High-throughput hemodialysis on the clinical efficacy and micro-inflammatory state, calcium and phosphorus metabolism, heart and kidney function in patients with end-stage renal disease

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Abstract: To compare the clinical efficacy, heart and kidney function, calcium and phosphorus metabolism, serological indicators, and the effects of micro-inflammatory status after two hemodialysis treatments to evaluate the best treatment for patients with end-stage renal disease. According to the criteria for inclusion and exclusion, collected in the Department of Nephrology, third People's Hospital of Gansu Province, patients were selected and received treatment between July 2019 and July 2021. A total of 60 cases were randomized. The urea nitrogen (BUN), blood creatinine (Scr), calcium and phosphorus metabolism levels, inflammation-related factors, and serum-related indicators of the two groups of patients before and after the treatment were detected for half a year. The effective rate (83.33%) of the observation group was higher than that of the control group (66.67%). After treatment, the iPTH, β2-MG, Hcy of the observation group were lower than those of the control group, and ALB was higher than that of the control group. The inflammation-related index observation group was significantly lower than the control. However, the difference in Scr and BNU index levels between the two groups of patients after treatment was not so obvious that they could not be evaluated. In terms of all indicators and parameters, high-flux hemodialysis can better treat ESRD and improve the heart and kidney function of patients.

Keywords: end-stage renal disease; high-throughput hemodialysis; microinflammation; calcium and phosphorus metabolism; heart and kidney function.

1. Introduction

A large number of studies have confirmed that end-stage renal disease (ESRD) is a disease that develops from chronic kidney disease to the End stage. Despite the continuous development of blood purification technology, the effect is still poor. The annual mortality and complications are still very high. At the same time, hemodialysis treatment of ESRD will bring other concomitant diseases, which not only bring a lot of trouble to medical institutions and society, but also make patients bear more economic burden. Currently, the most effective treatment for ESRD is kidney transplantation, but this treatment is extremely limited because it is expensive and patients lack matched donors. Most patients were kept alive by hemodialysis (control group) [1]. In contrast, high-throughput hemodialysis (observation group) was more effective in removing intermediate molecules with a molecular weight of 5000×15,000 Da and in prolonging patient survival, while improving patient well-being and survival. Therefore, it is necessary to study the comparison between ESRD patients after high-throughput hemodialysis and ordinary dialysis, and this study will discuss the clinical efficacy, cardiac and renal function, calcium and phosphorus metabolism, serological indicators, and microinflammation status.

2. Data and Methods

2.1 Inclusion and exclusion criteria

Inclusion criteria: (1) Stable vital signs, complete clinical data, survival time >6 months; (2) Patients diagnosed with end-stage renal disease; (3) No infectious diseases, cancer, tumor and other diseases occurred in the past six months; (4) Sign informed consent. Exclusion criteria: (1) pregnant or lactating women; (2) Cardiovascular symptoms; (3) Patients with organ function and mental diseases; (4) Patients with major surgical treatment less than 1 month.

2.2 General Information

According to the inclusion and exclusion criteria, patients were collected in the Department of Nephrology, the Third People's Hospital of Gansu Province. Patients were selected and treated between July 2019 and July 2021. A total of 60 patients were randomized. Observation group:
mean (57.92±3.84) years old, duration of disease 2-6 years, mean (4.18±1.46) years, body mass index (BMI, 22-27 kg/m², mean (24.46±1.57)kg/m², type of disease: There were 8 cases of chronic glomerulonephritis, 9 cases of hyperglycemic nephropathy, 7 cases of chronic interstitial nephropathy, and 6 cases of hypertensive nephropathy. Control group: mean (58.34±3.33) years old, duration of disease 2-6 years, mean (4.22±1.84) years, body mass index (BMI, 21-27 kg/m², mean (23.34±1.42)kg/m², type of disease: There were 9 cases of chronic glomerulonephritis, 8 cases of hyperglycemic nephropathy, 7 cases of chronic interstitial nephropathy, and 6 cases of hypertensive nephropathy.

2.3 Test Indicators
Patients were treated with high-throughput hemodialysis (observation group) and maintenance hemodialysis (control group). Relevant indicators were collected with the patient's consent, the first collected 6 months before treatment and the second collected 6 months after treatment. The levels of calcium and phosphorus metabolism before treatment and the second collected 6 months after treatment. The calcium and phosphorus metabolism before treatment and the second collected 6 months after treatment were comparable. There was no statistically significant difference in serum parameters such as hemoglobin (ALB), complete parathyroid hormone (iPTH), β2-microglobulin (β2-MG), homocysteine (Hcy) and K+ before treatment (P>0.05). After treatment, the hemoglobin (ALB) of the observation group was higher than that of the control group, and the whole parathyroid hormone (iPTH), β2-microglobulin (β2-MG), homocysteine (Hcy) were lower than those of the control group, and the difference between the two groups was significant (P<0.05).

### 3. The results

3.1 Clinical efficacy
The effective rate of the observation group (83.33%) was higher than that of the control group (66.67%), and the difference was statistically significant (P<0.05) (P<0.05). In Table 1, Table 2 Comparison of clinical efficacy of ESRD patients.

<table>
<thead>
<tr>
<th>Group</th>
<th>The number of cases</th>
<th>Excellent</th>
<th>Effective</th>
<th>Invalid</th>
</tr>
</thead>
<tbody>
<tr>
<td>The control group</td>
<td>30</td>
<td>12 (40.00%)</td>
<td>8 (26.67%)</td>
<td>10 (33.33%)</td>
</tr>
<tr>
<td>Observation group</td>
<td>30</td>
<td>16 (53.33%)</td>
<td>9 (30.00%)</td>
<td>5 (16.67%)</td>
</tr>
</tbody>
</table>

### 3.2 Serological indexes
There was no significant difference in serum parameters such as hemoglobin (ALB), complete parathyroid hormone (iPTH), β2-microglobulin (β2-MG), homocysteine (Hcy) and K+ before treatment (P>0.05). After treatment, the hemoglobin (ALB) of the observation group was higher than that of the control group, and the whole parathyroid hormone (iPTH), β2-microglobulin (β2-MG), homocysteine (Hcy) were lower than those of the control group, and the difference between the two groups was significant (P<0.05).

#### 3.3 Calcium and phosphorus metabolism indexes
There was no statistically significant difference in calcium and phosphorus metabolism before treatment (P>0.05). The calcium and phosphorus metabolism indexes of the two groups were decreased after treatment, but the observation group was closer to the normal value,
which was significantly better than the control group, and the difference between the two groups was significant (P<0.05). In Table 3,

3.4 Microinflammatory indicators
In Table 4, there was no significant difference in CRP, TNF-α and IL-6 between the two groups before treatment (P>0.05). After treatment, the expression levels of CRP, TNF-α and IL-6 in the two groups were increased, and the treatment effect of the observation group was lower than that of the control group, and the difference was significant (P<0.05).

3.5 Cardiac function indicators
In Table 5, there was no significant difference in E/A and LVEF of ESRD patients between the two groups before treatment (P>0.05). After treatment, LVEF and E/A in the observation group were higher than those in the control group, and the differences were statistically significant (P<0.05).

3.6 Renal function indicators
In Table 6, there was no significant difference in renal function indexes between the two groups before treatment (P>0.05). The levels of BNU and Scr in the two groups after treatment were significantly different from those before treatment (P<0.05), but there was no significant difference in the levels of BNU and Scr between the two groups after treatment (P>0.05).

4. Discuss
Currently, more than 2 million patients with advanced kidney disease worldwide are receiving hemodialysis (HD) or peritoneal dialysis (PD) [3]. Diabetes is the main cause of end-stage renal disease (ESRD), and about 40% of ESRD cases can be attributed to diabetic nephropathy [4]. According to the Renal Data System annual data report of the United States in 2017 [5], Taiwan has the highest prevalence and incidence of ESRD in the world, leading to severe use of renal dialysis, poor morbidity and mortality prognosis, and also causing a burden [6]. These kidney replacements use manual measurements to remove
excess water, solutes, and toxins from the blood to maintain internal fluid and chemical balance. Despite progress in dialysis treatment, patients with ESRD still experience a severe symptom burden [7]. Patients with ESRD are characterized by impaired immune system due to repeated exposure to bacterial subcutaneous vascular, lymphocyte and granulocyte function due to urotoxin and malnutrition [8]. In addition, the patient's own disease and the prognosis of hemodialysis may further complicate the disease [9] and bring more adverse effects.

High-throughput hemodialysis, with its filter membrane of polymer, higher diffusion performance and hydraulic permeability, high toxin clearance rate and hypersonic filtration effect, can filter out various large and medium molecular harmful substances in the blood to achieve effective detoxification and become the most reasonable dialysis method at present [10-12]. The results of this study showed that in the observation group, serological indexes such as K+, ALB, iPTH, β2-MG and Hey, calcium and phosphorus metabolism level, inflammatory factors such as CRP, TNF-α and IL-6, cardiac function indexes and renal function indexes all had better treatment and prognostic effects, and tended to normal values. It is suggested that high-throughput hemodialysis is related to blood biochemical indexes, calcium and phosphorus metabolism level, inflammatory factors and cardiac and renal function, which may reduce related prognostic diseases and reduce the burden of patients [13-14].

In short, compared with ordinary dialysis, high-throughput hemodialysis has a better therapeutic effect in ESRD patients, which may reduce changes in the microenvironment, have better clearance ability, and fewer poor prognostic diseases. The clinical application value is high, but it needs to be verified by subsequent studies.

References


