Original Paper

Risk Factors and Outcomes of Early-Onset Peritonitis in Chinese Peritoneal Dialysis Patients

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Key Words

Peritoneal dialysis • Peritonitis • Technique failure • All-cause mortality

Abstract

Background/Aims: Studies on the risk factors and outcomes of peritonitis within the first 6 months in peritoneal dialysis patients are sparse. This study aims to investigate the risk factors associated with early-onset peritonitis (EOP) and its influence on patients' technique survival and mortality. **Methods:** This is a retrospective observational cohort study. A total of 483 patients who had at least one episode of peritonitis were enrolled and followed from March 1, 2002, to August 31, 2016, at our center. According to the time to first peritonitis, we divided patients into two groups: EOP (≤ 6 months, $n=167$) and late-onset peritonitis (LOP, >6 months, $n=316$). Logistic regression was used to analyze the factors associated with EOP. A Cox proportional hazards model was constructed to examine the influence of EOP on clinical outcomes. **Results:** Of the 483 patients, 167 (34.6%) patients developed their first episode of peritonitis within the first 6 months. The EOP patient group had more male patients, a shorter time on peritoneal dialysis (PD), lower serum albumin levels at the time of PD initiation and a higher peritonitis rate ($P<0.05$). The EOP patient group had fewer infections with Gram-negative organisms ($P=0.013$) and more culture-negative peritonitis ($P=0.014$) than the LOP patient group for the first episode of peritonitis. The multivariate logistic regression analysis showed that factors associated with EOP included male gender (odds ratio (OR) 1.920, 95% confidence interval (CI) 1.272-2.897, $P=0.002$) and a low serum albumin level at the start of PD (OR 0.950, 95% CI 0.914-0.986, $P=0.007$). In the Cox proportional hazards model, EOP was a significant predictor of all-cause mortality (hazard ratio (HR) 2.766, 95% CI 1.561-4.900, $P<0.001$). There were no differences between EOP and LOP for technique failure. However, in continuous analyses, a negative correlation was observed between the time to first peritonitis

and technique failure (HR 0.988, 95% CI 0.980-0.997, $P=0.006$). In the Spearman analysis, the time to first peritonitis was negatively correlated with the peritonitis rate ($r=-0.573$, $P<0.001$). **Conclusion:** Male gender and a low serum albumin level before PD were strongly associated with EOP. Additionally, EOP patients had a higher risk of poor clinical outcomes. More importantly, an early peritonitis onset was associated with a high peritonitis rate.

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Introduction

Peritoneal dialysis (PD) is a major renal replacement therapy. In developing countries such as China, the number of PD patients has been increasing over time [1]. Peritonitis is still a major complication of PD and the leading cause of technique failure [2]. Peritonitis rates vary across regions and countries, ranging from 0.20 to 0.82 episodes/patient-year [3-6]. Long-term PD causes structural and functional changes in the peritoneum that can lead to peritoneal fibrosis [7]. Additionally, peritonitis may accelerate and exacerbate this process. Moreover, the frequency and the timing of infection could impact peritoneum function and change the permeability of the membrane [8].

There have been many studies examining the clinical characteristics, causative organisms, predictors and outcomes of the first episode of peritonitis in PD patients. However, for early-onset peritonitis (EOP), there are few studies. A study from the United States identified that 72.6% patients had their first episode of peritonitis within the first 6 months after PD initiation [9]. They also found that the risk of peritonitis, hospitalization or transfer to hemodialysis (HD) was higher in the first 3-6 months after PD initiation than after 6-12 months. Another two studies published in 2006 also reported that EOP patients had higher peritonitis rates, technique failure and mortality [10, 11].

According to current research, EOP is related to mortality and technique failure in PD patients. However, in the Chinese population, there are few studies concerning risk factors and outcomes of EOP. To determine the impact of EOP on clinical outcomes and predictors of EOP, we conducted this retrospective cohort study.

Materials and Methods

Study population

This was a retrospective observational study. All the patients requiring PD were followed from March 1, 2002, to August 31, 2016, in our center, the First Affiliated Hospital of Zhejiang University. There were 2087 PD patients examined for eligibility. A total of 571 patients who had at least one episode of peritonitis became our study participants. The exclusion criteria were as follows: patients who had been using PD for fewer than 90 days, patients with an age younger than 18 years and patients who initiated PD in other PD centers. Patients were followed until any of the following events: death, a change to HD, renal transplantation or until August 31, 2016. Among the 571 patients, 13 remained on PD for fewer than 90 days, 4 were younger than 18 years old when starting PD, and 17 started PD at other PD centers. In total, 483 patients were included in this study. According to the time to first peritonitis, we divided the 483 patients into two groups: early-onset peritonitis (≤ 6 months, $n=167$) and late-onset peritonitis (LOP, >6 months, $n=316$). We collected baseline characteristics within 1-3 months from the start of PD, including demographic data (age, gender, education level, BMI, CCI), biochemical data (albumin, hemoglobin, total cholesterol, serum potassium, serum calcium, serum phosphorus, and serum creatinine), PD adequacy indices and microbiological characteristics of the peritonitis. All data were collected from the patient records at our center.

Study definition

According to the 2010 International Society for Peritoneal Dialysis (ISPD) guidelines, peritonitis can be diagnosed if at least 2 of the following criteria are satisfied: (1) abdominal pain, cloudy effluent, with or without fever; (2) peritoneal fluid effluent containing a white cell count $>100/\text{mm}^3$, with more than 50%

polymorphonuclear neutrophilic cells; (3) a positive result of PD effluent culture [12].

Early-onset peritonitis was defined as the first episode of peritonitis occurring within 6 months after the initiation of PD. The outcomes we studied were all-cause mortality and technique failure. Death was an end-point event in the patient survival analysis. Switching to HD or receiving renal transplantation were censored. Technique failure was defined as the transfer to HD therapy permanently due to ultrafiltration failure, peritonitis, exit-site infection and other operational problems.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics 19.0 for Windows (IBM Corp., Armonk, NY, USA). Results were expressed as the mean $\pm$ standard deviation for normally distributed data and median values with the 25th to 75th percentile intervals for skewed data. Categorical data were presented as frequency (n) and percentage (%). Differences between the EOP and LOP groups were analyzed using Student's t-test for normally distributed data, the Wilcoxon rank sum test for skewed continuous data and the Chi-square test or Fisher's exact test for categorical data. The Kaplan-Meier survival curve was calculated for the analysis of technique survival and patient survival. Univariate Cox proportional hazards regression was used to select significant factors associated with study outcomes. Variables whose $P < 0.10$ were selected for inclusion in the final multivariate Cox model. Collinearity of variables was tested. Multivariate logistic regression was performed to select significant risk factors for EOP and the inclusion standard was also $P < 0.10$. The correlation of peritonitis rate and time to first peritonitis was done using Spearman analysis. A two-tailed P value < 0.05 was considered statistically significant.

Results

Study population

There were 2087 patients at our PD center during the study period, and 483 (23.1%) patients who met the inclusion criteria were included in the study. The first episode of peritonitis was experienced by 167 (8.0%) patients within 6 months after the start of PD. All patients used Dianeal with 1.5% or 2.5% dextrose. The connective systems were Y-sets and twin-bags. Mupirocin ointment was used in every patient to prevent exit site infection. Different PD solutions were utilized according to the patient's situation. Median follow-up time for the 483 patients was 37.7 months (interquartile range 22.0-60.7 months). The mean age was 52.1 ± 14.1 years and 62.9% of the patients were male. The mean age of the 2087 patients was 49.7 ± 15.3 years and 55.8% were male. The most common primary renal diseases were chronic glomerulonephritis (63.8%), diabetic nephropathy (11.4%) and hypertension (8.3%). The total peritonitis rate was 0.158 episodes per patient-year (483 patients presented 832 episodes of peritonitis during 5260.4 patient-years of follow-up). Clinical characteristics of the 483 patients are shown in Table 1. Compared with the LOP patient group, the EOP patient group had more male patients, a shorter time on PD, lower serum albumin levels at the time of initiation of PD and a higher peritonitis rate ($P < 0.05$). Most patients only had one episode of peritonitis, and the EOP patient group had more patients who experienced 3 or more episodes of peritonitis.

The causative organisms of the first episode of peritonitis are shown in Table 2. Of the 483 patients, 202 (41.8%) were due to Gram-positive organisms, 90 (18.6%) were due to Gram-negative organisms, 11 (2.3%) were due to fungi, 10 (2.1%) to multiple organisms, and 170 (35.2%) were culture-negative. Coagulase-negative Staphylococcus was the most common Gram-positive organism in both groups. Compared with the LOP patient group, the EOP patient group had fewer Gram-negative organism infections (12.6% vs. 21.8%, $P = 0.013$), and more culture-negative peritonitis (42.5% vs. 31.3%, $P = 0.014$).

For the whole study population, the peritonitis rate was negatively correlated with the time to first peritonitis ($r = -0.573$, $P < 0.001$).

Table 1. Baseline characteristics of the study population

Variable	Early-onset peritonitis (N=167)	Late-onset peritonitis (N=316)	P value
Men (%)	122(73.1)	182(57.6)	0.001
Age (years)	51.0±14.5	52.6±13.9	0.242
Education level (%)			0.224
≤ junior high school	132(79.1)	234(74.1)	
>junior high school	35(20.9)	82(25.9)	
Body Mass Index	22.0±2.9	21.9±3.1	0.644
PD duration (months)	25.2(11.8,40)	45.7(28.3,66.4)	<0.001
Charlson Comorbidity Index score	3.24±1.33	3.47±1.46	0.097
Diabetes (%)	27(16.2)	42(13.3)	0.390
Serum potassium (mmol/L)	4.29±0.69	4.23±0.68	0.368
Serum calcium (mmol/L)	2.09±0.27	2.09±0.26	0.821
Serum phosphorus(mmol/L)	1.79±0.55	1.83±0.48	0.433
Serum albumin (g/L)	35.7±5.2	37.2±5.0	0.003
Hemoglobin (g/L)	85±18	83±17	0.387
Total cholesterol (mmol/L)	4.31±1.18	4.33±1.21	0.898
Serum creatinine(μmol/L)	779.3±296.3	742.1±260.3	0.156
Total Kt/V	2.05±0.57	2.12±0.58	0.843
eGFR (ml/min/1.73 m ²)	7.18±2.79	7.12±3.00	0.164
Peritonitis rate (/patient year)	0.85(0.44,1.71)	0.39(0.24,0.66)	<0.001
Number of peritonitis episodes (%)	340	492	<0.001
1	87(52.1)	205(64.9)	
2	35(21.0)	73(23.1)	
≥3	45(26.9)	38(12.0)	
Time from first to second peritonitis (months)	5.8±13.5	5.2±11.5	0.623

Table 2. Details of causative organisms of the first episode of peritonitis

Causative organisms	Early-onset peritonitis episodes (n)	Late-onset peritonitis episodes (n)	P value
Gram-positive organisms (%)	73 (43.7)	129 (40.8)	0.540
Staphylococcus aureus	4 (5.5)	10 (7.8)	0.541
Coagulase-negative staphylococcus	49 (67.1)	69 (53.5)	0.059
Streptococcus species	12 (16.4)	34 (26.4)	0.106
Enterococcus species	3 (4.1)	6 (4.7)	1.000
Other Gram-positives	5 (6.8)	10 (7.8)	0.814
Gram-negative organisms (%)	21 (12.6)	69 (21.8)	0.013
Escherichia coli	13 (61.9)	38 (55.1)	0.580
Klebsiella species	4 (19.0)	11 (15.9)	0.744
Acinetobacter species	1 (4.8)	6 (8.7)	1.000
Other Gram-negatives	3 (14.3)	14 (20.3)	0.752
Multiple organisms (%)	1 (0.6)	9 (2.8)	0.176
Fungi (%)	1 (0.6)	10 (3.2)	0.107
Culture-negative peritonitis (%)	71 (42.5)	99 (31.3)	0.014

Technique failure

After adjusting for gender, serum albumin and diabetes, there were no significant differences between the EOP and LOP groups in the multivariate Cox proportional hazards model (Table 3). Fig. 1 describes technique survival by EOP and LOP groups using the Kaplan-Meier analysis. When the time to first peritonitis was considered as a continuous variable, the risk of technique failure decreased by 1.2% with every 1 month increase in time to first peritonitis (Table 3, HR 0.988, P=0.006).

Table 3. Cox proportional hazards model for technique failure and patient mortality. The analyzed variables included sex, age, time to first peritonitis, education level, body mass index, Charlson comorbidity index score, diabetes, serum albumin, hemoglobin, total cholesterol, total Kt/V and eGFR

Variable	Univariate Cox regression analysis			Multivariate Cox regression analysis		
	HR	(95%CI)	P value	HR	(95%CI)	P value
Technique failure (by group)						
Time to first peritonitis (EOP vs. LOP)	1.298	0.863-1.951	0.210	1.200	0.793-1.817	0.389
Sex (men vs. women)	1.376	0.943-2.010	0.098	1.318	0.898-1.933	0.158
Serum albumin	0.955	0.921-0.990	0.012	0.961	0.926-0.997	0.034
Diabetes	1.633	1.017-2.622	0.042	1.446	0.891-2.345	0.135
Technique failure (by time)						
Time to first peritonitis (months)	0.987	0.979-0.996	0.003	0.988	0.980-0.997	0.006
Sex (men vs. women)	1.376	0.943-2.010	0.098	1.294	0.885-1.891	0.183
Serum albumin	0.955	0.921-0.990	0.012	0.964	0.930-1.001	0.053
Diabetes	1.633	1.017-2.622	0.042	1.503	0.926-2.438	0.099
Patient mortality						
Time to first peritonitis (EOP vs. LOP)	2.849	1.638-4.954	<0.001	2.766	1.561-4.900	<0.001
Age	1.062	1.039-1.086	<0.001	1.047	1.012-1.084	0.008
Charlson Comorbidity Index score	1.589	1.343-1.879	<0.001	1.151	0.840-1.576	0.381
Diabetes	2.437	1.304-4.555	0.005	1.005	0.466-2.167	0.990
Serum albumin	0.889	0.840-0.935	<0.001	0.896	0.847-0.947	<0.001
eGFR	1.088	1.007-1.175	0.033	0.983	0.897-1.076	0.709

All-cause mortality

During the study period, a total of 55 patients died: 23 patients in the EOP group and 32 patients in the LOP group. Cardiovascular or cerebrovascular disease (29.1%) and infection (20%) were the most common causes. After adjusting for age, CCI, diabetes, serum albumin and eGFR in the multivariate Cox analysis for mortality, EOP was significantly associated with mortality compared with the LOP group, with a hazard ratio (HR) of 2.766 (Table 3, $P < 0.001$). Cumulative survival is shown in Fig. 2, with LOP patients having a longer survival time than EOP patients, using the log-rank test ($P < 0.001$).

Fig. 1. Technique survival according to EOP and LOP group.

Risk factors of early-onset peritonitis

Based on the simple logistic regression analysis of risk factors associated with EOP (Table 4), we constructed a multiple logistic regression model using variables including gender and baseline serum albumin level. These two factors, male gender and low serum albumin at the

start of PD, were significantly associated with EOP (Table 4). Male patients had a higher risk of EOP than female patients, with an odds ratio (OR) of 1.92, $P=0.002$. Every 1 g/L increase in the baseline serum albumin level lowered the risk of EOP by 5.0% (OR 0.950, $P=0.007$).

Discussion

We retrospectively studied 483 PD patients at our center who experienced at least one episode of peritonitis and found that EOP was significantly associated with technique failure and all-cause mortality. Male gender and low serum albumin at the start of PD were two predictors of EOP. A negative correlation was identified between the time to first peritonitis and the peritonitis rate. The earlier the first peritonitis infection occurred, the greater the risk of a high peritonitis rate.

Peritonitis is the major complication of peritoneal dialysis. According to previous reports, the risk factors for peritonitis include age, gender, smoking, diabetes, low education level, depression, low residual renal function, and low serum albumin level [13-17]. We undertook this research study because we hypothesized that if risk factors are detected early in PD, patient clinical outcomes may improve.

We found that male gender was an independent risk factor for EOP (OR 1.920, $P=0.002$). To our knowledge, there are no previous studies that have reported this finding. The effect of gender on peritonitis is still being debated. A multi-center prospective study found that female gender was a risk factor for peritonitis [18]. This might be related to more urogenital infections

Fig. 2. Patient survival according to EOP and LOP group.

Table 4. Logistic regression analysis of factors associated with early-onset peritonitis

Variable	Univariate logistic regression analysis			Multivariate logistic regression analysis		
	OR	(95%CI)	P value	OR	(95%CI)	P value
Sex (men vs. women)	1.996	1.327-3.002	0.001	1.92	1.272-2.897	0.002
Age	0.992	0.979-1.005	0.241			
Education level ($\leq$ junior high vs. $>$ junior high)	1.322	0.843-2.072	0.224			
Body Mass Index	1.015	0.953-1.080	0.643			
Charlson Comorbidity Index score	0.914	0.797-1.049	0.200			
Diabetes	1.258	0.745-2.126	0.391			
Hemoglobin	1.005	0.994-1.016	0.386			
Serum albumin	0.946	0.911-0.982	0.003	0.95	0.914--0.986	0.007
Total cholesterol	0.99	0.846-1.158	0.897			
Total Kt/V	0.789	0.565-1.102	0.165			
eGFR	1.006	0.944-1.073	0.843			

in females than males caused by Gram-negative organisms. However, a recent single-center retrospective study in China found a risk of first peritonitis that was 130% higher in males than in females [19]. In our study, we identified that male gender was associated with a higher risk for EOP compared to females. The EOP patient group had more male patients than the LOP group ($P=0.001$). The reason for this interesting finding may be as follows: firstly, adherence and personal health habits are worse in male patients; secondly, a man's income is generally the major source of income for a family in China; therefore, male patients may be more likely to keep working after the initiation of PD while females may prefer an early retirement, resulting in male patients who may be more easily impacted by environmental factors; thirdly, in our study, 55.8% of peritoneal dialysis patients and 62.9% of peritonitis patients were male; the proportion of males was higher in the peritonitis cohort.

A low baseline serum albumin level has been identified as a significant predictor of peritonitis in previous research. Our study reaffirmed its independent predictive value in EOP. The EOP patient group had lower serum albumin levels at the initiation of PD in our study ($P=0.003$). Every 10 g/L decrease in serum albumin concentration at the start of PD increased the risk of peritonitis by 74% in a study from the United States [20] and 67% in Hong Kong [15]. The serum albumin level was considered to be a marker of nutrition status. Low serum albumin was associated with malnutrition and an inflammatory state, increasing the risk of infection. Prasad et al. found a higher proportion of peritonitis and rate of malnutrition compared to patients with normal nutritional status [21]. The risk of EOP decreased by 5.0% for every 1 g/L increase in serum albumin in our study (OR 0.950, $P=0.007$).

Peritonitis is the leading reason for technique failure [22]. Although the peritonitis rate in PD has declined over time [23, 24], peritonitis-related technique failure was not reduced in a study from Canada [25]. Peritonitis has a negative impact on peritoneum structure and function, especially when the patient is suffering from severe or repeating peritonitis [26]. A multi-center study from Scotland showed that 42.2% of PD patients transferred to HD permanently due to peritonitis, and there was a significant correlation between peritonitis and technique failure [27]. After an attack of peritonitis, the structure and function of the peritoneum may be changed [28]. Repair of the peritoneum may be incomplete. This makes the peritoneum prone to infection, causing more episodes of peritonitis and persistent impairment of the peritoneum. Patients with early peritonitis had higher peritonitis rates than LOP patients in this study. Repeating peritonitis in EOP patients may have a significant impact on membrane permeability, reducing ultrafiltration and leading to technique failure [29]. In the present study, the time to first peritonitis was a significant predictor of technique failure, with a hazard ratio of 0.988 for every 1-month increase ($P=0.006$). While there were no significant differences in technique failure between the EOP and LOP groups, this may be explained by inappropriate group division for technique failure. Further research is needed to identify a better way to divide the groups.

The correlation between peritonitis and death has been investigated in previous reports [30, 31]. A Spanish study reported that each episode of peritonitis, or repeated regional and systematic inflammation, could increase the risk of death in patients on PD [32]. Another study found there was a correlation between early peritonitis (time to first peritonitis <20.28 months) and poor clinical outcomes [33]. They found that early peritonitis was a novel predictor for mortality, and the risk of death decreased 3% for every 1 month increase in the time to the first peritonitis. Another study from China found that early peritonitis (time to first peritonitis ≥ 6 months) was an independent predictor of mortality in elderly PD patients [34]. Consistent with previous studies, we found that the risk of all-cause mortality in the EOP group was higher compared to the LOP group (HR 2.766, $P<0.001$). A study found that the risk of death continued to increase in the 120 days after the occurrence of peritonitis, and the risk was highest during the initial 30 days [35]. Persistent systemic inflammation exists after an episode of peritonitis and this might lead to cerebrovascular disease, increasing the risk of death [36]. The EOP group was prone to have more episodes of

peritonitis and had a higher peritonitis rate in the present study. More episodes of peritonitis in EOP patients may lead to longer and more severe systemic inflammation, causing vascular injury, atherosclerosis, and cardiovascular or cerebrovascular disease, increasing the risk of death. This might explain the higher risk of all-cause mortality in EOP patients. Our findings support this hypothesis. Cardiovascular or cerebrovascular disease (29.1%) was the most common cause of death in peritonitis patients in our study, followed by infection (20%).

In our study, the causative organisms of the first peritonitis episode were mainly Gram-positive organisms in both groups, especially coagulase-negative *Staphylococcus*. Compared with the LOP patient group, the EOP patient group had fewer Gram-negative organism infections (12.6% vs. 21.8%, $P=0.013$), and more culture-negative peritonitis (42.5% vs. 31.3%, $P=0.014$). These results were consistent with previous reports. Fourtounas et al. found in both the early peritonitis group (time to first peritonitis <12 months) and late peritonitis group (>24 months), the main causative organisms were Gram-positive [11]. They also found that Gram-negative bacterial infections and fungal infections were more common in late peritonitis patients. In a recent retrospective study involving 309 peritonitis patients, 32% of causative organisms of the first peritonitis were Gram-positive organisms [19]. Gram-positive organism infection, especially coagulase-negative *Staphylococcus* infection, could be related to incorrect operation of the peritoneal fluid exchange [37]. This may partially explain our results. Unskilled peritoneal fluid exchange in the EOP patient group and overlooked details of the process in the LOP patient group may lead to more infections with Gram-positive organisms.

The culture-negative proportion for the first peritonitis episode was high in our study: 35.2% of the study population. This proportion was much higher than the reported rate published by ISPD (lower than 15%) in 2016 [38]. Many patients received antibiotic therapy at the early stage of peritonitis in local hospitals and then transferred to our center. Early antibiotic treatment before effluent culture might be a primary reason for the high culture-negative rate in our center. Also, we should review and improve our culture technique protocols. PD effluent centrifugation, culturing sediment and immediate delivery to the center laboratory might help enhance the yield of the effluent culture.

Our results identified that the peritonitis rate in the EOP group was much higher than in the LOP group (0.85 episodes/patient-year vs. 0.39 episodes/patient-year). There was a negative correlation between time to first peritonitis and peritonitis rate for the whole peritonitis cohort ($r=-0.573$, $P<0.001$). There are few studies that have investigated the relationship between the time to first peritonitis and peritonitis rate. A study from Taiwan found that the earlier the first peritonitis occurred, the higher risk of having a high peritonitis rate [33], which is consistent with our results. Patients who experienced peritonitis early after the initiation of PD were likely having more episodes of peritonitis, which may lead to technique failure [11]. An early peritonitis infection has a negative impact on peritoneum defense and repair functions. Compared to the peritoneum without peritonitis, incomplete repair of the peritoneum after early peritonitis results in greater susceptibility to infection, causing a vicious cycle and drop-out from PD due to technique failure [26]. The patients who experienced three or more episodes of peritonitis were more likely to be in the EOP group than in the LOP group (26.9% vs. 12.0%). EOP patients were more likely to have frequent peritonitis. We also identified that the EOP patient group stayed on PD for a shorter time. EOP patients experienced peritonitis more frequently and earlier than LOP patients in our study. As we mentioned previously, early and frequent peritonitis may lead to earlier technique failure and drop-out from PD. This might be a reason for the shorter PD duration in EOP patients. This finding was consistent with our study in which EOP was significantly associated with technique failure.

EOP was significantly associated with poor clinical outcomes in the present study. Male gender and a low baseline serum albumin level were two risk factors for EOP. We should recognize these risk factors early and undertake interventions to reduce the chance of EOP. For male patients, we should follow up more frequently, especially in the initial 6 months

of PD. The PD follow-up frequency could be twice a month or more often to improve the adherence of male patients. More attention should be paid to a low serum albumin level in PD patients, especially at the initiation of PD. The reason for a low serum albumin level should be investigated and corrected immediately. Adequate nutrition status and improvement of immunity could reduce the risk of EOP.

There are several limitations to this study. First, this was a retrospective cohort study, in which a small number of patients (1.2%) were lost to follow-up, which may have biased the results. Second, this was a single-center study, and the sample size was relatively small. Further studies, such as multi-center and prospective studies, are necessary.

Conclusion

This is the first retrospective cohort study done in Southern China that identified male gender and a low baseline serum albumin level as predictors of EOP and the negative correlation between time to first peritonitis and peritonitis rate. In line with previous studies, EOP was strongly associated with poor clinical outcomes. This could facilitate the early identification of patients at risk for EOP and lead to interventions to reduce complications.

Disclosure Statement

The authors of this manuscript state that they have no conflicts of interest to disclose.

Abbreviations

PD (peritoneal dialysis); EOP (early-onset peritonitis); LOP (late-onset peritonitis); HD (hemodialysis); CCI (Charlson comorbidity index); BMI (body mass index); eGFR (estimated glomerular filtration rate); ISPD (International Society for Peritoneal Dialysis); OR (odds ratio); HR (hazard ratio); CI (confidence interval).

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