Analysis of prognostic factors and their correlation with nutritional status in patients with single-center CAPD-associated peritonitis

Lv Ping, Wu Zhiwei, Yuan Ying, Zhu Qiang, Xie Jiayong*

Xinghua People's Hospital Affiliated to Yangzhou University, Taizhou, Jiangsu, 225700, China

xhxgfxjy@sina.com

*Corresponding author

Keywords: Single center continuous ambulatory peritoneal dialysis; associated peritonitis; prognosis; influencing factors; nutritional status; correlation analysis

Abstract: This study aimed to identify prognostic indicators of peritonitis in CAPD patients at one hospital and their connection to nutritional status. A total of 119 CAPD patients with peritonitis at Xinghua People's Hospital from April 2022 to March 2024 were divided into withdrawal (n=40) and non-withdrawal (n=79) groups based on prognostic assessment. Data from both groups were analyzed to assess potential prognostic factors through logistic regression analysis. Serum protein levels were measured using a biochemical analyzer, and the association between prognosis and nutritional status in patients with CAPD-associated peritonitis was examined using Pearson correlation analysis. Univariate and multivariate Logistic regression found age, potassium levels, white blood cell count, and hs-CRP were significant prognostic factors for CAPD-associated peritonitis. Serum total protein, hemoglobin, and albumin levels were lower in the PD withdrawal group compared to the non-withdrawal group. Various factors impact the poor outlook for patients with single-center CAPD-related peritonitis. Our study explored prognostic factors in these patients, emphasizing potential interactions and influences among them, including their connection to nutritional status. Tailored interventions targeting these factors could improve both nutrition and prognosis for patients.

1. Introduction

Peritoneal dialysis (PD) is a common therapy for acute kidney injury and chronic renal failure. It aims to remove metabolites and toxic substances from the patient's body and help correct disturbance of water and electrolyte through continuous replacement of peritoneal dialysate[1]. PD-associated peritonitis, however, is a major complication in PD patients. As the disease progresses, it may result in impairment of peritoneal function, leading to decreased residual renal function and thus influencing the therapeutic effect of PD[2-3]. For this reason, influencing factors, therapy and prognosis of peritonitis are becoming research hotspots in PD treatment at home and abroad [4]. Research by Naghashi S, et al.[5] has shown that the elderly, female, poor educational background, hypoproteinemia and poor residual renal function are risk factors for the occurrence of PD-associated peritonitis. At the same time, malnutrition is also a risk factor influencing the prognosis of PD patients. Patients with chronic kidney disease (CKD) are often complicated by varying degrees of changes in metabolic and body composition. Among them, malnutrition is an important reason for the increased hospitalization rate and mortality, especially for dialysis patients [6]. Research by Li Shuang et al.[7] has revealed that PD patients with low ALB record a higher level of all-cause, cardiovascular and infection mortalities. Based on the above results, we inferred that the occurrence of PD-associated peritonitis may be related to the patients' nutritional level. This study mainly investigates the factors influencing the prognosis of patients with single-center CAPD-associated peritonitis and their correlation with nutritional status. The report is as follows.

  DOI: 10.25236/icetmr.2024.019

2. Materials and Methods

2.1 Demographics

A total of 149 patients with CAPD-associated peritonitis admitted to a single center of Xinghua City People's Hospital between April 2022 and March 2024 were enrolled and divided into a withdrawal group (n=40) and a non-withdrawal group (n=79) based on prognosis. The study was approved by the hospital's Ethics Committee, and all patients signed the Informed Consent.

2.2 Diagnostic criteria

Diagnostic criteria for PD-associated peritonitis: (1) symptoms and signs of peritonitis; (2) turbid peritoneal dialysate with WBC >100 and Neut% >50%; (3) positive bacteria smear or culture (as for fungal peritonitis, fungus shall be detected). Those who met only one and any two of the above 3 conditions were judged as suspected cases and definite cases, respectively. As for suspected cases, PD effluents were sampled and collected, and cell counting and classification were performed according to routine procedures. At the same time, the collected PD effluents were inoculated in blood enrichment aerobic and anaerobic vials, respectively, and microbial culture test was completed[8].

2.3 Inclusion & exclusion criteria

Inclusion criteria: Patients who (1) met the diagnostic criteria for PD-associated peritonitis[9]; (2) had received PD catheterization in our hospital; (3) with more than 3 months of dialysis, and were capable of cooperating and completing continuous ambulatory peritoneal dialysis on a regular basis. Exclusion criteria: Patients (1) with severely abnormal heart and liver function and secondary abdominal organ perforation; (2) complicated by tuberculosis, chronic infectious diseases or diagnosed with organic diseases; (3) who received other combined treatment without permission or complicated by autoimmune system diseases.

2.4 Method

(1) Analysis of influencing factors. Medical records of the two groups were reviewed, and the patient's gender, age, educational background, primary disease of uremia, comorbidities, catheterization method, emergency status, WBC, Hb, PLT, NLR, PLR, hs-CRP, ALB, Cr, Urea, Na, K, Ca, P, Cl and other data were sorted. The above influencing factors were subject to univariate and multivariate logistic regression analysis. (2)Analysis of nutritional status and correlation TP, PAB and ALB levels were measured by an automatic biochemical analyzer in strict accordance with the use instructions of the instrument and test kit. Nutritional status of the two groups was compared. The correlation between the prognosis and nutritional status of patients with CAPD-associated peritonitis was analyzed by using the Pearson correlation analysis software.

2.5 Statistical analysis

SPSS26.0 was used for data processing. Enumeration data were subject to $\chi 2$ test and expressed as n (%); measurement data were subject to t-test and expressed as ($\bar{x} \pm s$). $P < 0.05$ indicated that the difference was statistically significant.

3. Result

3.1 Univariate analysis of factors influencing prognosis of patients with single-center CAPD-associated peritonitis

Post treatment, 40 of 119 patients experienced failed PD (accounting for 33.61%). Univariate analysis showed that gender, educational background, primary disease of uremia, emergency status, catheterization method, comorbidities, PLT, Cr, Urea, Ca, P and Cl did not cause statistical difference in prognosis of these patients (P>0.05), while age, Na, K, WBC, NLR, PLR, and hs-CRP caused statistical difference in prognosis (P<0.05), as shown in Table 1.

Table 1 Univariate analysis of factors influencing prognosis of patients with single-center CAPD-associated peritonitis

Variate	Total (N=119)	PD failed group (N=40)	PD non-failed group (N=79)	Statistics	P value
Gender [%]				0.004	0.918
Male	59 [49.6]	20 [50.0]	39 [49.4]		
Female	60 [50.4]	20 [50.0]	40 [50.6]		
Age [%]				10.578	0.001
<60	85 [71.4]	21 [52.5]	64 [81.0]		
>=60	34 [28.6]	19 [47.5]	15 [19.0]		
Educational background [%]				0.042	0.838
High school and above	19 [16.0]	6 [15.0]	13 [16.5]		
Below high school	100 [84.0]	34 [85.0]	66 [83.5]		
Primary disease of uremia [%]				3.619	0.057
Chronic nephritis	85 [71.4]	33 [82.5]	52 [65.8]		
Others	34 [28.6]	7 [17.5]	27 [34.2]		
Emergency status [%]				1.220	0.269
No	85 [71.4]	26 [65.0]	59 [74.7]		
Yes	34 [28.6]	14 [35.0]	20 [25.3]		
Catheterization method [%]				0.203	0.652
Conventional	57 [47.9]	18 [45.0]	39 [49.4]		
Kit	62 [52.1]	22 [55.0]	40 [50.6]		
Cl (mmol/L)	95.60 [92.85, 98.70]	94.60 [92.38, 97.62]	95.70 [93.20, 99.15]	-1.241	0.215
Na (mmol/L)	137.00 [134.00, 138.55]	135.55 [132.52, 137.67]	137.40 [134.65, 139.50]	-2.546	0.011
K (umol/L)	3.76 [0.76]	3.47 [0.78]	3.91 [0.71]	-3.033	0.003
Comorbidity [%]				0.072	0.788
None	28 [23.5]	10 [25.0]	18 [22.8]		
Yes	91 [76.5]	30 [75.0]	61 [77.2]		
PLT (10^9/L)	167.00 [125.50, 222.50]	169.00 [133.00, 226.00]	160.00 [122.00, 217.00]	-1.103	0.27
WBC (10^9/L)	8.30 [6.28, 11.84]	13.31 [8.48, 15.59]	7.16 [5.43, 9.55]	-5.620	<0.001
NLR	9.78 [5.14, 19.18]	17.98 [9.73, 26.25]	7.57 [4.50, 11.62]	-4.444	<0.001
PLR	221.67 [138.04, 391.25]	326.43 [157.79, 461.88]	196.25 [126.54, 355.72]	-2.048	0.041
Hs-CRP (mg/L)	15.90 [4.92, 73.42]	52.24 [15.57, 124.57]	10.00 [1.24, 50.00]	-3.811	<0.001
Cr (umol/L)	828.80 [724.80, 1012.80]	812.80 [678.95, 972.22]	839.90 [752.15, 1067.60]	-1.308	0.191
Urea (umol/L)	18.14 [14.16, 23.90]	16.82 [14.16, 20.03]	19.64 [14.36, 25.62]	-1.789	0.074
Ca (umol/L)	2.17 [2.04, 2.28]	2.17 [2.02, 2.29]	2.17 [2.05, 2.27]	-0.200	0.842
P (umol/L)	1.44 [1.04, 1.77]	1.29 [1.06, 1.69]	1.44 [1.04, 1.77]	-0.399	0.69

3.2 Multivariate analysis of factors influencing prognosis of patients with single-center CAPD-associated peritonitis

Multivariate logistic regression analysis showed that Na, NLR, and PLR were not factors influencing the patients' prognosis (P>0.05), while age, K, WBC and hs-CRP were influencing

factors of prognosis (P<0.05), as shown in Table 2.

Table 2 Multivariate analysis of factors influencing prognosis of patients with single-center CAPD-associated peritonitis

Variate	Coefficient	Standard error	Z value	P value	Odds ratio	95% CI	
						Lower limit	Upper limit
Age:							
<60	Ref	Ref	Ref	Ref	Ref	Ref	Ref
>=60	-1.664	0.62	-2.685	0.007	0.189	0.056	0.638
Na mmol/L	0.019	0.083	0.227	0.82	1.019	0.867	1.198
K mmol/L	1.081	0.543	1.992	0.046	2.948	1.017	8.545
WBC 10^9/L	-0.393	0.09	-4.358	< 0.001	0.675	0.565	0.805
NLR	-0.008	0.031	-0.25	0.803	0.992	0.934	1.054
PLR	-0.002	0.002	-0.904	0.366	0.998	0.995	1.002
Hs-CRP mg/L	-0.009	0.004	-2.404	0.016	0.991	0.983	0.998

3.3 Comparison of nutritional status between the two groups

There were statistical differences in TP, Hb and ALB between the withdrawal group and the non-withdrawal group (P<0.05). See Table 3.

Table 3 Comparison of nutritional status between the two groups (g/L)

Variate	Total (N=119)	PD failed group (N=40)	PD non-failed group (N=79)	Statistics	P value
TP (g/L)	57.99 [8.03]	55.27 [8.90]	59.36 [7.23]	-2.692	0.008
Hb (g/L)	98.52 [20.44]	90.89 [20.82]	102.39 [19.24]	-2.995	0.003
ALB (g/L)	30.35 [4.95]	27.29 [4.97]	31.89 [4.18]	-5.32	<0.001

3.4 Correlation between prognosis and nutritional status of patients with single-center CAPD-associated peritonitis

Pearson correlation analysis showed that the prognosis was positively correlated with TP, Hb and ALB (P<0.05), see Table 4.

Table 4 Correlation between prognosis and nutritional status of patients with single-center CAPD-associated peritonitis (r, P)

Correlation	TP	Hb	ALB
r	0.183	0.242	0.417
P	0.047	0.008	<0.001

4. Discussion

CAPD-associated peritonitis refers to acute infectious inflammation as a result of pathogens entering the abdominal cavity due to contact with contaminants, gastrointestinal infection or catheter-related infection during CAPD treatment[10-11]. Research by Liu Xiuping et al.[12] showed no significant difference in therapeutic effect, quality of life and long-term survival between PD and hemodialysis. However, the former, which is characterized by simple equipment, convenient operation and lower cost, is more suitable for community-level application. In spite of ever-improving technologies and awareness of aseptic operation, PD-associated peritonitis, a common complication in PD patients, remains a factor that influences the patients' prognosis, and its incidence has not been reduced significantly[13]. Univariate and multivariate logistic regression analysis in this study showed that age, K, WBC and hs-CRP were factors influencing the patients' prognosis (P<0.05). This result also revealed that there are many influencing factors of prognosis, and they can interact with each other. (1) Age. Age is an influencing factor of prognosis in patients with single-center CAPD-associated peritonitis. Elderly patients, who suffer from degenerated somatic function, complicated by multiple underlying diseases, generally have poor prognosis; (2)

WBC and hs-CRP. The above parameters reflect the condition of patients during the initial treatment, and the expression level is a measure of inflammatory state. During the initial treatment, the patients tend to have more serious conditions and inflammatory state, with elevated WBC and hs-CRP, and this leads to greater difficulty in treatment and poor prognosis[14-15]. Cause analysis: During the PD treatment, when the body is complicated by inflammatory infection, the inflammation stimulates the body to secrete cytokines, thus activating blood platelets. Beyond that, platelets can also be activated by binding with certain bacterial components. These can influence patients' prognosis[16]. (3) K. K level reflects the patient's renal function and the stability of internal environment. Patients with obvious low K level have a poor prognosis. [17]

Malnutrition is also a common complication in PD patients, which takes a heavy toll on their prognosis and quality of life. Cause analysis: PD patients have insufficient dietary intake, a higher level of basal metabolic rate, metabolic disorders, and increased dialysis-associated decomposition. These can affect their nutritional status, resulting in poor prognosis[18]. In the study, TP, Hb and ALB were lower in PD failed group than in PD non-failed group ($P<0.05$), and correlation results showed that the prognosis was positively correlated with these three indicators ($P<0.05$). It can be seen from the result that malnutrition is more obvious in PD cases with poor prognosis, and its expression level can be used to evaluate and predict the prognosis. ALB and Hb are common indicators of systemic nutritional status of human body. The higher the expression levels, the lower the incidence of PD-associated peritonitis. Therefore, in the clinical treatment of patients with single-center CAPD-associated peritonitis, it is necessary to strengthen assessment and intervention for the patients' nutritional status, and increase diet and nutritional support, thus improving their prognosis[19-20].

5. Conclusion

In conclusion, there are many influencing factors of the poor prognosis in patients with single-center CAPD-related peritonitis. Different factors can interact with each other, and are correlated with nutritional status. Intervention measures should be developed based on the above controllable factors to improve patients' nutritional status and prognosis.

References

[1] Huang Shixue, Yang Dingping. Correlation Analysis between Iron Metabolism and Peritoneal Transport Function in Patients with Continuous Ambulatory Peritoneal Dialysis [J]. Journal of Medical Research, 2020, 49 (2) :37-42.

[2] Zhang Jichao, Li Yuanyuan, Li Juan, et al. Correlation between Peritoneal Transport Characteristics and Microinflammation Status in Patients with Continuous Ambulatory Peritoneal Dialysis [J]. Chinese Journal of Integrated Traditional and Western Nephrology, 2020, 21(9): 780-783.

[3] Morimoto Y, Kawano H, Miyanaga K, et al. Association of lower extremity function with nutritional status and number of drugs in patients with chronic heart failure[J]. The Journal of international medical research, 2020, 48(10):030006052096437.

[4] Sun Qiaomin, Zhang Xiaoxia, Liu Jianxiao, et al. Relationship between the Levels of Urinary microRNA miR-34a and Serum Uric Acid and the Renal Function and Prognosis in Continuous Ambulatory Peritoneal Dialysis Patients [J]. Chin J Blood Purif, 2021, 20 (4): 234-238.

[5] Naghashi S, Somi MH, Nikniaz Z. Pretreatment nutritional status is associated with quality of life in patients with gastric cancer: a cross-sectional study from Iran[J]. Supportive Care in Cancer, 2022, 30(4):3313-3319.

[6] Huang Qinglong, Wu Yuechun, Hu Bin. Clinical Characteristics of Two Groups of Peritoneal Dialysis-Associated Peritonitis with Different Incidences [J]. Chin J Mod Med, 2020, 30(9):110-114.

[7] Li Shuang, Guo Xiaobing, Liu Na, et al. Analysis of Infection Characteristics and Prognosis of Peritoneal Dialysis-associated Peritonitis Patients [J]. Modern Preventive Medicine, 2020, 47 (2): 367-370, 380.

[8] Hu Xueqin, Chen Wen, Luo Yuanyu, et al. Analysis of the Relationship between Infection and Debilitation in Continuous Ambulatory Peritoneal Dialysis Patients [J]. Chinese Journal of Nosocomiology, 2020, 30 (8): 1201-1204.

[9] Hong LT, Liou TG, Rishi D, et al. Pharmacokinetics of Continuous Infusion Beta-lactams in the Treatment of Acute Pulmonary Exacerbations in Adult Patients with Cystic Fibrosis[J]. Chest, 2020, 154(5):1108-1114.

[10] Lu Haizhen, Huang Yanlin, Li Haoyu, et al. Study on the Correlation between Symptom Clusters and Dialysis Adequacy in Continuous Ambulatory Peritoneal Dialysis Patients[J]. China Medical Herald, 2021, 18 (22): 104-108.

[11] Zhang Yue, Liao Yumei, He Yan, et al. The Correlation between Nutritional Status and Quality of Life in Patients with Continuous Ambulatory Peritoneal Dialysis [J]. Guangdong Medical Journal, 2020, 41 (10): 1010-1014.

[12] Liu Xiuping, Peng Minfeng, Lyu Lingyun. The Value of WBC, PCT and CRP in the Diagnosis and Treatment of Daytime Ambulatory Peritoneal Dialysis Associated Peritonitis [J]. Chinese Journal of Health Laboratory Technology, 2020, 30(6):732-734.

[13] He Xiaorong, Xi Chunhua, Shen Ying. Role and Effect of Community Peritoneal Dialysis Full-time Nurses in Hospital-Community-Family Integrated Management [J]. Shanxi Medical Journal, 2021, 50 (6): 1027-1029.

[14] John A, Godzik-Spychalska J, Durda-Masny M, et al. Pseudomonas aeruginosa, the type of mutation, lung function, and nutritional status in adults with Cystic Fibrosis[J]. Nutrition, 2021, 89(6):111221.

[15] Gao Yueyue, Zhang Jie, Su Chunyan, et al. Analysis of Prognosis and its Influencing Factors in Peritoneal Dialysis-associated Peritonitis [J]. Chin J Blood Purif, 2021, 20 (9): 604-607.

[16] Li Hui, Liu Wenyuan, Zhang Guang, et al. Correlation between Phosphorus Metabolism Disorder and Left Ventricular Hypertrophy in Patients with Continuous Ambulatory Peritoneal Dialysis [J]. Chinese Journal of Integrative Medicine on Cardio-Cerebrovascular Disease, 2021, 19(14):2408 -2410.

[17] Liu C, Yang J, Dong W, et al. Effects of probiotics on gastrointestinal complications and nutritional status of postoperative patients with esophageal cancer: A protocol of randomized controlled trial[J].Medicine, 2021, 100(11):e25138.

[18] Zhang Mingzhu, Liu Ya, Jin Binbin, et al. Analysis of Related Factors Influencing Prognosis of Patients with Peritoneal Dialysis-associated Peritonitis [J]. J Clin Nephrol, 2020, 20 (4): 265-269.

[19] Luo Jicong, Zhao Jinghong, Wang Ying, et al. Research on the Construction and Performance of a Joint Care Mode for Automated Peritoneal Dialysis Patients Based on a Remote Monitoring System [J]. Chin J Blood Purif, 2020, 19 (11): 730-733.

[20] Cao Jingjing, Ding Yuehua. Analysis of Influencing Factors and Preventive Care of Secondary Pulmonary Infection in Bedridden Elderly Patients after Stroke [J]. International Journal of Geriatrics, 2020, 41 (3): 168-171.