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Clinical Value of rhBNP in the Treatment of Patients with Stanford Type B Aortic Dissection

Gang Li*, Weidong Fan, Yanyan Sun, Jie Han, Huina Wei, Jia Lu

Cardiology Department of Henan Provincial Chest Hospital, Zhengzhou 450000, Henan Province, China

***Corresponding author:** Gang Li, 642773122@qq.com

Abstract: *Objective:* To determine the clinical value of rhBNP in the treatment of patients with Stanford type B aortic dissection. *Methods:* From June 2018 to October 2021, 162 patients with Stanford type B aortic dissection were selected from the Cardiology Department of Henan Provincial Chest Hospital and randomly divided into two groups: control group (81 patients) and observation group (81 patients). The patients in the control group were treated with conventional therapy. On the basis of the control group, the patients in the observation group were treated with rhBNP. The cardiac function, renal function, pulmonary function, and inflammatory indices before and after treatment for 72 hours, as well as the incidence of adverse reactions between the two groups were compared. *Results:* After treatment, the cardiac function (LVEF and NT-pro BNP), renal function (urine output for 24 hours, S_{cr}, and Cys-C), pulmonary function (PaO_2, SPO_2, and PaO_2/FiO_2), and inflammatory (IL-6, hsCRP, and MCP-1) indices of the observation group improved significantly compared to those of the control group ($p < 0.05$). *Conclusion:* rhBNP can improve cardiac function, renal function, and pulmonary function, as well as alleviate inflammation in patients with Stanford type B aortic dissection. Hence, in the treatment of patients with Stanford type B aortic dissection, rhBNP provides multi-organ protection.

Keywords: rhBNP; Stanford type B aortic dissection; Multi-organ protection

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1. Introduction

Acute aortic dissection (AAD) is a vascular emergency with high mortality. This condition often progresses rapidly, of which Stanford type B aortic dissection accounts for about one-third of the cases. In the acute phase, patients may experience various conditions, such as hypoxemia, acute renal insufficiency, hypoalbuminemia, hypoxic encephalopathy, and even multiple organ dysfunction, all of which increase the risk of death and make it difficult for patients to overcome the acute stage safely [1]. Recombinant human brain natriuretic peptide (rhBNP) is a synthetic human BNP obtained from Escherichia coli by recombinant DNA technology. Previous studies have shown that recombinant human brain natriuretic peptide (rhBNP) has a significant effect on improving patients' cardiac function, renal function, and pulmonary ventilation, as well as reducing inflammatory response [2]. This study focuses on the therapeutic effect of rhBNP in patients with Stanford type B aortic dissection.

2. Subjects and methods

2.1. Research subjects

The research subjects comprised of 162 patients with Stanford type B aortic dissection, diagnosed by CTA of the aorta, under the Cardiology Department of Henan Provincial Chest Hospital from June 2018 to

October 2021; the onset time was within two weeks; there were 90 male patients and 72 female patients, age ranging from 35 to 76 years old, with an average age of 66.29 ± 6.10. The patients were divided into two groups based on the random number table method. In the observation group, there were 45 male patients and 36 female patients, age ranging from 43 to 75 years old, with an average age of 65.41 ± 5.88; in the control group, there were 43 male patients and 38 female patients, age ranging from 42 to 76 years old, with an average age of 67.31 ± 6.05. There was no significant difference in the basic data between the two groups ($p > 0.05$), as shown in **Table 1**.

Table 1. Comparison of patients' basic data in both the groups

Group	Number of cases	Gender		Age (years)	BMI (kg/m^2)	Hypertension	Smoking history	Renal insufficiency
		Male	Female					
Observation group	81	45	36	65.41 ± 5.88	26.35 ± 3.75	73	37	19
Control group	81	43	38	67.31 ± 6.05	25.67 ± 4.42	71	34	17

2.2. Treatment methods

Upon admission, the patients in both groups received conventional therapy, including oxygen therapy, bed rest, liquid diet, sedation, analgesia, blood pressure and heart rate control, circulation improvement, nutritional support, as well as other drug therapies. The patients in the observation group received rhBNP on this basis; the first loading dose was 1.5 μg/kg intravenously, and then 0.075 μg/kg/min was continuously pumped intravenously over 72 hours.

2.3. Observation indices

(1) Cardiac function indices: left ventricular ejection fraction (LVEF), left ventricular end diastolic diameter (LVEDD), and N-terminal pro-brain natriuretic peptide (NT-pro BNP). LVEF and LVEDD were detected by echocardiography, while NT-pro BNP was detected by immunoturbidimetry.

(2) Renal function indices: 24-hour urine volume (ml), serum creatinine (S_{cr}), and serum cystatin C (Cys-C). The concentrations of S_{cr} and Cys-C were detected by Roche Cobas C720 automatic biochemical analyzer.

(3) Pulmonary function indices: partial pressure oxygen (PaO_2), blood oxygen saturation (SPO_2), and oxygenation index (PaO_2/FiO_2).

(4) Inflammatory indices: IL-6 (serum interleukin-6), high-sensitivity C-reactive protein (hs-CRP), and monocyte chemoattractant protein-1 (MCP-1). IL-6 was measured by enzyme-linked immunosorbent assay (ELISA), hs-CRP was measured by rate scattering turbidimetry, while MCP-1 was determined by enzyme-linked immunosorbent assay (ELISA).

2.4. Statistical processing

SPSS 22.0 statistical software was used for data analysis. The measurement data were expressed by $\bar{x} \pm s$, the means of the two groups were compared by t-test, and the counting data of the two groups were tested using chi-square test. $p < 0.05$ shows statistical significance.

3. Results

3.1. Comparison of the changes in cardiac function indices between the two groups

There was no significant difference in the levels of LVEF, LVEDD, and NT-pro BNP between the two

groups before treatment ($p > 0.05$). After treatment, the LVEF and NT-pro BNP levels increased on average in both groups, but the NT-pro BNP level of the observation group was significantly higher than that of the control group ($p < 0.05$) (**Table 2**).

Table 2. Comparison of the changes in cardiac function indices between the two groups

Group	LVEF (%)		LVEDD (mm)		NT-pro BNP (pg/ml)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	53.4 ± 4.1*	62.3 ± 3.6&	43.6 ± 6.8*	43.7 ± 5.9	896.35 ± 5.67*	264.73 ± 6.42#&
Control group	53.6 ± 4.2	61.7 ± 4.3	44.1 ± 6.5	43.9 ± 6.1	889.68 ± 6.77	584.82 ± 8.56

*Compared with control group: $p > 0.05$; #compared with control group: $p < 0.05$; &compared with before treatment: $p < 0.05$

3.2. Comparison of the changes in renal function indices between the two groups

There was no significant difference in urine volume, S_{cr}, and Cys-C levels between the two groups 24 hours before treatment ($p > 0.05$). The 24-hour urine volume of the observation group was higher than that of the control group; in addition, the S_{cr} and Cys-C levels of the observation group were lower than those of the control group ($p < 0.05$). In the observation group, urine volume significantly increased 24 hours after treatment, while S_{cr} and CYS-C levels decreased significantly ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of the changes in renal function indices between the two groups

Group	24h urine volume (ml)		Scr (umol/ml)		Cys-C (mg/L)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	713 ± 132*	1043 ± 154#&	168 ± 56*	92 ± 9#&	3.6 ± 2.5*	1.5 ± 0.2#&
Control group	725 ± 166	797 ± 148	161 ± 63	147 ± 52	3.3 ± 1.9	3.1 ± 1.6

*Compared with control group: $p > 0.05$; #compared with control group: $p < 0.05$; &compared with before treatment: $p < 0.05$

3.3. Comparison of the changes in lung function indices between the two groups

There was no significant difference in PaO_2, SPO_2, and PaO_2/FiO_2 between the two groups 24 hours before treatment ($p > 0.05$). After treatment, the PaO_2, SPO_2, and PaO_2/FiO_2 of the observation group were significantly higher than those of the control group ($p < 0.05$). The PaO_2, SPO_2, and PaO_2/FiO_2 of the observation group significantly increased after treatment, in which the difference was statistically significant ($p < 0.05$), as shown in **Table 4**.

Table 4. Comparison of the changes in lung function indices between the two groups

Group	PaO_2 (mmHg)		SPO_2 (%)		PaO_2/FiO_2	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	76 ± 17*	132 ± 21#&	91 ± 4*	98 ± 2#&	189.45 ± 12.03*	360.37 ± 16.78#&
Control group	78 ± 15	86 ± 18	92 ± 3	93 ± 3	190.51 ± 11.46	285.07 ± 15.24

*Compared with control group: $p > 0.05$; #compared with control group: $p < 0.05$; &compared with before treatment: $p < 0.05$

3.4. Comparison of the changes in inflammatory indices between the two groups

There was no significant difference in serum IL-6, hsCRP, and MCP-1 levels between the two groups before treatment ($p > 0.05$). After treatment, the serum IL-6, hsCRP, and MCP-1 levels of the observation group were significantly lower than those of the control group ($p < 0.05$). After treatment, the three indices in the observation group were significantly lower than those before treatment ($p < 0.05$) (**Table 5**).

Table 5. Comparison of the changes in inflammatory indices between the two groups

Group	IL-6 (pg/ml)		hsCRP (ng/ml)		MCP-1 (pg/ml)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	169 ± 48*	106 ± 37$^{\#\&}$	13.1 ± 8.4*	4.2 ± 1.9$^{\#\&}$	310 ± 93*	175 ± 57$^{\#\&}$
Control group	167 ± 53	161 ± 49	12.8 ± 6.7	11.5 ± 2.6	309 ± 86	283 ± 74

*Compared with control group: $p > 0.05$; $^{\#}$compared with control group: $p < 0.05$; $^{\&}$compared with before treatment: $p < 0.05$

4. Discussion

With the advancement and refinement of clinical diagnosis and treatment methods, the therapeutic effect of acute aortic dissection has improved significantly. However, patients with acute aortic dissection are still prone to developing various conditions involving multiple organs, including acute heart failure, hypoxemia, acute renal insufficiency, hypoproteinemia, hypoxic encephalopathy, multiple organ dysfunction, and other serious complications [3]. Clinically, based on the principles of controlling blood pressure, heart rate, sedation, and pain relief, there is an urgent need for a drug that can protect these organs, stabilize patients over the acute stage, prevent serious complications, and improve the survival rate of patients [4].

The level of serum B-type brain natriuretic peptide (BNP) increases significantly with ventricular volume dilation and increased pressure load, and it acts as a vasodilator, diuretic, and natriuretic, thus reducing cardiac load before and after, as well as inhibiting the activation of the renin-angiotensin-aldosterone system (RAAS) [5]. Recombinant human brain natriuretic peptide (rhBNP) has the same 32 amino acid sequence, spatial structure, and biological activity as endogenous BNP [6]. Research at home and abroad has shown that rhBNP has significant curative effect on improving heart function, renal function, and lung ventilation, as well as reducing inflammatory response in patients [7,8]. Previous studies on rhBNP mostly focused on heart failure. There are surprisingly only a few reports on the use of rhBNP in aortic dissection considering that it is a cardiovascular emergency [9]. This study revealed that after treatment, the cardiac function (LVEF and NT-pro BNP), renal function (urine output for 24 hours, S_{cr}, and Cys-C), pulmonary function (PaO_2, SPO_2, and PaO_2/FiO_2), and inflammatory (IL-6, hsCRP, and MCP-1) indices of the observation group significantly improved compared to those of the control group ($p < 0.05$). These results suggest that rhBNP can also play a multi-organ protective role in the treatment of patients with Stanford type B aortic dissection, thus preventing serious complications from occurring as well as improving the survival and cure rate of patients.

In conclusion, rhBNP can improve the cardiac function, renal function, and pulmonary function, as well as alleviate inflammation in patients with Stanford type B aortic dissection. In the treatment of patients with Stanford type B aortic dissection, rhBNP can provide multi-organ protection. Therefore, rhBNP has good application prospect in the treatment of patients with Stanford type B acute aortic dissection. Due to the small sample size, the conclusion of this study needs to be further validated by larger clinical trials.

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Disclosure statement

The authors declare no conflict of interest.

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