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A Randomized Controlled Trial was Conducted to Investigate the Effects of Adjustable Sodium Dialysis on Blood Pressure and Blood Pressure Variability during Dialysis

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Abstract

Objectives: To explore the effect of adjustable sodium dialysis mode on blood pressure and blood pressure variation rate in MHD patients.

Methods: 130 patients were included, In the experimental group(n=65) were treated with adjustable sodium dialysis. the dialysate sodium concentration decreased gradually from 141mmol/L at the beginning of dialysis to 135mmol/L 30min before dialysis, and 30min maintained sodium concentration 140mmol/L before the end of dialysis.The control group (n=65) were dialyzed with constant sodium 140mmol/L. Age, sex, height, weight after last dialysis, pre-dialysis weight, dry weight and interdialysis weight growth were measured at baseline and 1 month later, and the interdialysis weight growth rate, systolic blood pressure variation rate and diastolic blood pressure variation rate were calculated. The differences of related indexes between the two groups were compared between the baseline and after 1 month.

Results: After dialysis with adjustable sodium for one month, the coefficient of variation of systolic blood pressure in the experimental group was 7.06%±3.18%, which was significantly lower than that in the control group (8.97%±5.06%, P=0.011).

Conclusion: After one month of adjustable sodium dialysis, the coefficient of variation of systolic blood pressure in MHD patients can be reduced.

Keywords: Adjustable sodium; Blood pressure; Coefficient of variation; Maintenance hemodialysis

Abbreviations: ESRD: End-Stage Renal Disease; BPV: Blood Pressure Variability; CKD: Chronic Kidney Disease; CVD: Cardiovascular Disease; DBP: Diastolic Blood Pressure; MAP: Mean Arterial Pressure; SBP: Systolic Blood Pressure

Introduction

Hemodialysis (MHD) is the most common method of renal replacement therapy, and the number of MHD is increasing all over the world [1], As of 2014, there were about 340,000 MHD patients in China, with an annual growth rate of about 20-30% [2]. MHD not only brings huge economic burden, but also significantly increases mortality, among which Cardiovascular Disease (CVD) is the main complication and death cause of MHD patients [3]. MHD not only brings huge economic burden, but also significantly increases mortality, among which Cardiovascular Disease (CVD) is the main complication and death cause of MHD patients [4]. Abnormal Blood Pressure Variability (BPV) often occurs in MHD patients [5], Usually manifested as Intradialytic Hypotension (IDH) and Intradialytic Hypertension (IDHT), which increase the risk of CVD, and IDHT has worse short-term and long-term prognosis and higher mortality [6]. Many studies have confirmed that BPV is an independent risk factor for cardiovascular death in MHD patients [7,8]. Therefore, controlling HPV during dialysis is of great significance to improve the prognosis of MHD patients.

Methodology

Patient recruitment and methods

- Subjects: MHD patients in Yuedong Hospital of the Third Affiliated Hospital, Sun Yat-Sen University, Yuedong Hospital, from April 2021 to June 2020 were selected and followed up for one month.
- Inclusion criteria: (1) MHD patients; (2)age ≥18 years.
- Exclusion criteria: (1) cerebrovascular accident; (2) the cardiac function is grade III~IV; (3) Patients with malignant tumor, mental illness or pregnancy.
- Grouping of research objects: The research objects were randomly divided into two groups. The experimental group used adjustable sodium dialysis, and the sodium concentration of dialysate gradually decreased from 141mmol/L to 135mmol/L 30min minutes before dialysisAnd the sodium concentration was maintained at 140mmol/L 30min before the end of dialysis. Patients in control group were treated with constant sodium 140mmol/L.

Baseline data collection and Biochemical Evaluation

The baseline variables included: demographic indicators (age, sex, height, weight after last dialysis, weight before this dialysis); Use electronic sphygmomanometer to measure blood pressure (including the blood pressure values of 0h, 1h, 2h and 3h during dialysis and after dialysis); Ultrafiltration volume of this dialysis (ml); Dry weight (kg), weight gain during dialysis (idwg);Weight growth rate during dialysis (IDWG%)=(Weight before dialysis-Weight after the first dialysis)/Dry weight×100%; Coefficient Of Variation(CV)=(Standard Deviation(SD)/Average Value (Mean) x100%.

Definition

Statistical analyses

SPSS(Statistical Product and Service Solutions)22.0 software was used to analyze the data, and continuous variables were expressed by mean±standard deviation. The measurement data conforming to normal distribution is expressed by x±s, and t test is adopted; Counting data were expressed in percentage, and χ^2 test was used for comparison between groups.

Results

Baseline characteristics of all the patients

There were 130 cases in the baseline group, including 65 cases in the experimental group and 35 cases (53.8%) in males, Age 63.32±12.78 years old, Coefficient of variation of systolic blood pressure 8.71%±4.44%, Coefficient of variation of diastolic blood pressure 7.78%±3.71%; IDWG% 4.2%±12.92%; Control group 65 cases, male 40 cases (61.5%), Age 60.82±13.41 years old, Coefficient of variation of systolic blood pressure 8.63±4.2%, Coefficient of variation of diastolic blood pressure 8.01%±4.7%; IDWG% 3.09%±2.26%; There was no significant difference in the observed indexes between the two groups at baseline (P > 0.05) (Table 1).

Variable	Experimental group (n=65)	Control group (n=65)	$t/\chi^2/Z$	P
Gender, (% male)	35 (53.8%)	40 (61.5%)	.788[a]	0.375
Age (Years)	63.32±12.78	60.82±13.41	1.091	0.277
Ultrafiltration volume (ml)	1861.54±1037.08	2099.08±995.36	-1.332	0.185
Dry weight (kg)	58.88±11.95	60.1±14.17	-0.526	0.6
Mean systolic blood pressure (mmHg)	148.34±22.24	147.27±21.46	0.28	0.78
Mean diastolic blood pressure (mmHg)	88.14±11.06	83.33±10.66	-0.625	0.533
Variation of systolic blood pressure (%)	8.71%±4.44%	8.63±4.2%	0.106	0.916
Variation of diastolic blood pressure (%)	7.78%±3.71%	8.01%±4.7%	-0.308	0.759
IDWG (kg)	2.66±8.92	1.81±1.31	0.754	0.452
IDWG%	4.2%±12.92%	3.09%±2.26%	0.683	0.496

Table 1: Baseline data of subjects.

Analysis of follow-up results

One month later, the differences between the two groups were compared, and the coefficient of variation of systolic blood pressure in the experimental 7.06%±3.18%, Coefficient of variation of systolic blood pressure compared with the control group 8.97%±5.06% Obvious decline (P=0.011). There was no significant difference in other observation indexes such as ultrafiltration, dry weight, coefficient of variation of diastolic blood pressure, interdialysis weight growth and interdialysis body weight growth between the two groups (P > 0.05) (Table 2).

Variable	Experimental group (n=65)	Control group (n=65)	$t/\chi^2/Z$	P
Ultrafiltration volume (ml)	2253.85±894.44	2153.85±966.16	0.612	0.541
Dry weight (kg)	59.48±13.37	58.46±10.59	0.484	0.629
Mean systolic blood pressure (mmHg)	157.57±17.82	154.42±18.86	0.979	0.329
Mean diastolic blood pressure (mmHg)	86.22±9.28	86.21±10.95	0.003	0.997
Variation of systolic blood pressure (%)	7.06%±3.18%	8.97%%±5.06%	-2.582	0.011
Variation of diastolic blood pressure (%)	7.19%%±0.0385	8.07%%±4.33%	-1.216	0.226
IDWG (kg)	1.98±1.58	2.05±1.24	-0.284	0.777
IDWG%	3.31%±2.43%	3.56%±2.37%	-0.598	0.551

Table 2: Comparison between the two groups after intervention.

Discussion

Most patients with MHD have BPV [9-11], It is especially obvious during hemodialysis, which further promotes the occurrence of CVD, and the abnormality of BPV is an independent risk factor for all-cause death in MHD patients [12]. BPV in patients with MHD is associated with cardiovascular disease, and the main mechanism is the aggravation of left ventricular hypertrophy [13], Aggravate the occurrence of arteriosclerosis [14], The correlation between systolic BPV abnormality and cardiovascular death is stronger. Studies have shown that ultrafiltration volume during dialysis is related to systolic Blood Pressure (BPV) during dialysis [9], In patients with high Interdialysis Weight Gain (IDWG), ultrafiltration volume increases accordingly, so controlling the growth of IDWG may help to reduce systolic Blood Pressure (BPV).

The main BPV manifestations of MHD patients were hypertension or hypotension. The incidence of hypertension during dialysis is about 18-31.1% [15], USRDS study showed that systolic blood pressure increased by 10mmHg during dialysis, and the risk of death increased by 6% [16]. The research of Inrig et al. [17] shows that, The difference of blood pressure changes during dialysis is more related to the prognosis. The incidence of hypotension during dialysis is also high, and hypotension during dialysis is also an independent risk factor for all-cause death in MHD patients [18], Avoiding high or low blood pressure during dialysis helps to reduce BPV. The coefficient of variation of systolic blood pressure in the experimental group was significantly lower than that in the control group. The function of regulating water and sodium in patients with MHD is impaired and they need to maintain the balance of sodium in the body through hemodialysisIf the concentration of sodium in the dialysate is too high, the patient will have water and sodium retention [19,20], and will cause the blood pressure to be on the high side [21]. At the same time, due to the increase in water content in the next dialysis ultrafiltration, the risk of hypotension increases accordingly studies have shown that lower dialysate sodium concentration is beneficial to the control of hypertension [22]. But lower dialysate sodium concentrations correspondingly increase the risk of hypotension and muscle spasm [23]. In this study, the sodium concentration of dialysate decreased gradually from 141 mmol/L at the beginning of dialysis to 135 mmol/L before dialysis, and the 30min maintained 140 mmol/L of sodium before the end of dialysis, and maintained a low level of dialysate sodium during dialysis, because 30min was adjusted to normal serum sodium level before the end of dialysis to avoid hyponatremia in patients with MHD. In this study, the sodium concentration of dialysate decreased gradually from the beginning of dialysis to 135 mmol/L before dialysis, and the dialysate sodium concentration was maintained at 140 mmol/L before the end of dialysis.

Limitations of the study

Due to the limited sample size, this study has some limitations and is retrospective. In addition, serum uric acid was evaluated only at baseline and there was no follow-up data.

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