden, M. W., Johnson, D. W., Jager, K. J., Mehrotra, R., ... & Lameire, N. (2017). Changes in the worldwide epidemiology of peritoneal dialysis. *Nature Reviews Nephrology*, *13*(2), 90-103.

5. Campbell, D., Fritsche, C., & Brandes, J. (1992, January). A review of urea and creatinine kinetics in predicting CAPD outcome. In *Advances in Peritoneal dialysis. Conference on Peritoneal Dialysis*, *8*(1), 79-83.
6. Cancarini, G., Costantino, E., Brunori, G., Manili, L., Camerini, C., Spitti, C., & Maiorca, R. (1992, January). Nutritional status in long-term CAPD patients. In *Advances in Peritoneal dialysis. Conference on Peritoneal Dialysis*, 8(1), 84-87.
7. Boen, S. T., Mion, C. M., Curtis, F. K., & Shilipetar, G. (1964). Periodic peritoneal dialysis using the repeated puncture technique and an automatic cycling machine. *ASAIO Journal*, *10*(1), 409-414.
8. McCauley, E. P., & Passarotti, C. T. (1966). Chronic Peritoneal Dialysis Norman Lasker. *ASAIO Journal*, *12*(1), 94-97.
9. Lameire, N., & Van Biesen, W. (2010). Epidemiology of peritoneal dialysis: a story of believers and nonbelievers. *Nature Reviews Nephrology*, *6*(2), 75-82.
10. Jain, A. K., Blake, P., Cordy, P., & Garg, A. X. (2012). Global trends in rates of peritoneal dialysis. *Journal of the American Society of Nephrology*, *23*(3), 533-544.
11. United States Renal Data System (USRDS). (2018). ESRD among children, adolescents, and young adults. In: Annual Data Report. Michigan; 463–500.
12. Fraser, N., Hussain, F. K., Connell, R., & Shenoy, M. U. (2015). Chronic peritoneal dialysis in children. *International journal of nephrology and renovascular disease*, 125-137.
13. North American Pediatric Renal Transplant Cooperative Study (NAPRTCS). (2011). Annual dialysis report. The EMMES Corporation, Rockville, MD. 2011.
14. Nayak, K. S., Prabhu, M. V., Sinoj, K. A., Subhramanyam, S. V., & Sridhar, G. (2009). Peritoneal dialysis in developing countries. In *Peritoneal Dialysis-From Basic Concepts to Clinical Excellence* (Vol. 163, pp. 270-277). Karger Publishers.
15. Rubin, H. R., Fink, N. E., Plantinga, L. C., Sadler, J. H., Kliger, A. S., & Powe, N. R. (2004). Patient ratings of dialysis care with peritoneal dialysis vs hemodialysis. *Jama*, *291*(6), 697-703.
16. Bargman, J. M., Thorpe, K. E., Churchill, D. N., & CANUSA Peritoneal Dialysis Study Group. (2001). Relative contribution of residual renal function and peritoneal clearance to adequacy of dialysis: a reanalysis of the CANUSA study. *Journal of the American Society of Nephrology*, *12*(10), 2158-2162.
17. Bamgboye, E. L. (2016). The challenges of ESRD care in developing economies: sub-Saharan African opportunities for significant improvement. *Clin Nephrol*, *86*(13), 18-22.
18. Arefin, M. S. U. (2015). A 2-year follow-up study of patients oncontinuous ambulatory peritoneal dialysis (CAPD) in specialized hospital in Dhaka. *Bangladesh. J Dhaka Med Coll*, *24*(2), 132-135.
19. Chaudhary, K., Sangha, H., & Khanna, R. (2011). Peritoneal dialysis first: rationale. *Clinical Journal of the American Society of Nephrology*, *6*(2), 447-456.
20. Choy, A. S. M., & Li, P. K. T. (2015). Sustainability of the peritoneal dialysis-first policy in Hong Kong. *Blood purification*, *40*(4), 320-325.
21. Chuengsaman, P., & Kasemsup, V. (2017, May). PD first policy: Thailand's response to the challenge of meeting the needs of patients with end-stage renal disease. In *Seminars in nephrology* (Vol. 37, No. 3, pp. 287-295). WB Saunders.
22. Asaduzzaman, M., Islam, S., Haque, M. E., & Patwary, M. H. M. (2023). Out Of Pocket Expenditure of End Stage Renal Disease Patients for Maintenance Haemodialysis. *Bangladesh Armed Forces Medical Journal*, *56*(1), 28-34.
23. Treerutkuarkul, A. (2010). Thailand: health care for all, at a price. *Bulletin of the World Health Organization*, *88*(2).
24. Bavanandan, S., Ahmad, G., Teo, A. H., Chen, L., & Liu, F. X. (2016). Budget impact analysis of peritoneal dialysis versus conventional in-center hemodialysis in Malaysia. *Value in Health Regional Issues*, *9*, 8-14.
25. Wearne, N., Kilonzo, K., Effa, E., Davidson, B., Nourse, P., Ekrikpo, U., & Okpechi, I. G. (2017). Continuous ambulatory peritoneal dialysis: perspectives on patient selection in low-to middle-income countries. *International journal of nephrology and renovascular disease*, 1-9.
26. Chang, Y. T., Hwang, J. S., Hung, S. Y., Tsai, M. S., Wu, J. L., Sung, J. M., & Wang, J. D. (2016). Cost-effectiveness of hemodialysis and peritoneal dialysis: a national cohort study with 14 years follow-up and matched for comorbidities and propensity score. *Scientific reports*, *6*(1), 30266.
27. Peppelenbosch, A., Van Kuijk, W. H., Bouvy, N. D., Van der Sande, F. M., & Tordoir, J. H. (2008). Peritoneal dialysis catheter placement technique and complications. *NDT plus*, *1*(suppl_4), iv23-iv28.
28. Li, P. K. T., Chow, K. M., Cho, Y., Fan, S., Figueiredo, A. E., Harris, T., ... & Johnson, D. W. (2022). ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. *Peritoneal dialysis international*, *42*(2), 110-153.
29. Schaefer, F., Borzych–Duzalka, D., Azocar, M., Munarriz, R. L., Sever, L., Aksu, N., ... & Warady, B. A. (2012). Impact of global economic disparities on practices and outcomes of chronic peritoneal dialysis in children: insights from the International Pediatric Peritoneal Dialysis Network Registry. *Peritoneal dialysis international*, *32*(4), 399-409.

30. Oza-Gajera, B. P., Abdel-Aal, A. K., & Almehmi, A. (2022, February). Complications of percutaneous peritoneal dialysis catheter. In *Seminars in Interventional Radiology* (Vol. 39, No. 01, pp. 040-046). Thieme Medical Publishers, Inc..
31. Verrina, E., Edefonti, A., Gianoglio, B., Rinaldi, S., Sorino, P., Zacchello, G., ... & Perfumo, F. (2004). A multicenter experience on patient and technique survival in children on chronic dialysis. *Pediatric Nephrology*, *19*, 82-90.
32. Prasad, N., Gulati, S., Gupta, A., Sharma, R. K., Kumar, A., Kumar, R., & Julu, D. V. (2006). Continuous peritoneal dialysis in children: a single-centre experience in a developing country. *Pediatric Nephrology*, *21*, 403-407.