Clinical efficacy of ultrafiltration in the treatment of acute decompensated heart failure with diuretic resistance.

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Abstract

Objective: To evaluate the clinical efficacy of ultrafiltration for Acute Decompensated Heart Failure (ADHF) with diuretic resistance.

Methods: Totally 120 patients with ADHF combined with diuretic resistance were enrolled in Affiliated Hospital of Nantong University. According to the treatment methods, 62 cases were included the observation group and 58 cases included the control group. The control group received conventional therapy, while the observation group received blood ultrafiltration and then compared the differences of clinical efficacy.

Results: The heart rate and respiratory rate of the observation group were significantly lower than those in the control group (80.04 ± 15.60 *vs.* 91.27 ± 16.75, P<0.05) and (22.36 ± 1.82 *vs.* 25.67 ± 1.28, P<0.05), the oxygen saturation of the observation group was significantly higher than that of the control group (94.42 ± 1.87 *vs.* 91.31 ± 1.54P<0.05). The serum creatinine and Brain Natriuretic Peptide (BNP) of the observation group were significantly lower than those in the control group (213.54 ± 57.46 *vs.* 301.52 ± 78.33, P<0.05), (520.57 ± 62.10 *vs.* 612.41 ± 78.50, P<0.05), the volume of 24 h urine of the observation group were significantly higher than those in the control group (1085.47 ± 145.63 *vs.* 910.44 ± 120.63, P<0.05).

Conclusion: The ultrafiltration treatment for ADHF with diuretic resistance can improve the patients' heart and kidney function and prognosis, increase the urine volume and decrease the level of serum BNP, which is worthy of clinical application.

Introduction

Most of the patients with Acute Decompensated Heart Failure (ADHF) were hospitalized for overburden and pulmonary congestion. Therefore, the treatment for ADHF was aimed to eliminate excessive sodium and sodium retention in the patient [1]. It is reported [2] that ADHF can often cause inadequate tissue perfusion, hemodynamic deterioration and other complications, thereby increasing the burden of renal function. About 30% of patients can be complicated by renal insufficiency, that is heart and kidney syndrome, which will further increase the fluid urinary retention, thus leading to the continued deterioration of cardiac function, and further aggravating the condition and affecting the prognosis of patients. Diuretics as the preferred drug for ADHF treatment have significantly reduced diuretic effect for patients with renal insufficiency that contributes a higher dose of diuretics, resulting in diuretics resistance [3]. Some studies have shown that [4], the application of blood ultrafiltration in the treatment of acute decompensated heart failure with diuretic resistance can effectively control the fluid retention in patients, thereby alleviating the patient's condition. The blood ultrafiltration can reduce the body capacity load, improve heart function, and maintain the stability of the body electrolyte [5]. For ADHF patients with renal insufficiency, blood ultrafiltration can correct some body's hyperkalemia, thus reducing the risk of cardiac events to a certain extent [6]. In addition, ultrafiltration can reduce the levels of norepinephrine, renin, aldosterone and other neuroendocrine hormones, which contribute to the improvement of hemodynamics [7]. In order to further confirm the efficacy of blood ultrafiltration on ADHF patients with diuretics resistance and provide the basis for the clinical treatment of patients, this study selected 120 patients in our hospital as research objects, to investigate the clinical efficacy of blood ultrafiltration by using case-control study.

Materials and Methods

Clinical data

A number of 62 patients with acute decompensated heart failure combined with diuretic resistance in Affiliated Hospital of Nantong University from February 2013 to February 2016 were enrolled as the observation group of subjects, and another 58 cases in the same period were as control group. There were 67 male patients and 53 female cases, aged from 42 to 74 y,

mean age of (57.63 ± 10.38 y). All patients were treated with fortified diuretics (furosemide>80 mg/d) and positive inotropic drugs, but urine output of patients continued to decrease, even vanished, there is still diuretic resistance and no significant

improvement in heart failure. There was no significant difference between the two groups in the baseline data (P>0.05), with comparability between the two groups (Table 1).

Table 1. Comparison of clinical data of the two groups (n, ($\bar{x}$ ± s)).

Clinical data	Observation group (n=62)	Control group (n=58)	t/χ^2 value	P value
Gender				
Male	36	31	0.259	>0.05
Female	26	27		
Average age (y)	56.49 ± 13.21	58.43 ± 10.27	0.894	>0.05
Heart failure course (y)	3.36 ± 0.74	3.59 ± 0.83	1.604	>0.05
Left ventricular ejection fraction (%)	33.67 ± 3.50	32.85 ± 4.12	1.178	>0.05

Inclusion criteria and exclusion criteria

Inclusion criteria: 1. ADHF patients with diuretics resistance; 2. patients with III or IV NYHA cardiac function; 3. patients and authorized agents voluntarily signed informed consent, willing to cooperate with clinical observation.

Exclusion criteria: 1. patients combined with contraindications of CVVH treatment; 2. patients with severe infection, severe lung or liver dysfunction; 3. serum creatinine levels ≥ 3 mg/dL or kidney transplant patients; 4. combined with coagulation dysfunction, severe anemia and malignant tumor patients; 5. lactation and pregnant women; 6. patients combined with mental illness; 7. uncompleted clinical observers who midway transfer, asked to withdraw and other reasons. This research was approved by Ethical Committee of Affiliated Hospital of Nantong University.

Therapeutic method

Control group: The patients in this group were given with conventional heart failure therapy, once diuretics resistance occurred, the dose of diuretics will increased (20~40 mg per time). The conventional dose of agent diuretics was 20~40 mg, and the dose for patients with diuretics resistance will be increased to 60~80 mg/times. If the treatment effect is still poor, a one-time loop diuretics load 120~180 mg will be given to the patients, and then 24 h continuous pumping 50% saline +100 mg dopamine+200 mg furosemide.

Observation group: Patients with diuretics resistance were treated continually with diuretics. When the urine or creatinine of patient was up to AKI-3 standard, bedside CVVH treatment will be applied. The internal jugular vein or femoral vein catheterization of dual lumen catheter was used to establish access with the German company Bailang Diapact CRRT blood purification system, and Diacap Acute blood purifier. Based on the patient's condition, blood flow was controlled between 120~200 ml/min, ultrafiltration volume of 2000~4000

ml/d, the daily ultrafiltration duration of 6~10 h, the interval of 2 d, low molecular weight heparin was used for anticoagulation. The original drug dose was maintained during CVVH treatment.

Observe indicators

1. Comparison changes in clinical indicators, including heart rate, oxygen saturation, respiratory rate, systolic blood pressure, diastolic blood pressure before treatment and after 7 d treatment of the two groups; 2. Comparison the levels of serum creatinine, 24 h urea and brain natriuretic peptide two groups of patients before treatment and after 7 d treatment of the two groups.

Statistical analysis

Data were analysed by SPSS 22.0 and the t test was used to compare the measurement data, χ^2 test for comparison the counting data. P<0.05 means statistically significant difference.

Results

Changes in clinical indicators of the patients in the two groups

There was no significant difference in heart rate, blood oxygen saturation, respiratory rate and blood pressure between the two groups before treatment (P<0.05). After treatment, the heart rate and respiratory rate were significantly decreased (P<0.05), blood oxygen saturation was significantly increased (P<0.05). The heart rate and respiratory rate of the observation group were significantly lower than those of the control group (P<0.05). Besides, the heart rate and respiratory rate of the observation group were significantly lower than those of the control group, and the blood oxygen saturation was significantly higher than that of the control group (P<0.05).

However, there was no significant difference in blood pressure between the two groups (P>0.05) (Table 2).

Table 2. *Changes in clinical indicators of the patients in the two groups ($\bar{x} \pm s$).*

Groups	Time	Heart rate (times/min)	Oxyhemoglobin saturation (%)	Respiratory rate (times/min)	Systolic pressure (mmHg)	Diastolic pressure (mmHg)
Observation group (n=62)	Before treatment	108.42 ± 16.47	88.35±± 1.24	28.34 ± 2.05	128.53 ± 22.30	70.32 ± 8.39
	7 d after treatment	80.04 ± 15.60*	94.42 ± 1.87*	22.36 ± 1.82*	122.52 ± 17.84	68.58 ± 9.38
	T value	9.851	21.301	17.177	1.657	1.089
	P value	<0.05	<0.05	<0.05	>0.05	>0.05
Control group (n=58)	Before treatment	110.43 ± 14.73	89.03 ± 1.77	28.06 ± 1.76	127.42 ± 28.31	71.53 ± 7.21
	7 d after treatment	91.27 ± 16.75	91.31 ± 1.54	25.67 ± 1.28	122.36 ± 19.22	68.52 ± 9.02
	T value	6.542	7.401	8.364	1.126	1.985
	P value	<0.05	<0.05	<0.05	>0.05	>0.05

Note: compared with control group at 7 d after treatment, *P<0.05

The level changes of serum creatinine, 24 h urine output and brain natriuretic peptide of the patients in the two groups

There was no significant difference in serum creatinine, 24 h urine output and brain natriuretic peptide levels between the two groups before treatment (P>0.05). After treatment, serum creatinine, 24 h urine output and brain natriuretic peptide levels were significantly improved in both groups after treatment (P<0.05), and the observation group was significantly better than the control group (P<0.05) (Table 3).

Table 3. *The level changes of serum creatinine, 24 h urine output and brain natriuretic peptide of the patients in the two groups ($\bar{x} \pm s$).*

Groups	Time	Creatinine (μmol/L)	24 h urine output (ml)	Brain natriuretic peptide (pg/ml)
Observation group (n=62)	Before treatment	478.53 ± 96.47	496.53 ± 60.48	768.53 ± 58.62
	7 d after treatment	213.54 ± 57.46*	1085.47 ± 145.63*	520.57 ± 62.10*
	T value	18.582	29.408	22.863
	P value	<0.05	<0.05	<0.05
Control group (n=58)	Before treatment	492.35 ± 89.42	508.31 ± 69.47	793.42 ± 67.39
	7 d after treatment	301.52 ± 78.33	910.24 ± 120.63	612.41 ± 78.50
	T value	12.226	21.989	13.325
	P value	<0.05	<0.05	<0.05

Note: compared with control group at 7 d after treatment, *P<0.05

Discussion

Although there is no uniform definition of diuretics resistance at present, most scholars believe that diuretic resistance refers to a clinical state in which diuretic effects are diminished or lost before the goal of reducing edema has not been achieved [8]. For patients with heart failure, in the event of diuretic resistance, the near-long-term mortality was significantly increased. The study showed that there was independent correlation between total mortality and sudden death or death caused by pump failure in patients with diuretic resistance and heart failure. Besides that diuretic resistance may also be the clinical manifestations of other potential disease progression, which is an important factor in the prognosis of patients with heart failure [9]. Relevant studies have demonstrated that the incidence of diuretic resistance is about 20 to 35% for patients with heart failure, while the incidence was even higher than 50% for patients with acute decompensated heart failure [10]. The present study found that [11], the occurrence of diuretic resistance in acute heart failure patients is closely linked with

renal insufficiency, heart and kidney syndrome; In addition, some studies have shown that [12], diuretics resistance is also closely related to arteries atherosclerotic disease, diabetes and hypoalbuminemia of patients. In particular, for elderly patients, due to renal dysfunction, hemodynamic changes in the body, hardening of the arteries, malnutrition and other high risk factors, the risk of diuretics resistance in old patients with acute decompensated heart failure is higher.

For patients with acute decompensated heart failure, loop diuretics are the first drug choice for the current treatment, while for patients with acute decompensated heart failure accompanied with renal insufficiency, the effect of diuretics will be significantly reduced, a higher dose is needed. However, the intensive treatment of diuretics will lead to activation of the body's neuroendocrine system, and further reduce the glomerular filtration rate, causing further deterioration of renal function in patients. Therefore, the safety of intensive treatment of diuretics in diuretics resistance patients is still controversial [13]. It is reported that [14], blood ultrafiltration has an obvious advantage in improving patient heart function, maintaining the body electrolyte stability and reducing the body capacity burden. This study was aimed to investigate the clinical efficacy of hemofiltration in the treatment of acute decompensated heart failure with diuretic resistance and compared with intensive diuretic therapy.

The results of this study indicated that the improvement of heart rate, respiratory rate and blood oxygen saturation in the observation group was significantly better than those in the control group. The levels of creatinine, 24 h urine and brain natriuretic peptide in the observation group were significantly better than those in the control group, suggesting that the blood ultrafiltration on the treatment of patients had more significant effect. It is possible that the ultrafiltration can remove the retention of the body of water to effectively reduce the body capacity load; and reduced capacity load can significantly lower the plasma osmotic pressure, and thus can effectively alleviate the body tissue interstitial edema and improve the body microcirculation, making the organization cells of increased oxygen, reducing the release of acidic substances, which can effectively improve the body's sensitivity to diuretics. At the same time, the water and sodium retention of the body were significantly reduced, which can improve the patient's left ventricular function, stable the neuroendocrine system and enhance renal function to increase 24 h urine output [15,16]. In addition, serum brain natriuretic peptide as an important predictor of patients with heart failure, has been confirmed a prognostic factor in the prognosis of patients with heart failure [17]. This study shows that the patients in observation group had significantly reduced the brain natriuretic level compared with the control group, indicating that the blood ultrafiltration can effectively improve the prognosis of patients and contribute to the improvement of life quality of patients.

In summary, the blood ultrafiltration treatment of acute decompensated heart failure with diuretics resistance can effectively enhance the patient's heart and kidney function, increase patient urine output, reduce serum brain natriuretic peptide levels, improve prognosis, which is worthy of clinical promotion.

Acknowledgement

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