Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 3
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application Research of Continuous Ambulatory Peritoneal Dialysis and Automated Peritoneal Dialysis Machine in Patients with End-Stage Renal Disease Undergoing Peritoneal Dialysis

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Abstract: This study analyzed the therapeutic effects of continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis (APD) on patients with end-stage renal disease. Fifty patients admitted between January 2024 and December 2024 were randomly assigned to two groups, with the observation group receiving APD and the reference group receiving CAPD. Renal function indicators, nutritional indicators, mineral metabolism, urine volume, and ultrafiltration volume changes were compared between the two groups. After treatment, the observation group showed lower renal function indicators, higher nutritional indicators, and better mineral metabolism levels compared to the reference group ($P < 0.05$). While there was no significant difference in urine volume between the two groups ($P > 0.05$), the observation group demonstrated superior ultrafiltration volume ($P < 0.05$). These findings suggest that APD offers better clinical outcomes than CAPD by improving renal function, nutritional status, mineral metabolism regulation, and ultrafiltration efficiency in patients with end-stage renal disease.

Keywords: Continuous ambulatory peritoneal dialysis; Automated peritoneal dialysis machine; End-stage renal disease; Peritoneal dialysis

Online publication: April 3, 2025

1. Introduction

Patients with end-stage renal disease are in a critical condition, with significantly reduced renal function, requiring long-term symptomatic treatment to prolong survival [1]. Peritoneal dialysis is one of the effective treatment methods. Compared to hemodialysis, it offers stronger operational convenience, protecting existing renal function and preventing adverse events such as blood-borne diseases. CAPD is a frequently used peritoneal dialysis mode

with mature operating techniques and strong dialysis adequacy. However, this mode requires standardized manual operation, which may lead to complications such as abdominal cavity infection due to improper operation. APD is an automated treatment mode that breaks through the tedium of manual operation, making it easier for patients to return to society. Based on the above theory, this study selected 50 patients with end-stage renal disease to evaluate the differences in treatment between CAPD and APD.

2. Materials and methods

2.1. General information

Fifty patients with end-stage renal disease who were admitted to the hospital between January 2024 and December 2024 were selected. They were divided using a random number table into an observation group (25 cases) and a reference group (25 cases). The observation group consisted of 13 males and 12 females, aged between 25 and 74 years, with a mean age of (55.27 ± 3.19) years. The duration of dialysis ranged from 4 to 29 months, with a mean of (16.72 ± 2.17) months. The primary diseases included 8 cases of primary glomerulonephritis, 11 cases of diabetic nephropathy, 4 cases of hypertensive nephropathy, and 2 other cases. The reference group consisted of 14 males and 11 females, aged between 28 and 71 years, with a mean age of (55.36 ± 3.22) years. The duration of dialysis ranged from 5 to 27 months, with a mean of (16.06 ± 2.24) months. The primary diseases included 7 cases of primary glomerulonephritis, 10 cases of diabetic nephropathy, 7 cases of hypertensive nephropathy, and 1 other case. There was no significant difference in data between the two groups ($P > 0.05$).

Inclusion criteria included a peritoneal dialysis duration of at least one month, a hospital stay of at least three days, normal intellectual level and communication ability, clear consciousness, and informed, full consent to participate in the study. Exclusion criteria included the presence of malignant tumors, selection of hemodialysis during the transition period, difficulty tolerating peritoneal dialysis treatment, solitary kidney, or withdrawal from the study.

2.2. Methods

The treatment duration for both groups was 5 days, using a low-calcium peritoneal dialysis solution (Baxter China, model 5C6M00, Guojiexuzhu: 20182450154) with glucose concentrations of 1.5% and 2.5%.

The observation group underwent APD treatment mode. The dialysis solution concentration and usage were scientifically determined based on the patient's urine output, body surface area, and edema situation. Treatment was performed using an automated peritoneal dialysis machine, alternating with a low-calcium peritoneal dialysis solution. All operations are carried out by the nurse. The dialysis machine was first started, followed by the connection of the drainage tube, drainage bag, or drainage bucket. Once the dialysis solution was connected, the treatment commenced. Both daytime and nighttime dialysis used 2 bags each, with a specification of 5L per bag, and the daily dialysis duration was 10 to 12 hours.

The reference group underwent CAPD treatment mode. The responsible nurse took the peritoneal dialysis catheter, connected its external tube to the low-calcium peritoneal dialysis solution, opened the switch, and drained the fluid accumulated in the abdominal cavity. After full drainage, the short tube switch was closed and a new dialysis solution was used to flush the pipeline. After fully discharging the gas in the pipeline, the drainage bag was clamped, the switch of the external short tube was opened to ensure that the dialysis solution could slowly flow into the abdominal cavity. After the above infusion treatment was completed, the short tube switch was

closed, and the external short tube and dialysis solution bag were separated, ensuring sterile operation throughout. It was necessary to exchange the dialysis solution 3 to 5 bags per day, with a dialysis volume of 2L each time.

2.3. Observation indices

(1) Renal function indicators: Collect 3–5ml of venous blood (on an empty stomach) and measure serum creatinine (Scr), blood urea nitrogen (BUN), and uric acid values using an automatic biochemical analyzer.

(2) Nutritional indicators: Collect venous blood (on an empty stomach), measure hemoglobin (Hb) using an automatic blood cell analyzer, and measure prealbumin (PA) and serum albumin (SA) using an automatic biochemical analyzer.

(3) Mineral metabolism: Collect venous blood (on an empty stomach) and measure phosphorus (P), calcium (Ca), and intact parathyroid hormone (iPTH) values using an automatic biochemical analyzer.

(4) Urine volume and ultrafiltration volume: Record the patient's daily urine volume and ultrafiltration volume for 5 days of dialysis.

2.4. Statistical analysis

Data processing was completed using SPSS 28.0 software. Measurement values were compared and tested using t-values, and count values were compared and tested using chi-squared values. The criterion for statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of renal function indicators between the two groups

Before treatment, there was no difference in renal function indicators between the two groups ($P > 0.05$). After treatment, the renal function indicators of the observation group were lower than those of the reference group ($P < 0.05$). The results are shown in **Table 1**.

Table 1. Comparison of renal function indicators between the two groups ($\bar{x}\pm s$)

Grouping	*n*	Scr(μmol/L)		BUN(mmol/L)		Uric acid(μmol/L)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation Group	25	814.59 ± 57.22	634.15 ± 26.71	24.94 ± 5.33	12.64 ± 2.05	428.34 ± 27.94	365.91 ± 20.14
Reference Group	25	813.71 ± 56.07	698.78 ± 34.10	24.91 ± 5.70	16.70 ± 2.14	427.13 ± 28.31	390.28 ± 22.43
t		0.055	7.460	0.019	6.850	0.152	4.042
P		0.956	0.000	0.985	0.000	0.880	0.000

3.2. Comparison of nutritional indicators between the two groups

Before treatment, there was no significant difference in nutritional indicators between the two groups ($P > 0.05$). However, after treatment, the nutritional indicators of the observation group were significantly higher than those of the reference group ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of nutritional indicators between the two groups ($\bar{x}\bar{x}$±s, g/L)

Grouping	*n*	Hb		PA		SA	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation Group	25	81.37 ± 9.91	79.88 ± 6.12	282.06 ± 17.62	282.11 ± 16.27	33.07 ± 4.16	32.77 ± 4.19
Reference Group	25	81.44 ± 8.79	74.19 ± 6.08	281.95 ± 18.03	244.19 ± 14.91	33.10 ± 4.27	29.18 ± 4.22
t		0.026	3.298	0.022	8.591	0.025	3.018
P		0.979	0.002	0.983	0.000	0.980	0.004

3.3. Comparison of mineral metabolism between the two groups

Based on **Table 3**, the mineral metabolism level of the observation group was lower than that of the reference group ($P < 0.05$).

Table 3. Comparison of mineral metabolism between the two groups ($\bar{x}\bar{x}$±s)

Grouping	*n*	P(mmol/L)	Ca(mmol/L)	iPTH(pg/ml)
Observation Group	25	1.64 ± 0.27	2.58 ± 0.47	282.97 ± 20.77
Reference Group	25	1.91 ± 0.33	2.24 ± 0.31	355.91 ± 24.91
t		3.166	3.019	11.245
P		0.003	0.004	0.000

3.4. Comparison of urine volume and ultrafiltration volume between the two groups

The urine volume of the observation group was close to that of the reference group ($P > 0.05$), and the ultrafiltration volume of the observation group was greater than that of the reference group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of urine volume and ultrafiltration volume between the two groups ($\bar{x}\bar{x}$±s, ml/d)

Grouping	*n*	Urine volume	Ultrafiltration volume
Observation Group	25	1245.69 ± 80.61	590.75 ± 41.62
Reference Group	25	1243.62 ± 91.77	149.77 ± 10.13
t		0.085	51.474
P		0.933	0.000

4. Discussion

Peritoneal dialysis is one of the commonly used treatment methods for patients with end-stage renal disease. It allows peritoneal dialysis fluid to enter the abdominal cavity through dialysis tubing, enter the bloodstream, and then use dialysis fluid to draw toxins from the blood to achieve blood purification [2]. Among various peritoneal dialysis treatment modes, CAPD and APD have better clinical efficacy. The former can complete dialysis treatment with manual operation, which is highly convenient and efficient [3]. However, there are potential risks of

human operation and the probability of intra-abdominal infection or volume overload is relatively high. APD has a lower time cost, can automate dialysis treatment without the need for manual operation, and it can reduce the frequency of manually replacing the dialysis fluid so the technical risk is low. Therefore, the dialysis efficiency is more excellent, which can significantly improve the treatment comfort of patients [4].

The results showed that after treatment, the renal function index of the observation group was lower than that of the reference group ($P < 0.05$). APD allows precise control over dialysis fluid volume, treatment duration, and dialysis frequency, reducing the need for multiple manual fluid replacements. This not only enhances treatment efficiency but also improves the clearance rate of small-molecule solutes, leading to better overall renal function [5]. The nutritional index of the observation group was higher than that of the reference group ($P < 0.05$). APD can improve dialysis adequacy, prevent a large amount of protein from being carried in the dialysis fluid, prevent malnutrition, and protect the patient's nutritional function. Moreover, APD has less damage to the patient's body, can improve its physiological function, and increase the absorption of nutrients by the gastrointestinal tract. Therefore, the level of nutritional indicators is relatively high [6].

The mineral metabolism level of the observation group was lower than that of the reference group ($P < 0.05$). APD adopts an automated perfusion form of dialysis fluid, which can maintain positive calcium balance, improve mineral clearance rate, and prevent serious complications such as metabolic acidosis or phosphorus retention. In addition, APD has high precision and can efficiently remove substances such as P and Ca, which can reduce the incidence of mineral metabolism disorders [7]. After 5 days of treatment, there was no difference in urine volume between the two groups, $P > 0.05$, and the ultrafiltration volume of the observation group was greater than that of the reference group, $P < 0.05$. Both treatment methods can significantly exert curative effects and promote the excretion of urine volume, so there is no significant difference in urine volume comparison. APD patients have an empty stomach during the day, and the treatment process of dialysis fluid infusion-retention-drainage can be automatically completed at night. It mainly increases the clearance of water and sodium through more frequent short-term retention at night, reduces the volume load, and is easier to increase the ultrafiltration compared with CAPD.

5. Conclusion

In summary, the effectiveness of APD treatment for patients with end-stage renal disease is higher, which can improve patients' renal function and nutritional status, prevent mineral metabolism disorders, and increase ultrafiltration. Its treatment effect is better than CAPD.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Guan P, Jiang Y, Han T, et al., 2022, Effects of continuous ambulatory peritoneal dialysis and low-flux hemodialysis on the micro-inflammatory state of patients with diabetic nephropathy stage V. Clinical Medicine, 42(8): 39–41.

[2] Ruan X, 2020, Study on the influence of continuous ambulatory peritoneal dialysis on iron metabolism and prognosis of patients with end-stage renal disease. Medical Frontiers, 10(35): 156–157.

[3] Sun X, Zhang Q, Wang H, et al., 2023, Expression of heat shock protein 47 in serum and peritoneal dialysis fluid of patients with continuous ambulatory peritoneal dialysis and its relationship with micro-inflammation. Medical Research and War Trauma Treatment, 36(4): 382–387.

[4] Cai H, 2023, Application effect of manual peritoneal dialysis and automated peritoneal dialysis machine in end-stage renal disease patients with peritoneal dialysis. Medical Equipment, 36(5): 82–85.

[5] Luo L, Zhao J, Yu F, et al., 2023, Comparison of the application effects of automated peritoneal dialysis and manual peritoneal dialysis treatment in nephrology patients. Chinese Contemporary Medicine, 30(1): 108–111.

[6] Jiang Y, 2023, Comparison of the efficacy of manual peritoneal dialysis and automated peritoneal dialysis machines in end-stage renal disease patients with peritoneal dialysis. Medical Information, 36(3): 136–139.

[7] Zhang Z, Li M, Yu H, et al., 2020, Effects of automated peritoneal dialysis on cardiac function and clinical symptoms in patients with end-stage renal failure. Shaanxi Medical Journal, 49(9): 1130–1133.