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Clinical Efficacy and Safety Evaluation of Continuous Blood Purification in the Management of Critically Ill Sepsis Patients in the Intensive Care Unit

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Abstract: *Objective*: To observe and explore the effectiveness and safety of continuous blood purification intervention in the clinical treatment of patients with severe sepsis in the Intensive Care Unit (ICU). *Methods*: Medical records were collected from March 2024 to March 2025, including a total of 54 patients with severe sepsis in the ICU. The patients were divided into two groups using a random number table method: the conventional group (27 patients receiving conventional treatment) and the observation group (27 patients receiving continuous blood purification in addition to conventional treatment). C-reactive protein, arterial lactate, mean arterial pressure, respiration, and heart rate were measured. The Sequential Organ Failure Assessment (SOFA) score was compared, and adverse reactions were observed. *Results*: The observation group had lower levels of C-reactive protein, arterial lactate, respiration, heart rate, and total SOFA score compared to the conventional group, while the mean arterial pressure was higher ($P < 0.05$). The incidence of adverse reactions during treatment was lower in the observation group than in the conventional group ($P < 0.05$). *Conclusion*: The use of continuous blood purification in the clinical treatment of patients with severe sepsis in the ICU is effective. It can alleviate the disease, improve vital signs, reduce inflammatory damage, and reduce adverse reactions.

Keywords: Sepsis; Blood purification; Adverse reactions

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1. Introduction

Sepsis occurs due to trauma or infection, causing toxic metabolites and pathogenic bacteria to breach the body's defense mechanisms and spread throughout the body via the bloodstream [1]. This triggers the immune system, leading to a systemic inflammatory response that can affect critical organs such as the abdominal cavity, lungs, kidneys, and urinary system, potentially resulting in death due to multiple organ failure [2]. Continuous blood purification technology can improve the prognosis by removing toxic metabolites and inflammatory mediators,

assisting the body in enhancing the stability of its internal environment [3, 4]. This study included 54 patients with severe sepsis in the ICU and specifically aimed to evaluate the treatment with continuous blood purification for reference.

2. Materials and methods

2.1. General information

Medical records are collected from March 2024 to March 2025, including 54 patients with severe sepsis in the ICU. The patients are randomly divided into two groups: the conventional group (27 patients) and the observation group (27 patients). Inclusion criteria are: meeting the diagnostic criteria for severe sepsis, staying in the ICU for ≥ 24 hours, no blood system diseases, and normal coagulation and immune function. Exclusion criteria included blood transfusion or anticoagulation therapy in the past 6 months, pregnancy, lactation, organ transplantation, heart, liver, or kidney dysfunction, cachexia or malignancy, personality disorders, or mental disability.

2.2. Methods

The conventional group received conventional treatment, including broad-spectrum antimicrobial treatment based on drug sensitivity results, electrolyte balancing, dynamic monitoring of respiratory, blood pressure, pulse oxygen, and heartbeat changes, intravenous infusion of compound sodium acetate Ringer's injection for fluid resuscitation, and nutritional, respiratory, and circulatory support as prescribed.

The observation group received continuous blood purification in addition to conventional treatment. This involved initiating continuous venovenous hemofiltration (CVVH) treatment mode, controlling blood flow rate at 150–200 ml per minute, and adjusting replacement fluid and dialysis fluid rates hourly. The blood filter is replaced every 12 to 24 hours. Both groups are evaluated for efficacy after 72 hours of continuous treatment.

2.3. Observation indicators

(1) Before and after treatment, blood was drawn from the median cubital vein to prepare serum. The serum C-reactive protein is measured using immunoturbidimetry at a low speed of 3000 rpm per minute, 9cm radius, and for 10 minutes. Simultaneously, arterial blood lactate is detected using a blood gas biochemical analyzer (Guangzhou Wondfo Biotech, Guangdong Medical Device Registration No. 20172220716, Instrument Model BGA-102).

(2) Heart rate and respiration are monitored using a multi-parameter monitor (Beijing Taeyang Electronics Technology, Beijing Medical Device Registration No. 20192070420, Instrument Model SOLAR6000B). Mean arterial pressure is measured using a hemodynamic analyzer (Jiangxi Yiludeli Medical Technology, Jiangxi Medical Device Registration No. 20192070181, Instrument Model HM92-03A).

(3) Before and after treatment, the Sequential Organ Failure Assessment (SOFA) score is used for quantitative evaluation. The scoring range is from 0 to 24, and a lower score indicates a less severe condition.

(4) Adverse reactions are observed during the treatment process.

2.4. Statistical processing

The observation indicators in this study are analyzed using statistical software (SPSS version 22.0). The incidence of adverse reactions, described as [n(%)], is compared between the two groups using the chi-square test (x2) to

determine any differences. The C-reactive protein, arterial lactate, mean arterial pressure, respiration, heart rate, and total SOFA score, described as mean ± standard deviation (x ± s), all met the requirements of the Shapiro-Wilk normal distribution test. The t-test is used to compare these variables between the two groups and assess any differences. The significance level (α) is set at 0.05. When the test result P is less than 0.05, the statistical significance is established.

3. Results

3.1. Comparison of C-reactive protein and arterial lactate between the two groups

There were no significant differences in the levels of C-reactive protein and arterial lactate between the two groups before treatment. However, after treatment, the levels of C-reactive protein and arterial lactate in both groups further decreased, but the observation group showed a more significant decrease compared to the conventional group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of C-reactive protein and arterial lactate between the two groups ($\overline{x} \pm s$)

Group	Number of cases	C-reactive protein (mg/L)		Arterial blood lactate (mmol/L)	
		Before treatment	After treatment	Before treatment	After treatment
Observation Group	27	94.88 ± 8.87	25.63 ± 5.75*	5.56 ± 0.60	1.88 ± 0.22*
Conventional group	27	94.86 ± 8.75	50.16 ± 3.23*	5.55 ± 0.61	2.43 ± 0.26*
t		0.008	19.326	0.060	8.391
P		0.993	< 0.001	0.952	< 0.001

Note: * denotes $p < 0.05$ compared with pre-treatment

3.2. Comparison of mean arterial pressure, respiration, heart rate, and total SOFA score between the two groups

The mean arterial pressure, respiration, heart rate and total SOFA score of the two groups before treatment did not show any significant difference. The mean arterial pressure of the two groups after treatment further increased, but the observation group increased significantly more than the conventional group. The respiration, heart rate and total SOFA score of the two groups further decreased, but the observation group decreased significantly more than the conventional group ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of mean arterial pressure, respiration, heart rate, and total SOFA score between two groups ($\overline{x} \pm s$)

Group	Number of cases	Mean arterial pressure (mmHg)		Respiration (breaths/min)	
		Before treatment	After treatment	Before treatment	After treatment
Observation group	27	50.52 ± 6.77	59.16 ± 1.98*	26.88 ± 2.01	16.07 ± 1.61*
Conventional group	27	50.55 ± 6.78	54.08 ± 2.33*	26.82 ± 2.02	19.95 ± 1.63*
t		0.016	8.632	0.109	8.799
P		0.987	< 0.001	0.913	< 0.001

Table 2 (Continued)

Group	Number of cases	Heart rate (beats/min)		Total SOFA score (points)	
		Before treatment	After treatment	Before treatment	After treatment
Observation Group	27	128.36 ± 8.89	79.75 ± 3.63*	6.75 ± 1.55	2.02 ± 0.38*
Conventional group	27	128.33 ± 8.87	99.04 ± 3.34*	6.72 ± 1.46	2.88 ± 0.47*
t		0.012	20.319	0.073	7.393
P		0.990	< 0.001	0.942	< 0.001

Note: * indicates $P < 0.05$ compared with pre-treatment

3.3. Comparison of adverse reactions occurring in the two groups

Less adverse reactions occurred in patients in the observation group than in the conventional group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of adverse reactions occurring in the two groups [n (%)]

Group	Number of cases	Dizziness	Yellowing of the skin	Bleeding	Infection	Total occurrence
Observation Group	27	2(7.41%)	0	0	1(3.70%)	3(11.11%)
Conventional group	27	5(18.52%)	1(3.70%)	1(3.70%)	3(11.11%)	10(37.04%)
x^2						4.964
P						0.026

4. Discussion

Septicaemia has a very high lethality, due to a large number of inflammatory mediators, toxic metabolites in the organism for a long time synergistically or singly, and thus strongly stimulate the abdominal cavity, liver, kidney, lungs, urinary system, etc., so that each organ cannot withstand and out of control, the formation of systemic inflammatory response syndrome, and even cause organ failure [5]. Conventional anti-infective treatment, fluid resuscitation, immunomodulation, nutritional support, respiratory and circulatory support, and other therapeutic measures are of limited benefit and time-consuming, and it is difficult to effectively constrain the underlying factors of sepsis, so that the clinical efficacy is not very satisfactory [6]. While continuous blood purification has good biocompatibility, the process of removing toxic metabolites and inflammatory mediators is gentle and stable, and it can be continuously purified for 24 hours a day, which is better able to meet the needs of the human physiological state, maintain the stability of the internal environment, and promote the recovery of the prognosis [7].

In this randomized controlled study, the observation group showed significantly lower levels of C-reactive protein, arterial blood lactate, respiratory rate, heart rate, and total SOFA score compared to the conventional group, while the mean arterial pressure was significantly higher ($P < 0.05$). To analyze the reasons, the continuous blood purification treatment technology based on the convection principle has significant advantages in the removal of medium and small molecule solutes, which can better help patients to remove toxic products from the body, reduce the content of inflammatory factors in the body, reduce the body's burden, and alleviate hyperthermia. It can also accurately control the fluid balance, correct the electrolytes, improve the internal circulatory environment, and promote the restoration of vital signs [8]. Continuous blood purification therapy has

a sustained and stable effect, and can provide continuous support for the patient's condition regression in order to prevent deterioration and aggravation of the condition [9].

In this randomized controlled study, the incidence of adverse reactions during treatment in the observation group was only 11.11%, significantly lower than the 37.04% observed in the conventional group ($P < 0.05$). The improved safety of continuous blood purification can be attributed to its isotonic, slow, and uniform removal of toxic substances, which minimizes the negative impact on effective circulating blood volume. This helps patients maintain relatively stable hemodynamics and enhances treatment safety. Moreover, the therapy allows for timely and precise adjustment of treatment parameters based on the patient's condition, reducing the risk of adverse reactions caused by internal environment disturbances. Combined with continuous monitoring by a professional medical team, this approach provides comprehensive safety assurance for patients [10].

5. Conclusion

In conclusion, continuous blood purification therapy has idealized clinical effects, can assist ICU patients with severe sepsis to alleviate their condition, stabilize haemodynamics, improve vital signs, reduce inflammatory damage, and reduce adverse reactions, and can be recommended.

Disclosure statement

The author declares no conflict of interest.

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