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Original Article

Reasons for drop-out of peritoneal dialysis in pediatric patients: A single-center experience

Beltinge Demircioglu Kilic[1], Melek Aksay Urgun[2]

[1]Gaziantep University, Faculty of Medicine, Department of Pediatric Nephrology, Gaziantep, Turkey
[2]Gaziantep University, Faculty of Medicine, Department of Pediatric Nephrology Dialysis Nursing, Gaziantep, Turkey

Abstract

Aim: Peritoneal dialysis is the first line treatment for patients with end-stage renal disease in childhood, due to a number of advantages offered. However, patients drop-out for various reasons during the course of the treatment. Identifying and preventing the emergence of those causes is very important for maintaining treatment with peritoneal dialysis.

Material and Methods: Patients who were followed up between January 2005 and March 2019 in the peritoneal dialysis outpatient clinic of the Department of Pediatric Nephrology were examined retrospectively. The patients' demographic data, as well as their reasons for drop-out of treatment were taken from patient files.

Results: The results revealed that 89 patients (51.7% female, 48.3% male, mean age 83.17±56.78 months) underwent PD treatment over a period of 14 years and that 12 of them switched to another medical facility during their follow-up and that the peritoneal dialysis treatment of 34 (44.2%) of the remaining 77 patients was discontinued. The average duration of PD treatment was 38.21±27.93 months. In terms of the etiology of end-stage renal disease, urological anomalies (28.1%) and glomerular diseases (25.8%) were the most common. 18 patients (52.9%) dropped out of peritoneal dialysis due to hemodialysis, 11 (32.3%) due to transplantation, 4 (11.7%) due to death, and one (2.9%) due to a break from the treatment. Of the patients who switched to hemodialysis, 11 (61.2%) did so due to recurrent/resistant peritonitis, 4 (22.3%) due to failure of ultrafiltration, 2 (11%) due to mechanical problems (one case of hydrothorax, one case of leakage) while one (5.5%) patient voluntarily switched to hemodialysis.

Conclusion: Although peritoneal dialysis offers many advantages in childhood, the transition to HD due to recurrent peritonitis remains the most common cause of peritoneal dialysis treatment discontinuation.

Keywords: Chronic peritoneal dialysis; drop-out; pediatric patients

INTRODUCTION

Chronic peritoneal dialysis (PD) is the most commonly used dialysis method worldwide for children with end-stage renal disease due to advantages (1). Through this method; the family can undertake dialysis at home, the family and the child can live close to the usual, the child can go to school, the holidays can be planned more easily, the residual renal function is better preserved, dietary restriction less becomes, anemia is less seen, no vascular interventions and needle pain, there is less need heparin, and it ensures healthier growth and development compared with hemodialysis (1). However, during treatment, factors like recurrent peritonitis, catheter-related technical problems and failure of ultrafiltration make treatment discontinuation a compulsory requirement. Patients drop-out of PD by either switching to hemodialysis (HD) or by having a kidney transplant. In general, kidney transplantation is the preferred method. However, it is not always possible and patients switch to HD (2). Reports from the North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) and the International Pediatric Peritonitis Registry (IPPR) have shown that peritonitis is a major cause of change in dialysis modality (3,4).

Although the transition to HD as a result of complications of peritoneal dialysis in adult patients is considered a solution, it is difficult to do HD in pediatric patients as the vascular access routes are mostly inadequate. Therefore,

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Corresponding Author: Beltinge Demircioglu Kilic, Gaziantep University, Faculty of Medicine, Department of Pediatric Nephrology, Gaziantep, Turkey **E-mail:** beltingeiklim@hotmail.com

it is more important to protect pediatric patients against PD related complications and also to protect the peritoneal membrane until kidney transplantation (3).

The aim of this study is to determine the causes for the drop-out of peritoneal dialysis in pediatric patients who underwent peritoneal dialysis due to chronic kidney disease and to develop treatment strategies to prevent discontinuation of treatment.

MATERIAL and METHODS

The study was conducted on the basis of a retrospective analysis of patients followed up between January 2005 and March 2019 as part of a chronic PD program in the Pediatric Nephrology Clinic of Gaziantep University Hospital. Approval from the Ethics Committee of Gaziantep University Medical Faculty was obtained prior to the study. Demographic data, etiological diagnoses, laboratory values and reasons for dropping out of PD were taken from patient records. Patients with missing data were excluded, and a total of 89 patients were included in this study. With the exclusion of 12 patients who went to another center during their follow-up, the remaining 77 patients were divided into two categories, namely those who dropped out of PD and those who continued PD, and the risk factors were determined.

The received data were evaluated with the statistics program SPSS Version 22.0. Numerical values were expressed in terms of mean ± standard deviation or number of cases (%). When comparing non-normally distributed variables in the groups, the Mann-Whitney-U test was used and the relationships between categorical variables were tested by the chi-square test. Values of $p < 0.05$ were considered as statistically significant.

RESULTS

This study revealed that 89 patients (51.7% female, 48.3% male, mean age 83.17 ± 56.78 (2-203 months)) had undergone treatment with PD over a period of 14 years and that 18 (20.2%) of these patients were Syrian citizens.The average duration of PD treatment was 30.19 ± 24.88 months (2-128 months). There were 47 patients (52.8%) receiving continuous ambulatory PD (CAPD) and 42 patients (47.2%) receiving automated PD (APD). Table 1 shows the general characteristics of the patients.

In an evaluation of the CKD etiology in the study groups, urological abnormalities were the most common cause affecting 25 patients (28.1%). Glomerular diseases were second in etiology with 23 patients (25.8%).No etiological factors were identified in 13 patients (14.6%). Table 2 shows the etiologic causes for end stage renal disease in patients.

After 12.42 ± 14.26 months (2-50 months), 12 patients (13.5%) were no longer followed up with or switched to another center for various reasons. Of the 77 patients who were followed up with, 34 (44.2%) dropped out of PD treatment (61.8% female, 38.2% male, mean age 75.71 ± 51.29 months (2-177 months)). The average duration of PD treatment patients who dropped out was 38.21 ± 27.93 months (2-128 months). Table 3 shows the general characteristics of patients who dropped out of PD.

Table 1. General characteristics of peritoneal dialysis patients

Number of patients (n)	89
Gender	
Female (n/%)	46 (51.7%)
Male (n/%)	43 (48.3%)
Age (mean±SD) (month)	83.17±56.78
PD follow-up period (mean±SD) (month)	30.19±24.88
PD method	
CAPD (n/%)	47 (52.8%)
APD (n/%)	42 (47.2%)
Nationality	
Turkey	71 (79.8%)
Syria	18 (20.2%)

PD: Peritoneal dialysis, CAPD: Continuous ambulatory peritoneal dialysis, APD: Automated peritoneal dialysis, SD: Standard deviation

Of the 34 patients whose PD treatment was discontinued, 18 patients (52.9%) dropped out of PD due to hemodialysis (HD), 11 (32.3%) due to transplantation, 4 (11.7%) due to death, and one (2.9%) due to a break from the treatment. Of the patients who died during follow-up, two patients died from severe pulmonary edema, one died from severe pulmonary infection and pulmonary hypertension and one died of sepsis. Of the patients who switched to hemodialysis, 11 (61.2%) did so due to recurrent/resistant peritonitis, 4 (22,3%) due to failure of ultrafiltration, 2 (11%) due to mechanical problems (hydrothorax, leakage) while one (5.5%) patient voluntarily switched to hemodialysis. Treatment was terminated after an average of 5.0 ± 3.7 (2-14) peritonitis episodes due to peritonitis. The peritonitis episode of patients who continued peritoneal dialysis was 1.5 ± 1.6 (0-5). Table 4 shows the reasons why patients dropped out of PD, while Table 5 shows the reasons why they switched to HD.

Excluding the 12 patients who switched to another center and the 11 patients who had a transplant, having compared the patients who dropped out of PD with those who continued it, it was observed that there was no significant difference in terms of age, sex, follow-up time of PD treatment, PD method or nationality but there was a significant difference in terms of peritonitis episodes (p:0.011). A comparison of laboratory values showed that the hemoglobin (Hb) and parathormone (PTH) values did

not differ significantly that the hypoalbuminemia value was borderline significant (p: 0.062) and that the level for hyperphosphatemia and calcium x phosphorus (CaxP) was significant (p: 0.013, p: 0.048, respectively) (Table 6).

Table 2. Etiology of end-stage renal disease of patients

Etiology of ESRD	n	%
Urological Abnormalities	25	28.1
VUR	6	
Hydronephrosis	1	
Neurogenic Bladder	18	
Hinman syndrome	1	
Idiopathic	5	
Operated anal atresia	2	
Operated meningomyelocele	4	
PUV	6	
Glomeruler disease	23	25.8
FSGS	15	
Kongenital Nephrotic Syndrome	3	
aHUS/MPGN	5	
Cystic kidney disease	13	14.6
Nephronophthisis	2	
ARPKD	9	
Bardet Biedl Syndrome	2	
Hereditary disease	10	11.2
Primary hyperoxaluria	5	
Cystinosis	5	
Hypoplastic dysplastic kidney disease	3	3.4
Other	2	2.3
Renal coloboma	1	
Seckel Syndrome	1	
Etiology unknown	13	14.6

ESRD: End stage renal disease, VUR: Vesico ureteral reflux, PUV: Posterior urethral valve, FSGS: Focal segmental glomerulosclerosis, aHUS: Atypical Hemolytic Uremic Syndrome, MPGN: Membrano proliferative glomerulonephritis, ARPKD: Autosomal recessive polycystic kidney disease

Table 3. General characteristics of patients who dropped-out of peritoneal dialysis

Number of patients (n)	34
Age	
Female (n/%)	21 (61.8%)
Male (n/%)	13 (38.2%)
Age (mean±SD) (month)	75.71± 51.29
PD follow-up period (mean±SD) (month)	38.21±27.93
PD method	
CAPD (n/%)	17 (50%)
APD (n/%)	17 (50%)
Nationality	
Turkey	31 (91.2%)
Syria	3 (8.8%)

PD: Peritoneal dialysis, CAPD: Continuous ambulatory peritoneal dialysis, APD: Automated peritoneal dialysis, SD: Standard deviation

Table 4. Causes for drop-out of peritoneal dialysis in patients

Drop-out causes	n (%)
Hemodialysis	18 (52.9%)
Transplantation	11 (32.3%)
Death	4 (11.7%)
Interruption of treatment	1 (2.9%)

Table 5. Causes for transfer of patients from peritoneal dialysis to hemodialysis

Causes of transfer to hemodialysis	n (%)
Peritonitis	11 (61.2%)
Ultrafiltration insufficiency	4 (22.3%)
Mechanical problems	2 (11%)
Voluntary transition	1 (5.5%)

Table 6. Comparison of patients with and without peritoneal dialysis drop-out

	PD patients with drop-out (HD-exitus) (n:22)	PD patients without drop-out (n:43)	p
Mean age (month)	79.41±52.77(4-177)	84.26±65.40(2-203)	0.713*
Age (Female/Male)	13/9	19/24	0.255**
Mean PD follow-up period (month)	43.27±32.21(2-128)	28.81±22.06(3-89)	0.055*
PD method (CAPD/APD)	11/11	19/24	0.656**
Mean number of peritonitis	3.32±3.19 (0-14)	1.49±1.65 (0-5)	0.005*
Nationality (Turkey/Syria)	20/2	36/7	0.427**
Laboratory Results			
Hb	8.24±1.37(5.5-10.9)	8.96±1.87 (5.8-13.6)	0.190*
P	5.78±1.45 (2.82-9)	4.83±1.33 (2.1-7.7)	0.013*
CaxP	52.18±12.90 (22.2-72)	45.27±14.84 (9.6-79.8)	0.048*
Albumin	2.99±0.75 (1.8-4.8)	3.19±0.60 (1.18-4.3)	0.062*
PTH	506.31±475.95 (85-2051)	560.49±597.80 (17.5-2135)	0.835*

PD: Peritoneal dialysis, CAPD: Continuous ambulatory peritoneal dialysis, APD: Automated peritoneal dialysis, Hb: Hemoglobin, P: Phosphorus, Ca: Calcium, PTH: Parathorman
* Mann-Whitney U test ** Chi-square test

DISCUSSION

Peritoneal dialysis is the most common renal replacement therapy for children with end-stage renal disease up until the time of transplantation (1). Technological advances have made PD more convenient, which has had a positive effect on the quality of life and life expectancy. However, during treatment, factors like recurrent peritonitis, catheter exit-site infections, catheter-related technical problems and failure of ultrafiltration make it compulsory to discontinue treatment and switch to HD. Furthermore, patients also drop-out of PD due to kidney transplant or at their own request (5,6).

In the literature, studies on drop-out causes from peritoneal dialysis refer mainly to adult patients. Studies on children are shown in the reports. Reports from the North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) and the International Pediatric Peritonitis Registry (IPPR) have shown that peritonitis is a major cause of changes in dialysis modality (3,4).

In our study, peritoneal dialysis discontinued mostly (52.9%) due to patients switching to HD, with peritonitis being the most common cause (61.2%) for it. In addition, this study found that the incidence of peritonitis was significantly higher when patients who dropped out of PD were compared to patients continuing treatment with PD, with the exclusion of those transferred to other centers (p: 0.005). In the literature, there is no study on the rate of drop-outs from peritoneal dialysis due to peritonitis in children; however, this rate has been shown to be between 19% and 52% in studies on adults (7-11). Turkish Society of Nephrology (TSN) 2017 records showed that PD-related infection rate in children was 22.7% (11). On the basis of this information, it could be concluded that the rate of patients leaving PD was high due to peritonitis. It may also have contributed to the higher rates that the study population is made up of patients from lower social and economic backgrounds.

Failure of ultrafiltration and mechanical problems were other factors forcing patients to discontinue treatment with PD. The loss of ultrafiltration may occur as a natural outcome of the treatment process or it may be due to peritonitis. Recurrent episodes of peritonitis lead to structural changes in the peritoneal membrane that disrupt fluid and solute transport and leads to loss of ultrafiltration (8). It has been shown that ultrafiltration deficiency in adults ranges between 18% - 32% (11,12). TSN 2017 records indicate that ultrafiltration failure is the most common (63.6%) cause of discontinuation of peritoneal dialysis in pediatric patients. The same records

also show that the rate of patients who drop out of PD for mechanical reasons is 9.1% (11). In our study, the rate of transition to HD due to ultrafiltration failure was lower than in the literature (22.3%); however, the rate of patients who had to leave for mechanical reasons was similar (11%).

Although the rate of voluntary transition from PD to HD is higher in adults, this rate is lower in children due to the ease of use of PD. On the basis of the Turkish Society of Nephrology's recent records, an analysis of the reasons why adult PD patients in Turkey discontinued PD treatment in 2017 shows that 10% of the patients dropped out of PD voluntarily (11). According to reports from the North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS), 16% of patients changed their dialysis modality and switched to HD of their own accord, or at the request of their parents (3). In our study, there was only one patient (5.5%) who voluntarily discontinued treatment and switched to HD. It has been assumed that the rate may be low due to the high prevalence of vascular access problems during HD practices in children, and the small number of centers that offer HD to children in the region where the current study was conducted. The latest TSN records also show that there are no pediatric patients who voluntarily switch to HD (11).

On the basis of the Turkish Society of Nephrology's recent records, an analysis of the reasons why pediatric PD patients in Turkey discontinued PD treatment in 2017 shows that 52.4% of the patients switched to HD and that 26.2% had a renal transplant with reported cases of mortality at 21.4% (11). In our study, the rate of patients who switched to HD was similar (52.9%), while kidney transplantation rates were higher (32.3%) and mortality rates lower (11.7%). Kidney transplantation is the most desirable cause for the discontinuation of PD treatment on the part of patients, and current results suggest that the rate of kidney transplants among patients studied is fairly good.

A comparison of the laboratory values of patients continuing peritoneal dialysis and those who had to discontinue due to non-transplant causes show that hyperphosphatemia and CaxP multiplier levels were effective (p:0.013, p:0.048, respectively). This suggests that hyperphosphatemia and the CaxP multiplier level may be a risk factor for dropping out of PD, especially in patients with poor compliance with treatment and diet. An adult study in the literature (9) found that anemia, albumin deficiency and CaxP multiplier levels were especially high in patients who died, but no difference was observed between the patients who switched to HD. In our study, any separate risk factors were not examined due to the low rate of patients who died. A common evaluation of patients who died and who switched to HD and their comparison to patients, who continued with PD, has shown a significant relationship between the P level and the CaxP multiplier level. However, no significant correlation was found between Hb, albumin and PTH values.

Our study has found that recurrent and/or resistant peritonitis episodes are the most common cause for discontinuation of treatment with PD, suggesting that a number of measures should be taken. In the International Society for Peritoneal Dialysis (ISPD) guidelines, a consensus guide was published in 2012 on the prevention and treatment of catheter-related infections and peritonitis in pediatric patients receiving peritoneal dialysis, which was updated in 2016 (13,14). This guideline suggests that; administration of systemic prophylactic antibiotics (Cefazolin / Vancomisin) just before catheter insertion, repeated antibiotic prophylaxis prior to other invasive procedures (colonoscopy, polypectomy and cholecystectomy), daily application of topical antibiotic creams or ointments (mupirocin or gentamicin) for the care of the catheter exit-site, immediate treatment of an active exit site or a catheter tunnel infection, periodical training of parents, repetition of this training, especially after a prolonged stay in hospital and following a peritonitis or catheter infection, and finally fungal prophylaxis during treatment with antibiotics (Mycostatin, Fluconazole). Preventing peritonitis may also reduce PD deficiencies of patients. Our clinic where the present study conducted attempts to apply the ISPD recommendations as much as possible. However, case studies have shown that patients' relatives do not comply with the required hygiene regulations despite the training provided. For this reason, it is considered vital to repeat the training regularly and to visit the patients in their actual domestic environments.

LIMITATIONS

Our study has some limitations. The major limitations of this study are its retrospective design and inclusion of children who all attended the same clinic. So, multicenter prospective studies including larger number of patients are needed to confirm and generalize our results.

CONCLUSION

In summary, peritonitis is still the most important and common complication of PD in children. It is also inevitable that recurrent peritonitis and peritoneal dialysis solutions with high glucose content will lead to failure of ultrafiltration. The prevention of peritonitis, along with the preservation of the peritoneal membrane in children included in a chronic PD program up until kidney transplantation, can lead to longer terms of treatment with PD.

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Beltinge Demircioglu Kilic ORCID: 0000-0001-9408-2139
Melek Aksay Urgun ORCID: 0000-0003-1103-7696

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