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Effect Study of the Recombinant Human Brain Natriuretic Peptide in Patients with Heart Failure Combined with Hypotension

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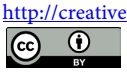

Abstract

Objective: This paper aims to investigate the effect of applying recombinant human brain natriuretic peptide in patients with heart failure combined with hypotension. Recombinant human brain natriuretic peptide is a synthetic polypeptide drug that is primarily used to treat acute heart failure. Its mechanism of action closely mimics that of human endogenous brain natriuretic peptide. By binding to receptors on cardiomyocytes, it exerts its pharmacological effects. **Methods:** For the study, 76 heart failure patients with hypotension were selected from our hospital between May 2022 and June 2023. These patients were divided into two groups: a control group and an observation group, each comprising 38 patients. The control group received dopamine treatment, while the observation group was treated with recombinant brain natriuretic peptide. The objective was to compare the effects of the treatments in both groups by analyzing cardiac function indices and levels of vasoactive substances to identify any significant differences in outcomes. **Results:** The overall response rate of the patients in the observation group and the control group was 94.74% and 73.68%, significantly higher as compared with the observation group ($P < 0.05$); besides, compared with the indicators of cardiac function in group 2, the patients of the observation group were better than those in the control group ($P < 0.05$); in addition, BNP, ANP and urine volume in the 2 groups before treatment, the difference was not statistically significant ($P > 0.05$). After the following treatment, BNP, ANNP and urine output in the observation group were significantly different compared with the control group, of the statistical significance ($P < 0.05$). **Conclusion:** For the treatment of heart failure patients with hypotension, the clinical application of recombinant human brain natriuretic peptide is the most ideal, and significantly improves the cardiac function of patients, which is worth popularizing.

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Keywords

Recombinant Human Brain Natriuretic Peptide, Heart Failure, Hypotension

1. Introduction

Heart failure encompasses a range of structural and functional diseases of the heart that impair ventricular filling and/or ejection functions. This condition results in cardiac output being insufficient to meet the metabolic demands of body tissues, leading to congestion in the pulmonary and/or systemic circulation and reduced blood perfusion to organs and tissues. Clinically, heart failure is primarily characterized by dyspnea, limited physical activity, and fluid retention. Additionally, hypotension frequently accompanies heart failure due to the heart's inadequate ejection capacity, which compromises perfusion to vital organs such as the brain and kidneys, resulting in cerebral ischemia and renal insufficiency. In simpler terms, the onset of hypotension in heart failure patients who previously had normal blood pressure often signals a progression to advanced stages of the disease, necessitating immediate and appropriate pharmacological intervention. Clinical treatments typically involve pressor drugs, such as dopamine, to improve renal perfusion and address heart failure, though improper use of these agents can exacerbate hypotension and even precipitate hypotensive shock. Recent clinical research has highlighted the therapeutic potential of recombinant brain natriuretic peptide (BNP) [1], a synthetic analog of the naturally occurring BNP. This agent not only enhances cardiac output and reduces cardiac workload but also exhibits antihypertensive properties, thereby proving more effective in achieving desired treatment outcomes. Based on these insights, this study divides 76 patients with heart failure and hypotension admitted to our hospital in recent years into two treatment groups. The study aims to investigate and compare the efficacy of specific treatment regimens to develop optimized therapeutic strategies for this patient population.

2. Data and Methods

2.1. General Information

Recombinant human brain natriuretic peptide (rhBNP) is a synthetic polypeptide drug primarily utilized for treating acute heart failure. Like endogenous human brain natriuretic peptide, rhBNP exerts its pharmacological effects by binding to specific receptors on cardiomyocytes. This binding facilitates its mechanism of action, which is crucial in managing heart failure. This paper aims to investigate the impact of administering rhBNP in patients with heart failure, specifically those who also suffer from hypotension. The patients in the 2 groups met the diagnostic criteria of heart failure and hypotension, and the patients voluntarily volunteered to join the investigation; the hospital approved the study; excluded the patients with malignant

tumor, severe mental disorders or cognitive impairment, vital organ dysfunction, rheumatic heart disease, hypertrophic heart disease and incomplete data. Clinical baseline data of the enrolled patients on age, sex, disease duration and cardiac function grade, the difference was not significant and could be compared ($P > 0.05$).

2.2. Methods

1) Patients in the control group chose dopamine for treatment. First, the primary disease of the patients was treated, after removing the inducement, their daily diet and water intake were scientifically controlled, oxygen support and appropriate diuretics were given, and intravenous dopamine was injected at a dose of 2 - 5 μg/kg [2] [3] per minute.

2) Patients in the observation group were treated with recombinant human brain natriuretic peptide. 1.5 μg/kg recombinant human brain natriuretic peptide was injected IV, followed by 0.0075 μg/kg per minute for 72 h, after which dopamine was pumped continuously, and the treatment regimen was that with the control group. If the patient continues hypotension, reduce the diuretic dosage and adjust the dopamine dosage to 10 μg/kg per minute. If the patient's blood pressure rises, decrease as appropriate; if the patient's heart rate is >100 beats/min, give 0.2 - 0.4 mg for [4] [5] [6].

2.3. Observed Indicators

1) The effect of treatment is determined according to the symptoms of the two groups. If the patient's heart failure symptoms such as dyspnea, limited physical activity and fluid retention disappear, the cure is confirmed; if the heart failure symptoms such as dyspnea, limited physical activity and fluid retention are reduced, the improvement is confirmed; if the patient's condition does not change or worsen, it is ineffective. Total response rate = 100% − (invalid cases/100% total).

2) The cardiac function of the two groups was examined, and the LVEF (left ventricular ejection fraction), CO (cardiac output), LVEDD (left ventricular end-diastolic diameter), SV (per volume), LVMI (left ventricular weight index), E/A (peak E/A peak ratio) were recorded.

3) BNP (brain natriuretic peptide) and ANP (atrial natriuretic factor) levels were assessed via radioimmunoassay before and after treatment, while urine volume was recorded over 24 hours.

2.4. Statistical analysis

Study data were analyzed and processed according to SPSS23.0 software package. Measurement data between groups ($x \pm s$), t, count data (%), and χ^2. The detection difference was $P < 0.05$, which was statistically significant.

3. Results

3.1. Compare the Treatment Effect of the 2 Groups

The total response rate of patients in the observation and control groups was

94.74% and 73.68%, which was significantly higher than that in the observation group (P < 0.05); see Table 1.

3.2. Compare the Cardiac Function Indicators in the 2 Groups

Compared with the indexes of cardiac function in group 2, the index levels of the observation group were better than those of the control group (P < 0.05); see Table 2.

3.3. Compare the Vasoactive Substance Level and Urine Volume in the 2 Groups

BNP, ANP and urine volume from the two groups were not statistically significant (P > 0.05); after treatment, BNP, ANP and urine volume from the control group (P < 0.05); see Table 3.

Table 1. Comparison of effects of treatment in group 1 2 [n (%)].

Group	Number of cases (n)	Cure	Improve	Ineffective	Total effective rate
Observation (n)	38	25 (65.79)	11 (28.95)	2 (5.26)	36 (94.74)
Matched (n)	38	20 (52.63)	8 (21.05)	10 (26.32)	28 (73.68)
χ^2 value					7.167
P value					<0.05

Table 2. 2 Comparison of cardiac function indicators (x ± s).

Group	Number of cases (n)	LVEF (%)	CO (L/min)	LVEDD (mm)	SV (ml/ci)	LVMI (g/m^2)	E/A
Observation (n)	38	56.11 ± 3.19	5.66 ± 0.34	47.31 ± 2.24	70.59 ± 2.76	113.99 ± 14.02	1.09 ± 0.22
Matched (n)	38	50.59 ± 2.54	4.52 ± 0.28	51.43 ± 1.88	54.87 ± 2.54	128.01 ± 13.98	0.82 ± 0.17
t value		4.879	4.986	5.084	5.125	4.969	4.927
P value		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Table 3. 2 Comparison of vasoactive substance levels and urine volume (x ± s).

Group	Number of cases (n)	BNP (pg/ml)		ANP (nmol/L)		Urine volume (ml/24h)	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Observation (n)	38	435.97 ± 27.02	216.96 ± 19.04	1.22 ± 0.18	0.66 ± 0.15	1204.03 ± 114.99	2146.99 ± 165.04
Matched (n)	38	420.02 ± 37.99	323.11 ± 21.09	1.19 ± 0.25	0.94 ± 0.22	1238.98 ± 100.05	1651.12 ± 128.83
t value		0.817	5.008	1.126	4.997	0.589	5.082
P value		>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

4. Discussion

When the patient is in the end stage of heart failure, the patient's heart cavity structure is expanded, the heart ejection capacity is reduced, easy to combine with hypotension, and the body cannot produce sufficient natriuretic peptide to compensate, resulting in the significant increase of ventricular filling pressure, and then causes water and sodium retention, posing a serious threat to the patient's life and health.

Clinical studies have demonstrated that brain natriuretic peptide (BNP) is a peptide hormone secreted by ventricular cells, which exerts diuretic and natriuretic effects and shows a significant increase during heart failure, closely correlating with the severity of the condition in patients [7]. Recombinant human brain natriuretic peptide, an analogue of the endogenous hormone, acts as an antagonist to the renin-angiotensin-aldosterone system. It functions by dilating blood vessels, enhancing perfusion to the heart and kidneys, and inhibiting tubular sodium absorption. These actions help prevent water and sodium retention in patients, thereby alleviating the symptoms of heart failure. Additionally, recombinant BNP demonstrates a superior tolerance profile and offers a faster onset of efficacy compared to dopamine drugs, rendering it more effective in achieving ideal antihypertensive effects and improving cardiac function in patients.

Recombinant human brain natriuretic peptide originated from its endogenous brain natriuretic peptide, similar in amino acid spatial structure, arrangement, and biological activity, can reduce its heart load, reduce peripheral resistance, produce the effect of antihypertensive and increase heart displacement, its diuretic sodium discharge effect is good [8].

5. Conclusion

In conclusion, the clinical application of recombinant human brain natriuretic peptide (rhBNP) has demonstrated the most significant effect in the treatment of heart failure patients with hypotension. This treatment provides substantial relief of clinical symptoms and promotes the improvement of cardiac function. Therefore, rhBNP is highly recommended for widespread adoption in clinical practice.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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