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The prevalence of constipation in end-stage kidney disease patients

A cross-sectional observation study

Liuping Zhang, MS[a], Fang Tang, BS[a], Fengmei Wang, MD, PhD[a], Qinglei Xie, MS[a], Meixia Xia, BS[a], Liangyunzi Jiang, BS[a], Ze-Mu Wang, MD, PhD[b], Bin Wang, MD, PhD[a,*]

Abstract

The aim of our study was to determine the prevalence, distribution, and risk factors for constipation in peritoneal dialysis (PD) and hemodialysis (HD) patients in our center. In this cross-sectional study, 858 dialysis patients over 18 years of age (681 HD cases and 177 PD cases from our hospital) were enrolled. A constipation assessment scale (CAS) questionnaire was used to evaluate constipation status. Logistic regression analysis was performed to define independent risk factors for CAS scores. The prevalence of constipation in HD and PD patients was 52.7% and 77.4%, respectively. The mean CAS score in HD and PD patients was 1.73 ± 2.31 and 2.42 ± 2.34, respectively. Age ≥ 65 and diabetic kidney disease for renal failure were independent risk factors associated with constipation in the HD population (OR = 1.67, 95% CI: 1.15–2.90, P = .019; OR = 3.31, 95% CI: 1.65–6.11, P < .001, respectively). In the PD population, only serum prealbumin was independently associated with constipation (OR = 0.88, 95% CI: 0.79–0.96, P = .007). The multivariable logistic regression analysis demonstrated that PD modality, age ≥ 65 and diabetic kidney disease for renal failure were independent risk factors for constipation (OR = 2.15, 95% CI: 1.41–3.32, P < .001; OR = 1.65, 95% CI: 1.13–2.33, P = .003; OR = 3.19, 95% CI: 1.76–5.093, P < .001, respectively). The prevalence of constipation in PD patients was higher than that in HD patients in our center. PD modality for renal replacement therapy, age ≥ 65 and diabetic kidney disease for renal failure were closely associated with constipation in dialysis patients.

Abbreviations: ALP = alkaline phosphatase, APD = automatic peritoneal dialysis, BMI = body mass index, CAPD = continuous ambulatory peritoneal dialysis, CAS = constipation assessment scale, CI = confidence interval, CKD = chronic kidney disease, HD = hemodialysis, iPTH = intact parathyroid hormone, OR = odds ratio, PD = peritoneal dialysis, UA = uric acid.

Keywords: constipation, hemodialysis, peritoneal dialysis, prevalence

1. Introduction

Constipation is one of the most frequent gastrointestinal disorders encountered either in the general population or in chronic illness populations.[1–3] The prevalence of constipation in the general population is up to one-fifth, increases with age and is more frequent in females.[4–7] According to previous reports, constipation is a very common complication for patients receiving dialysis, with an incidence of 53% (8%–57%).[8–10] Epidemiological surveys have shown that the prevalence of adult chronic kidney disease (CKD) is 10.8% in China and is also a worldwide public health problem.[11] With the decrease in the glomerular filtration rate and metabolic dysfunction in CKD patients, a variety of complications occur. Constipation is increasing significantly, which can affect quality of life, psychological preoccupations, and socioeconomic burden.

Classically, the term "constipation" refers to infrequent bowel motions or hard feces and the disorder is heterogeneous and tends to be poorly understood and inadequately treated in dialysis patients.[12,13] Herein, constipation in our study was focused on "functional constipation" and was diagnosed according to the Rome III Criteria.[14,15] In addition, a recent study demonstrated that constipation status and severity were associated with a higher risk of incident CKD, incident end-stage kidney disease, and progressive estimated glomerular filtration rate decline, independent of known risk factors.[16] Zuvela J et al have reviewed 5 studies contrasted the prevalence of constipation between HD and PD patients. Four findings demonstrated that constipation was more common in HD.[17] Yasuda G et al have found HD patients had a 3.14 times higher relative risk of constipation than PD patients.[18] In a study from China with 605 dialysis patients, the incidence of constipation defined by the Rome III criteria was 71.7% in HD patients and 14.2% in PD patients who presented with a significantly worse health-related quality of life.[19]

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The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] Institute of Nephrology, Zhong Da Hospital, Southeast University School of Medicine, Nanjing, Jiangsu, China, [b] Department of Cardiology, The First Affiliated Hospital of Nanjing Medical University, Nanjing, Jiangsu Province, China.

**Correspondence: Bin Wang, Institute of Nephrology, Zhong Da Hospital, Southeast University School of Medicine, Nanjing, Jiangsu, China (e-mail address: wangbinhewei@126.com).*

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According to the previous studies, several factors affect the incidence and severity of constipation, such as patient selection, dietary intake, drugs, and lifestyles.[3,20,21] However, there is a lack of strong evidence regarding the constipation assessment scale (CAS) in dialysis patients. CAS has well established validity and reliability to document the presence and severity of constipation in a series of studies.[22,23] Little is known about the risk factors contributing to constipation in HD or PD groups. Thus, the aim of this study was to investigate the prevalence and severity of constipation in a cross-sectional cohort of HD and PD patients in a single center in China. Possible associated risk factors contributing to constipation were then analyzed.

2. Methods

2.1. Study design

In this cross-sectional study, a total of 1052 patients from the blood purification center of our hospital participated from January 2021 to March 2021, excluding 41 patients with cognitive deficits (n = 18), who were incapable of answering the questionnaire (n = 23). Consequently, 1011 patients (HD 834, PD 177) underwent the CAS, and 858 patients (HD 681, PD 177) were enrolled in the study (the screening flow chart is shown in Fig. 1). All patients aged 18 years or older who had received HD or PD for more than 3 months were screened for participation. The inclusion criteria for all subjects in the study were as following: diagnosis of end-stage renal disease, receiving current conventional HD (3 times per week) or maintenance PD treatment, older than 18 years, voluntary participation. The exclusion criteria included those patients with gastroenteric tumors or colorectal inflammation disease; those undertaking dialysis for less than 3 months; kidney transplant recipients; patients with cognitive deficits and those with illiteracy who could not complete a written questionnaire. In our study, all the enrolled HD patients received hemodialysis 3 times every week with high-flux membrane dialyzers, which of the surface is 1.6 m^2~1.8 m^2. In addition, the majority of the enrolled HD patients also received 1 or 2 times hemodiafiltration every month, thus the hemodialysis of modality includes diffusion and convection. In our blood purification, a single-pool Kt/V at 1.20 to 1.40 per thrice-weekly dialysis session is employed to evaluate the efficiency quantification. The proportion of PD patients on automatic peritoneal dialysis (APD) has been steadily increasing over the past few years. In our center, the percentage of PD patients on APD is about 5%, the majority of PD patients receive only continuous ambulatory peritoneal dialysis (CAPD). In CAPD, the patient must perform at least 4 to 5 exchanges every day, and 8 liters of dialysate are fundamental. In home APD group, the range value of dialysate liters is 4~5. What's more, some patients simultaneously receive CAPD and APD. Theoretically, the peritoneal dialysis target Kt/V is greater or equal to 1.7 weekly (according to the International Society of Peritoneal Dialysis). However, we cannot define adequate dialysis with the single Kt/V value, because Kt/V urea only reflects the clearance of solute without taking into consideration the overall conditions of PD patients.

Written informed consent was obtained from each participant for the research. The study complied with the Declaration of Helsinki and was approved by the local ethics committees of Zhongda Hospital affiliated with Southeast University.

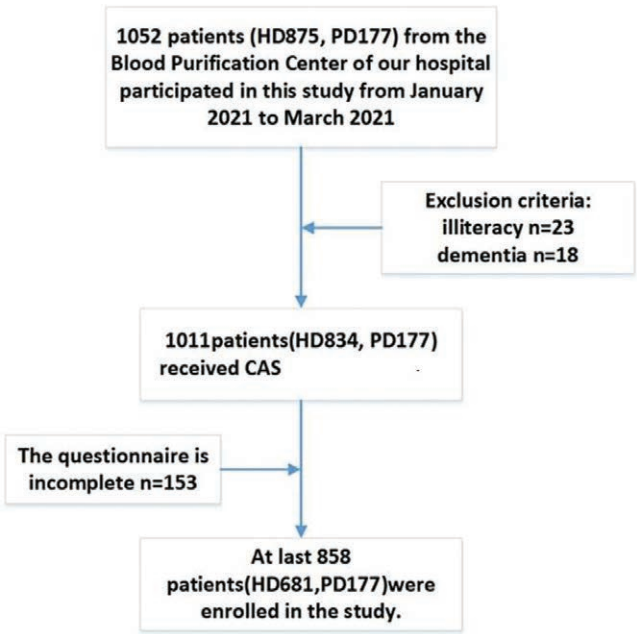

Figure 1. The screening flow chart of patients in the study.

2.2. Measurements

2.2.1. Constipation definition. The constipation diagnosis standards were established according to Rome III Diagnostic Criteria.[14] The detailed definition is as follows: symptom onset more than 6 months prior to the diagnosis, with the following criteria fulfilled for the past 3 months: Loose stools rarely present without the use of laxatives; Insufficient criteria met to establish a diagnosis of irritable bowel syndrome; Two or more of the following criteria must be met: Less than 3 bowel movements per week; Manual maneuvers necessary to facilitate defecation more than 25% of the time; Hard or lumpy stools more than 25% of the time; Sensation of incomplete evacuation more than 25% of the time; Sensation of anorectal obstruction more than 25%of the time; Straining with defecation more than 25% of the time.

2.2.2. Constipation status. In our study, the severity of constipation was evaluated by the constipation assessment scale (CAS), which has well established validity and reliability to document the presence and severity of constipation in a series of studies.[22,23] CAS is an 8-item 3-point summated rating scale that measures the presence (score greater than 0 on items) and intensity of constipation. CAS evaluates 8 items, including abdominal distention or flatulence, changes in the amount of exhaust, reduced frequency of defecation, loose stools, rectal obstruction and feeling of pressure, rectal pain during defecation, low fecal volume, and failure of defecation, with a total score of 0 to 16.[22] During the face-to-face interviews, every participant was asked the above 8 symptoms and scored accordingly. Each item is rated by the patient as no problem (0), some problem (1), or severe problem (2). Total scores may range from 0 (no constipation) to 16 (worst possible constipation). In general, 5 points on the CAS is indicative of severe constipation requiring medical intervention, compared to 0 to 2 points indicating minor symptoms not requiring intervention.[24,25] Thus, CAS ≤ 2 was defined as mild constipation status, 3 ≤ CAS < 5 as moderate constipation status, and CAS ≥ 5 as severe constipation status in our study.

2.3. Demographic and clinical data at baseline

During the face-to-face interviews, demographic characteristics (sex, age, and educational status) and disease characteristics (including dialysis duration, dialysis modality and primary kidney diseases for renal failure) were collected. Body mass index (BMI) was calculated as body weight (kg)/[body height (m)]^2, and laboratory data, including hemoglobin, serum albumin, serum potassium, serum calcium, serum intact parathyroid

hormone (iPTH), serum creatinine, blood urea nitrogen, uric acid (UA), and serum alkaline phosphatase (ALP) levels, were gathered from medical records.

2.4. Statistical analysis

Statistical software SPSS 25.0 (SPSS, Chicago, IL) was employed for all statistical analyses. Quantitative data are expressed as the mean ± standard deviation, median with range (minimum, maximum) or number (%). A multivariable logistic regression model was applied to identify the predictors of constipation status. The results are expressed as odds ratios (ORs) with 95% confidence intervals (CIs). $P < .05$ was considered statistically significant.

3. Results

3.1. Characteristics of HD and PD patients

In total, 858 respondents (485 men [56.5%] and 373 women [43.5%]) had a mean age of 56.1 ± 14.7 years. Their demographic and socioeconomic features are shown in Table 1. The 2 groups significantly differed in age, sex, dialysis duration, education status, primary kidney diseases for renal failure, BMI, hemoglobin, serum calcium, ALP, serum albumin, and serum prealbumin (all $P < .05$).

3.2. The prevalence and distribution of constipation in HD and PD patients

The prevalence of constipation in HD and PD patients was 52.7% and 77.4%, respectively. The mean CAS score in HD and PD patients was 1.73 ± 2.31 and 2.42 ± 2.34, respectively. The scores of constipation distribution are summarized in Figure 2. Furthermore, we compared the percentage of different constipation scores in HD and PD patients. The results demonstrated that the percentage of CAS ≤ 2 in HD patients was significantly higher than that in PD patients ($P = .004$). In addition, the percentage of $3 \leq CAS < 5$ in HD patients was significantly lower than that in PD patients ($P = .038$). The percentage of CAS ≥ 5 between HD and PD patients did not significantly differ ($P = .144$) (Table 2).

3.3. Risk factors for constipation in the HD population

As shown in Table 3, the univariate logistic regression and the multivariable logistic regression analysis were conducted to predict constipation with the following candidate predictors: age, sex, years of dialysis, education, primary kidney diseases for renal failure, BMI, Hb, serum albumin, serum prealbumin, serum potassium, serum calcium, iPTH and ALP levels. The results demonstrated that age ≥ 65 and diabetic kidney disease for renal failure were risk factors (odds ratio [OR], 1.67; 95% CI, 1.18–2.35; $P = .004$; OR, 3.37; 95% CI, 1.85–6.14; $P < .001$, respectively) in the univariate logistic regression analysis. In addition, in the multivariable logistic regression analysis showed that age ≥ 65 was an independent risk factor associated with constipation (odds ratio [OR], 1.67; 95% CI, 1.15–2.90; $P = .019$). Diabetic kidney disease for renal failure was also an independent risk factor for constipation (OR, 3.31; 95% CI, 1.65–6.11; $P < .001$).

3.4. Risk factors for constipation in the PD population

The univariate and multivariable logistic regression analysis included the same parameters used in the HD analysis. In the univariate logistic regression analysis shown age ≥ 65 was risk factors for constipation (OR = 3.22, 95% CI: 1.13–9.17, $P = .028$). In addition, serum prealbumin was independently associated with constipation either in univariate logistic regression analysis or in multivariate logistic regression analysis (OR = 0.87, 95% CI: 0.80–0.95, $P = .002$; OR = 0.88, 95% CI: 0.79–0.96, $P = .007$, respectively, detailed in Table 4). The other parameters were not associated with constipation in the PD population.

Table 1

Sociodemographic and clinical data of HD and PD participants.

Characteristics	HD (n = 681)	PD (n = 177)	*P* value
Age in yrs (mean ± SD)	58.6 ± 14.2	46.7 ± 12.9	<.001
Female sex, n (%)	311 (45.7%)	62 (35%)	.01
Dialysis yrs	6.3 ± 5.2	2.0 ± 1.6	<.001
Education, n			<.001
Up to Junior high school	438(64.3%)	83(46.9%)	
High school	141(20.7%)	50(28.2%)	
Junior college	64(9.40%)	24(13.5%)	
Bachelor degree or above	38(5.60%)	20(11.3%)	
Primary kidney disease, n (%)			<.05
Nephritis	209(30.7%)	85(48.0%)	
Hypertensive nephrosclerosis	258(37.9%)	43(24.3%)	
Diabetic kidney disease	104(15.3%)	24(13.6%)	
Others	110(16.2%)	25(14.1%)	
Weight (kg) (mean ± SD)	61.8 ± 13.4	66.6 ± 12.8	<.001
Height (m) (mean ± SD)	1.64 ± 0.09	1.66 ± 0.08	.001
Body mass index (kg/m^2)*	23.1 ± 10.5	23.8 ± 3.5	<.001
Hemoglobin (g/L) (mean ± SD)	103.55 ± 19.74	91.64 ± 17.64	.000
Serum calcium (mmol/L) (mean ± SD)	2.27 ± 0.27	2.10 ± 0.21	.000
Serum phosphate (g/L) (mean ± SD)	1.69 ± 0.64	1.76 ± 0.65	.355
iPTH (pg/mL) (mean ± SD)	449.78 ± 447.23	363.85 ± 253.68	.116
ALP (U/L) (mean ± SD)	100.92 ± 73.63	83.16 ± 38.19	.048
Serum albumin (g/L) (mean ± SD)	39.45 ± 6.19	34.26 ± 5.31	.000
Serum prealbumin (g/L) (mean ± SD)	176.77 ± 207.02	31.53 ± 7.91	.000
BUN (mmol/L)(mean ± SD)	24.00 ± 5.85	23.60 ± 5.74	.585
Creatinine (umol/L) (mean ± SD)	1109.44 ± 191.86	1067 ± 192.07	.997
Uric acid (umol/L)(mean ± SD)	227.03 ± 139.48	225.93 ± 137.55	.572

ALP = alkalinephosphatase, BMI = body mass index, BUN = blood urea nitrogen, HD = hemodialysis, iPTH = intact parathyroid hormone, PD = peritoneal dialysis, SD = standard deviation.

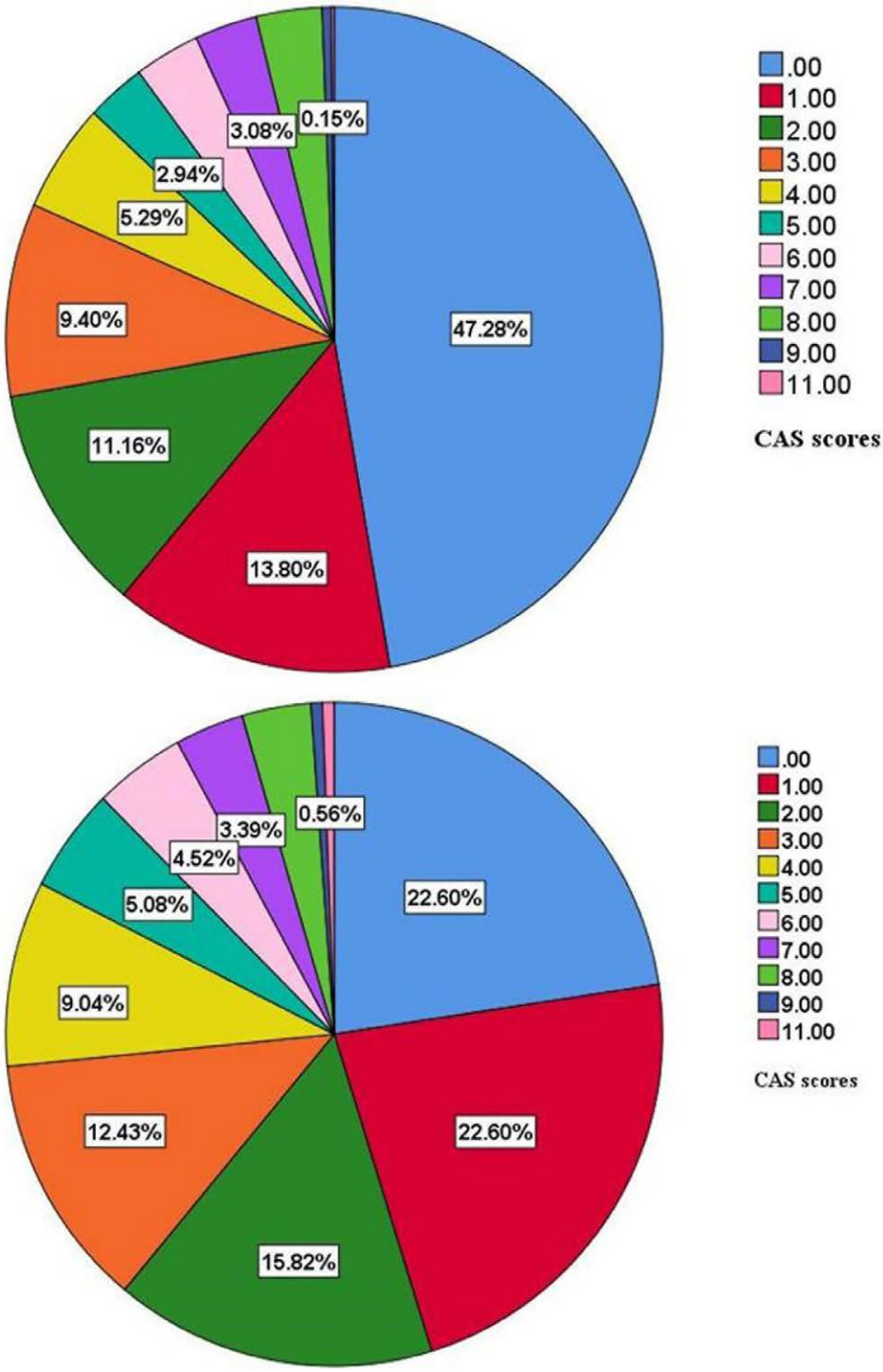

Figure 2. The CAS scores of constipation distribution. A: The CAS of constipation in HD population. B: The CAS of constipation in PD population. CAS = constipation assessment scale, HD = hemodialysis, PD = peritoneal dialysis.

3.5. Risk factors for constipation in all dialysis populations

We further conducted a multivariable logistic regression analysis in the entire dialysis population to predict constipation. It was shown that PD modality, age ≥ 65, diabetic kidney disease for renal failure were risk factors by the univariate logistic regression analysis. Dialysis time more than 5 years, serum phosphate, serum iPTH level and serum albumin were protective factors (detailed in Table 5). The multivariate logistic regression analysis, the results demonstrated that PD modality was an independent risk factor for constipation (OR = 2.15,

Table 2

CAS scores in HD and PD patients.

	Groups		
CAS scores	**HD**	**PD**	***P* value**
CAS ≤ 2 n (%)	492(72.2%)	108(61.0%)	.004
3 ≤ CAS < 5 n (%)	100(14.7%)	38(21.5%)	.038
CAS ≥ 5 n (%)	89(13.1%)	31(17.5%)	.144

CAS = constipation assessment scale, HD = hemodialysis, PD = peritoneal dialysis.

Table 3

Multivariate logistic regression analysis of risk factors for constipation in HD population.

		Univariate logistic regression			Multivariate logistic regression		
Factors	**Groups**	**OR**	**95%CI**	***P* value**	**OR**	**95%CI**	***P* value**
Sex	Female						
	Male	0.90	(0.64,1.26)	.527	0.96	(0.61,1.55)	.904
Age in yrs	<65						
	≥65	1.67	(1.18, 2.35)	.004	1.67	(1.15, 2.90)	.019
Dialysis yrs	≤5						
	>5	0.79	(0.56,10)	.166	0.93	(0.59, 42)	.899
Education	Up to Junior high school						
	high school	0.85	(0.56, 1.31)	.464	1.01	(0.62, 1.57)	.793
	junior college	0.80	(0.44, 1.46)	.464	1.02	(0.53, 1.90)	.889
	Bachelor degree or above	0.54	(0.23, 1.26)	.154	0.66	(0.27, 1.59)	.354
Primary kidney disease	Nephritis	1.35	(0.78, 2.35)	.134	1.23	(0.59, 2.12)	.307
	Hypertensive nephrosclerosis	1.20	(0.70, 2.10)	.202	1.18	(0.66, 2.00)	.540
	Diabetic kidney disease	3.37	(1.85, 6.14)	<.001	3.31	(1.65, 6.11)	<.001
	Other						
Weight		1.00	(0.99, 1.02)	.447	1.00	(0.96, 1.01)	.526
Height		0.30	(0.05, 1.86)	.196	0.42	(0.10, 4.68)	.462
Body mass index	<18.5						
	18.5-23.9	0.76	(0.47,1.22)	.257	0.61	(0.33, 1.10)	.101
	≥24	0.90	(0.55,1.46)	.659	0.68	(0.31, 1.47)	.342
Hemoglobin		1.00	(0.99, 1.01)	.347	1.00	(0.99, 1.01)	.540
Serum calcium		0.76	(0.39, 1.49)	.425	0.87	(0.43, 1.78)	.701
Serum phosphate		0.76	(0.57, 1.02)	.067	0.82	(0.61, 1.12)	.216
iPTH		1.00	(0.99, 1.00)	.050	1.00	(0.99, 1.00)	.057
ALP		1.00	(0.99, 1.00)	.969	1.00	(0.99, 1.00)	.262
Serum albumin		0.97	(0.94, 1.00)	.086	0.99	(0.97, 1.01)	.199
Serum prealbumin		1.00	(0.99, 1.00)	.915	1.00	(0.99, 1.00)	.677
BUN		0.97	(0.97, 1.00)	.054	0.97	(0.94, 1.00)	.051
Creatinine		1.00	(0.99, 1.00)	.352	0.99	(0.99, 1.00)	.240
Uric acid		1.00	(0.99, 1.00)	.879	1.00	(0.99, 1.00)	.873

ALP = alkaline phosphatase, BUN = blood urea nitrogen, CI = confidence interval, HD = hemodialysis, iPTH = intact parathyroid hormone, OR = odds ratio.

Table 4

Multivariate logistic regression analysis of risk factors for constipation in PD population.

		Univariate logistic regression			Multivariate logistic regression		
Factors	**Groups**	**OR**	**95%CI**	***P***	**OR**	**95%CI**	***P***
Sex	Female						
	Male	1.13	(0.60, 2.14)	.706	0.61	(0.17, 2.00)	.429
Age in yrs	<65						
	≥65	3.22	(1.13, 9.17)	.028	1.96	(0.62 6.61)	.327
Dialysis yrs	≤1						
	>1	1.07	(0.57, 0)	.833	1.10	(0.52, 22.3)	.726
Education	Up to Junior high school						
	high school	1.91	(0.94, 3.90)	.074	1.69	(0.75, 3.83)	.229
	junior college	0.73	(0.27, 1.95)	.528	0.58	(0.21, 2.11)	.446
	Bachelor degree or above	0.76	(0.26, 2.18)	.606	0.78	(0.26, 2.59)	.668
Primary kidney disease	Nephritis	0.40	(0.16, 1.01)	.052	0.56	(0.20, 1.55)	.273
	Hypertensive nephrosclerosis	0.71	(0.26, 1.92)	.497	0.78	(0.26, 2.30)	.675
	Diabetic nephropathy	2.63	(0.81, 8.56)	.108	3.66	(0.99, 14.12)	.054
	Other						
Weight		1.00	(0.98, 1.03)	.835	1.07	(0.99, 1.23)	.161
Height		1.48	(0.03, 65.71)	.839	0.27	(0.00, 1017.16)	.736
Body mass index	<18.5						
	18.5-23.9	0.88	(2.45, 3.10)	.836	0.67	(0.13, 3.24)	.603
	≥24	0.64	(0.18, 2.29)	.498	0.31	(0.13, 2.43)	.172
Hemoglobin		1.00	(0.97, 1.03)	.893	1.00	(0.99, 1.01)	.205
Serum calcium		1.17	(0.11, 12.93)	.900	1.05	(0.04, 27.23)	.973
Serum phosphate		0.55	(0.24, 1.27)	.162	0.73	(0.28, 1.93)	.528
iPTH		1.00	(0.99, 1.00)	.427	1.00	(1.00, 1.00)	.856
ALP		0.99	(0.98, 1.01)	.429	1.00	(0.98, 1.02)	.924
Serum albumin		0.90	(0.82, 1.00)	.053	0.87	(0.79, 0.96)	.389
Serum prealbumin		0.87	(0.80, 0.95)	.002	0.88	(0.79, 0.96)	.007
BUN		0.98	(0.90.1.07)	.630	0.96	(0.86,1.06)	.405
Creatinine		1.00	(0.99,1.00)	.992	1.00	(0.99,1.00)	.756
Uric acid		1.00	(0.99,1.00)	.232	0.99	(0.99,1.00)	.500

ALP = alkaline phosphatase, BUN = blood urea nitrogen, CI = confidence interval, iPTH = intact parathyroid hormone, OR = odds ratio, PD = peritoneal dialysis.

Table 5

Multivariate logistic regression analysis of risk factors for constipation in all dialysis population.

		Univariate logistic regression			Multivariate logistic regression		
Factors	**Groups**	**OR**	**95%CI**	***P***	**OR**	**95%CI**	***P***
Modalities of renal replacement therapy	HD						
	PD	1.66	(1.18, 2.35)	.004	2.15	(1.41, 3.32)	<.001
Sex	Female						
	Male	0.98	(0.73, 1.32)	.706	0.91	(0.61,1.38)	.671
Age in yrs	<65						
	≥65	1.52	(1.12, 2.08)	.008	1.65	(1.13, 2.33)	.003
Dialysis yrs	≤5						
	>5	0.66	(0.49, 90)	.009	0.93	(0.61,7.88)	.807
Education	Up to Junior high school						
	high school	1.12	(0.79, 1.60)	.529	1.12	(0.71, 1.62)	.421
	junior college	0.81	(0.48, 1.34)	.407	0.91	(0.50, 1.49)	.786
	Bachelor degree or above	0.66	(0.35, 1,25)	.203	0.66	(0.28, 1.26)	.284
Primary kidney disease	Nephritis	1.03	(0.65, 1.64)	.895	0.96	(0.53, 1.43)	.904
	Hypertensive nephrosclerosis	1.02	(0.64, 1.62)	.944	1.11	(0.79, 1.94)	.785
	Diabetic kidney disease	3.04	(1.81, 5.11)	<.001	3.19	(1.76, 5.09)	<.001
	Other						
Weight		1.00	(0.99, 1.02)	.356	1.00	(1.00, 1.03)	.124
Height		0.53	(0.10, 2.72)	.447	0.41	(0.04, 3.78)	.461
Body mass index	<18.5						
	18.5-23.9	0.76	(0.47, 1.22)	.257	0.63	(0.39, 1.13)	.079
	≥24	0.90	(0.55, 1.46)	.659	0.51	(0.22, 1.00)	.078
Hemoglobin		1.00	(0.97, 1.00)	.325	1.00	(0.99, 1.01)	.663
Serum calcium		0.78	(0.41, 1.46)	.432	0.90	(0.45, 1.80)	.772
Serum phosphate		0.74	(0.56, 0.97)	.029	0.78	(0.55, 1.02)	.107
iPTH		1.00	(0.99, 1.00)	.034	1.00	(1.00, 1.00)	.063
ALP		0.89	(0.99, 1.00)	.429	1.00	(0.99, 1.00)	.294
Serum albumin		0.97	(0.94, 1.00)	.026	0.95	(0.91, 1.00)	.077
Serum prealbumin		1.00	(0.99, 1.00)	.810	1.00	(0.99, 1.00)	.606
BUN		0.97	(0.94, 0.99)	.040	0.97	(0.94,1.00)	.038
Creatinine		1.00	(0.99, 1.00)	.384	1.00	(0.99, 1.00)	.286
Uric acid		1.00	(0.99, 1.00)	.822	1.00	(0.99, 1.00)	.606

ALP = alkaline phosphatase, BUN = blood urea nitrogen, CI = confidence interval, HD = hemodialysis, iPTH = intact parathyroid hormone, OR = odds ratio, PD = peritoneal dialysis.

95% CI: 1.41–3.32, $P < .001$). Age ≥ 65 and diabetic kidney disease for renal failure were also independent risk factors associated with constipation (OR = 1.65, 95% CI: 1.13–2.33, $P = .003$; OR = 3.19, 95% CI: 1.76–5.09, $P < .001$, respectively) (Table 5).

4. Discussion

This study describes the prevalence, characteristics, and independent risk factors for constipation in a relatively large sample of end-stage kidney disease patients who underwent hemodialysis and peritoneal dialysis in a single Chinese cohort.

According to early reports, 40% to 70% of HD patients and 14.2% to 28.9% of PD patients have constipation.[4,26] In a Japanese study and a study from south China, the frequency of constipation in HD was much higher relative risk of constipation than PD patients.[18,19] Previous studies have shown that the lower prevalence of constipation in PD patients might be caused by the dialysis modality-based lifestyle, nutrition, higher total dietary fiber intake, warm dialysate in the peritoneum, employment status, and mean time receiving dialysis, which could all affect the incidence of constipation.[27] However, in our blood purification center, the incidence of constipation based on CAS was 52.7% in HD patients and 77.4% in PD patients. The severity of constipation according to the CAS scores in PD patients was higher than that in HD patients.

The prevalence of constipation varies depending on the definition used, the rates and age of the population studied, whether it is self-reported or diagnosed by a healthcare provider, and the setting in which the investigation is performed. Our study demonstrated a much higher prevalence of constipation in PD patients than in HD patients, which might suggest variance from the different clinical consequences. Based on the baseline characteristics of the patients in our cohort, the parameters in HD patients, including lower BMI, higher mean hemoglobin, and higher mean serum albumin and prealbumin, were not in favor of causing constipation compared to PD patients. Theoretically, characteristics including younger age, higher education in PD patients may lead to a lower incidence of constipation. PD treatment also generally offers increased autonomy and control, flexibility in daily life, and reduction of dietary and social restrictions. Thus, we speculated that the significantly different baseline between HD and PD is not comparable such as age, dialysis years, serum ALB, which might be associated with the severity of the constipation in our study. Previous study has illustrated that more PD patients with gastrointestinal symptoms including constipation, were related to the onset of dialysis, compared with HD. A greater number of PD patients (compared with HD patients) documented a reduction in food intake and changes in their dietary habits to alleviate symptoms.[28] In our study, the dialysis time for PD patients is much shorter than that for HD patients, which might be contributed to the higher prevalence of constipation. Furthermore, serum concentrations of albumin and prealbumin, which are major nutritional parameters, were lower compared with those in the HD patients in our study. It is likely that the different prevalence of constipation between the 2 dialysis groups could be attributed to nutritional state. However, the results need to be further verified in cohort studies with a greater number of PD and HD patients in the future.

As well known, the pathogenesis of constipation remains unclarified clearly. However, it is documented that constipation is associated with increasing age, female sex, Lower socioeconomic status, lower parental education rates, less self-reported physical activity, certain medications, stressful life events, physical and so on.[20] In our study, we found that age ≥ 65 years was always an independent risk factor in the univariate or multivariate regression analysis, enrolled the PD patients, HD patients and all patients, respectively, which was consistent with the previous report.[3] And study in dialysis patients also showed that an increased rate of constipation in line with age, especially in patients with age ≥ 61 years.[18] Moreover, diabetic kidney disease was an independent risk factors for constipation severity in HD patients or all (HD + PD) patients. In agreement with our findings, several studies suggested that constipation was among the most frequent gastrointestinal symptom in patients with diabetes mellitus,[29–34] which contributed to constipation severity. The exact pathogenesis of constipation in diabetes and diabetic kidney disease is not well clarified. The main mechanisms were as the following: Autonomic dysfunction with a lack of synchronicity between the gut musculature and the sphincters is thought to be the major contributing factor.[35] some diabetic patients with chronic constipation had absent gastrocolonic response to feeding, resulting in mild to moderate constipation.[36] High blood sugar levels in diabetes could lead to loss of interstitial cells of Cajal and diabetic neuropathy, which caused the serious damage to the nerves controlling the digestive tract motility.[37] In PD patients, the logistic regression analysis showed that mean serum prealbumin was the only independent risk factor for constipation severity, which suggest that poor nutritional status might affect gastroenteric functions. The exact mechanism remains unknown. However, combined with the previous reports, we inferred that it might be associated with shorted dialysis time with a reduction in food intake and changes in their dietary habits.[28] In the logistic regression analysis that enrolled all the patients, PD modality, age ≥ 65 and diabetic kidney disease were risk factors for constipation severity. The results suggest that PD patients should be given more attention in our center due to the higher risk for constipation, the reasons for which might be multifactorial and warrant future investigation.

In summary, we confirmed a high prevalence of constipation in a large population of dialysis patients in our single center, including HD and PD patients. PD patients had more frequent constipation than hemodialysis patients, which may result from multifactorial causes. Our findings might differ from those in different cultures, races, and regions; thus, we cannot confidently state that our results are representative. Several limitations need to be acknowledged: this study is a cross-sectional survey, which could not allow us to infer causality; the HD and PD patients enrolled in our center might not be representative of dialysis patients in general and patient selection bias could not be eliminated.

In conclusion, the overall prevalence of constipation in PD patients was higher than that in HD patients in our center. PD modality for renal replacement therapy, age ≥ 65 and diabetic kidney disease for renal failure are closely associated with constipation in dialysis patients.

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Author contributions

Liuping Zhang and Fang Tang drafted and revised the manuscript. Fengmei Wang, Qinglei Xie, and Meixia Xia collected the clinical data. Bin Wang and Ze-Mu Wang acted as the corresponding author, designed the study, and revised the manuscript.
Data curation: Qinglei Xie, Meixia Xia, Liangyunzi Jiang.
Project administration: Bin Wang.
Writing – original draft: Fang Tang.
Writing – review & editing: Liuping Zhang, Fengmei Wang, Ze-Mu Wang.

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