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## Cardiovascular Reviews

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# Clinical Study on Self-Made Lixin Granules Combined with Natriuretic Peptide in the Treatment of Refractory Heart Failure

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**Abstract:** *Objective:* To analyze the clinical effects of the combined application of self-made Lixin Granule and natriuretic peptide in treating refractory heart failure. *Methods:* From January 2022 to June 2023, 40 patients with refractory heart failure were randomly divided into groups using the envelope method. A reference group ( $n = 20$ ) received conventional Western medicine treatment, while an observation group ( $n = 20$ ) received self-made Lixin Granules and natriuretic peptide. Clinical efficacy, heart failure scores, traditional Chinese medicine (TCM) syndrome scores, inspection indicators, and adverse reactions of the two groups were compared. *Results:* The effective treatment rate in the observation group was significantly higher than that in the reference group ( $P < 0.05$ ). There were no significant differences in heart failure scores and traditional Chinese medicine (TCM) syndrome scores between the two groups before treatment ( $P > 0.05$ ). However, both scores in the observation group were lower than those in the reference group after treatment ( $P < 0.05$ ). Before treatment, there were no significant differences in the inspection indicators between the two groups ( $P > 0.05$ ). After treatment, the left ventricular ejection fraction (LVEF) of the observation group was higher than that of the reference group, while the N-terminal pro b-type natriuretic peptide (NT-proBNP) level and fractional shortening (FS) of the observation group were lower than those of the reference group ( $P < 0.05$ ). There were no apparent adverse reactions in either group during treatment. *Conclusion:* The combined application of self-made Lixin Granules and natriuretic peptide in treating refractory heart failure improved clinical efficacy, alleviation of clinical symptoms, and enhanced cardiac function. This approach is deemed safe and holds high application value.

**Keywords:** Self-made Lixin Granules; Natriuretic peptide; Refractory heart failure; Clinical efficacy

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## 1. Introduction

Chronic heart failure has persistently posed clinical challenges, remaining a refractory disease. Despite the application of neuroendocrine blockers and the continuous progress in medical technology and concepts over the past few decades, the mortality rate of this disease has decreased. However, the 5-year mortality rate following its onset remains high, ranging from 60% to 80%, akin to that of malignant tumors. It stands as one

of the most severe cardiovascular diseases <sup>[1,2]</sup>.

Refractory heart failure denotes patients whose clinical symptoms persist uncontrollably or worsen despite routine treatment interventions. Natriuretic peptide, a lyophilized recombinant human brain natriuretic peptide, has been substantiated by studies to expand blood vessels, induce diuresis, and significantly impact anti-heart failure measures <sup>[3,4]</sup>. According to traditional Chinese medicine (TCM), heart failure results from heart qi deficiency. Lixin Granule, a self-made prescription fostering blood circulation, eliminating blood stasis, and promoting yang warmth and diuresis, is believed to alleviate refractory heart failure symptoms. A group of 40 patients with refractory heart failure admitted to Gaoyou Hospital of Traditional Chinese Medicine from January 2022 to June 2023 were observed in this study.

## 2. Materials and methods

### 2.1. General information

This study was conducted from January 2022 to June 2023, encompassing 40 subjects, all of whom were refractory heart failure patients admitted to Gaoyou Hospital of Traditional Chinese Medicine within this period. There were ten male and ten female patients in the reference group, with their age ranged from 63 to 81 years and an average of  $72.29 \pm 4.35$  years. The primary diseases included nine patients with coronary heart disease, six with dilated cardiomyopathy, three with high heart disease, and two with rheumatic heart disease. There were twelve male and eight female patients in the observation group, with their age ranged from 62 to 83 years and an average of  $72.96 \pm 4.47$  years. The primary disease included eight patients with coronary heart disease, six with dilated cardiomyopathy, three with high heart disease, and three with rheumatic heart disease. The baseline data of both patient groups were balanced and comparable ( $P > 0.05$ ).

Inclusion criteria included all patients who met the diagnostic criteria for refractory heart failure, utilizing sufficient doses of diuretics, aldosterone antagonists, angiotensin-converting enzyme receptor antagonists/inhibitors, and beta-receptor blockers, symptoms persisted despite routine heart failure treatment, and all volunteered and signed the consent form.

Exclusion criteria included patients with severe heart valve disease, cerebral infarction or cerebral hemorrhage within the last six months, acute coronary syndrome within the last three months, co-infection, malignant tumor, autoimmune system diseases, recent major trauma or surgery history, hepatic and renal insufficiency, thyroid disease, uncorrected electrolyte imbalance, atrial fibrillation with a permanent pacemaker or a history of blood embolism within the past six months, pulmonary heart disease, and allergy to any drug component in the treatment plan.

### 2.2. Diagnostic criteria

The diagnostic criteria for chronic heart failure outlined in the “Guidelines for the Diagnosis and Treatment of Chronic Heart Failure” (2014 edition) were followed <sup>[5]</sup>: in addition to the original heart disease-related symptoms, dyspnea, decreased activity tolerance, chest tightness, and wheezing gradually appeared. The situation was confirmed by echocardiography, and the cardiac function was analyzed using the New York Heart Association (NYHA) criteria.

Additionally, TCM diagnostic criteria from the “Guiding Principles for Clinical Research of New Drugs of Traditional Chinese Medicine (Trial)” on Qi and Yang Deficiency and Water-damp Internal Stop Syndrome were considered <sup>[6]</sup>: main symptoms included palpitations, shortness of breath, face/limb edema, chest tightness, chest pain, fear of cold, cold limbs, lack of urination; secondary symptoms included abdominal fullness, spontaneous sweating, irritability; tongue examination revealed white and greasy tongue coating, dark red/dull

tongue; pulse examination revealed thready and rapid pulse or intermittent pulse.

### 2.3. Methods

The reference group was treated with conventional Western medicine according to the “Guidelines for the Diagnosis and Treatment of Chronic Heart Failure” (2014 edition). The observation group received self-made Lixin Granules and natriuretic peptide (Chengdu Nuodikang Bio-Pharmaceutical Co., Ltd., S20050033) in addition to routine Western medicine treatment. The initial treatment amount was 1.5 µg/kg, adjustable to 0.075 µg/kg, and continued for three days. The full prescription of self-made Lixin Granules included 30 g of *Astragalus membranaceus*, 30 g of motherwort, 15 g of polygonatum, 12 g of psoralea, and 12 g of descurainia seed. Self-made Lixin Granules were taken once a day, one bag each time, for 14 days as a course of treatment, with continuous treatment for three courses.

### 2.4. Observation indicators

- (1) Clinical efficacy comparison: Evaluated based on criteria. Edema resolution, liver size reduction (> 2 cm), disappearance of jugular venous distension, complete or significantly weakened pulmonary moist rales, dyspnea disappearance, and improved heart function (Grade 2 or above) as markedly effective. Edema subsidence, liver shrinkage (≤ 2 cm), relief of jugular venous distension, reduced lung moist rales, improved dyspnea, tolerable side effects, and improved heart function (Grades 1–2) as effective; No improvement in heart function of clinical-related symptoms as ineffective. The effective rate of treatment was calculated as  $100.00\% - (\text{number of ineffective cases} / 20 \times 100.00\%)$ .
- (2) Heart failure points and TCM syndrome points comparison: Assessed using Lee’s treatment integral method (1982). Higher heart failure and TCM syndrome scores indicated more severe heart failure<sup>[6]</sup>.
- (3) Relevant inspection indicators comparison: N-terminal pro-b-type natriuretic peptide (NT-proBNP) detection using an automatic fluorescent immunoassay analyzer, and echocardiography for left ventricular ejection fraction (LVEF) and left ventricular fractional shortening (FS).
- (4) Incidence of adverse reactions comparison.

### 2.5. Statistical methods

Data were processed using SPSS 24.0 statistical software. Descriptive statistics included [*n* (%)] for clinical curative effect and adverse reaction incidence, while heart failure score, TCM syndrome score, and heart function indexes were presented as mean ± standard deviation (SD). Group comparisons were conducted using *t*-tests and  $\chi^2$  tests, with  $P < 0.05$  considered statistically significant.

## 3. Results

### 3.1. Comparison of clinical efficacy

The treatment’s effective rate was 90.00% (18/20) in the observation group, with 60.00% (12/20) markedly effective, 30.00% (6/20) effective, and 10.00% (2/20) ineffective. In the reference group, the effective rate was 55.00% (11/20), including 25.00% (5/20) markedly effective, 30.00% (6/20) effective, and 45.00% (9/20) ineffective. The treatment efficiency in the observation group was significantly higher ( $P = 0.033$ ,  $\chi^2 = 4.514$ ).

### 3.2. Comparison of heart failure points and TCM syndrome points.

Before treatment, no significant difference existed in heart failure and TCM syndrome scores between the two groups ( $P > 0.05$ ). After treatment, both scores in the observation group were significantly lower than those of

the reference group ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of heart failure and TCM syndrome scores before and after treatment (mean  $\pm$  SD, points)

Group	Heart failure score		TCM Syndrome Points	
	Before	After	Before	After
Reference group ( $n = 20$ )	12.51 $\pm$ 1.49	7.84 $\pm$ 1.23*	29.45 $\pm$ 3.94	15.38 $\pm$ 4.32*
Observation group ( $n = 20$ )	12.63 $\pm$ 1.67	4.79 $\pm$ 1.65*	29.61 $\pm$ 4.14	8.09 $\pm$ 3.68*
<i>t</i>	0.239	6.627	0.125	5.744
<i>P</i>	0.811	< 0.001	0.901	< 0.001

\*  $P < 0.05$  compared with the group before treatment

### 3.3. Comparison of relevant inspection indicators

Prior to treatment, no significant differences were found in NT-proBNP, LVEF, and FS between the two groups ( $P > 0.05$ ). Post-treatment, NT-proBNP and FS in the observation group were lower than those in the reference group, and LVEF was higher than that in the reference group ( $P < 0.05$ ), as indicated in **Table 2**.

**Table 2.** Comparison of relevant inspection indicators before and after treatment (mean  $\pm$  SD)

Group	NT-proBNP (pg/mL)		LVEF (%)		FS (%)	
	Before	After	Before	After	Before	After
Reference group ( $n = 20$ )	8,670.75 $\pm$ 125.34	6,214.54 $\pm$ 107.63*	28.89 $\pm$ 3.16	33.47 $\pm$ 3.53*	23.44 $\pm$ 2.61	26.73 $\pm$ 2.12*
Observation group ( $n = 20$ )	8,683.62 $\pm$ 126.51	3,213.79 $\pm$ 112.58*	28.31 $\pm$ 3.33	42.69 $\pm$ 2.85*	23.39 $\pm$ 2.58	28.48 $\pm$ 2.31*
<i>t</i>	0.323	86.161	0.565	9.088	0.060	2.496
<i>P</i>	0.748	< 0.001	0.575	< 0.001	0.951	0.017

\*  $P < 0.05$  compared with the group before treatment

### 3.4. Comparing the incidence of adverse reactions

No apparent adverse reactions were observed in either group during the treatment.

## 4. Discussion

With the aging of the population, the incidence of chronic diseases, such as hypertension, diabetes, and coronary heart disease, is on the rise. Consequently, the occurrence of heart failure is increasing, turning it into a significant ailment that poses a serious threat to human health and life safety, burdening patient's families and society. It has become a global public health concern [7].

Heart failure is characterized by the excessive activation of the renin-angiotensin system, sympathetic nervous system, continuous decline in cardiac function, and ventricular remodeling. It represents an inevitable consequence of abnormal expression of cardiomyocyte genes [8,9]. Refractory heart failure refers to a state where heart failure symptoms persist despite the use of digitalis, diuretics, vasodilators, and other medications. At this juncture, the primary objective of treatment should be to alleviate clinical symptoms, reduce the risk of mortality, and lower readmission rates.

Natriuretic peptide emerges as a therapeutic agent capable of dilating arterioles and venules, reducing arterial blood pressure, pulmonary capillary wedge pressure, atrial pressure, and peripheral vascular resistance [10,11]. This leads to increased stroke output and cardiac output, effectively alleviating dyspnea and improving

hemodynamic status without causing reflexive heart rate acceleration. Additionally, it promotes sodium excretion and diuresis.

In line with traditional Chinese medicine, the pathogenesis of chronic heart failure involves heart-qi deficiency. A mild heart yang potential is at the root, while water stagnation is the visible manifestation. If left unaddressed, it can lead to liver and kidney deficiency and damage. Treatment, therefore, should emphasize promoting blood circulation, benefiting water, nourishing qi, and moistening yang<sup>[12,13]</sup>. The self-made Lixin Granule incorporates medicinal materials that aid qi and warm yang, coupled with restorative components promoting blood circulation and dredging collaterals to invigorate qi and enhance blood flow. This combination also fosters water reduction and swelling alleviation. The prescription includes polygonatum and *Radix astragali*, both invigorating qi, invigorating the spleen, promoting diuresis, and reducing swelling; psoralen for warming yang, transforming qi, and invigorating heart and kidney qi; descurainia seed for relieving asthma, lung alleviation, and diuresis; and motherwort for promoting blood circulation and diuresis. These ingredients collectively warm yang, induce diuresis, relieve asthma, purge lungs, promote blood circulation, remove blood stasis, and protect the heart.

The study results demonstrated that the addition of self-made Lixin Granules and natriuretic peptide to conventional Western medicine treatment significantly improved clinical efficacy, TCM syndromes, heart failure scores, heart function, and NT-proGNP compared to the reference group ( $P < 0.05$ ). This result suggesting the effectiveness and safety of this combined approach for refractory heart failure patients.

In conclusion, the combination of self-made Lixin Granules and natriuretic peptide in treating refractory heart failure exhibits substantial improvements in clinical efficacy, symptomatic relief, and safety.

## Disclosure statement

The authors declare no conflict of interest.

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# Research Progress on Dexmedetomidine Regulating Autophagy in the Treatment of Acute Lung Injury

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**Abstract:** Dexmedetomidine, extensively utilized as an intravenous anesthetic in anesthesia, intensive care units, and other related medical departments, exhibits significant anti-inflammatory effects while inducing sedation. Numerous studies have demonstrated its capability to regulate autophagy, thereby exerting potent anti-inflammatory effects and offering therapeutic benefits in the treatment of acute lung injury. This article comprehensively reviews the mechanisms underlying autophagy, the role of dexmedetomidine in autophagy regulation, and the protective effects it confers in the context of acute lung injury. By doing so, it contributes positively to the arsenal of strategies aimed at both preventing and treating acute lung injury.

**Keywords:** Dexmedetomidine; Acute lung injury; Autophagy

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## 1. Introduction

Acute lung injury (ALI) manifests as damage to alveolar epithelial cells and capillary endothelial cells, a consequence of severe pulmonary/extrapulmonary infections, shock, trauma, and various diseases. This damage leads to diffuse pulmonary interstitial and alveolar edema, potentially culminating in respiratory insufficiency or failure. In more severe cases, it can progress to acute respiratory distress syndrome (ARDS), marked by tachypnea, cyanosis, oxygen transport dysfunction, and diminished lung compliance <sup>[1]</sup>.

Current treatment modalities for ALI/ARDS encompass protective mechanical ventilation, drug therapy, Chinese herbal medicine, extracorporeal membrane oxygenation, and fluid management. Despite progress, a specific treatment approach for ALI/ARDS remains elusive. Even with available drugs, the associated mortality rate remains alarmingly high <sup>[2]</sup>.

Given this scenario, the exploration of effective treatments for ALI assumes paramount importance. This

article aims to contribute to this imperative task by examining the intricate landscape of ALI, shedding light on existing treatment methods, and emphasizing the pressing need for innovative and targeted interventions.

## **2. Autophagy and the role of autophagy in acute lung injury**

### **2.1. The definition and process of autophagy**

The term “autophagy,” derived from Greek, translates to “eating oneself,” encapsulating the concept of self-degradation. Autophagy represents a highly conserved cellular process, crucial for cell survival and the maintenance of the internal environment. This process involves the degradation of aging organelles, denatured proteins, and various macromolecular substances, coupled with the recycling of resulting decomposition products<sup>[3]</sup>. Autophagy, therefore, stands as a fundamental mechanism contributing to cellular health and the preservation of the internal milieu.

### **2.2. Signal transduction pathways related to autophagy**

The mammalian target of rapamycin (mTOR) kinase stands out as a crucial regulatory molecule for initiating autophagy. Pathways activating mTOR, such as the mitogen-activated protein kinase (MAPK)/extracellular signal-regulated kinases 1 and 2 (ERK1/2) and phosphoinositide-3-kinase (PI3K)/protein kinase B (Akt) pathways, act as inhibitors of autophagy. Conversely, negative regulation of mTOR, facilitated by pathways such as AMP-activated protein kinase (AMPK) and tumor protein p53, promotes autophagy. For instance, growth factors can activate the PI3K/Akt pathway, subsequently activating mTOR and inhibiting autophagy.

The core protein unc-51-like kinase (ULK), endowed with serine/threonine kinase activity, forms the ULK1 serine/threonine kinase complex [comprising ULK1, scaffolding subunit FAK family kinase-interacting protein of 200 kD (FIP200), bridging subunit Atg13, and Atg101]. ULK1 catalyzes the phosphorylation of various downstream factors, playing a pivotal role in autophagy initiation. AMPK and mTOR catalyze ULK1 phosphorylation; when the body faces energy insufficiency, activated AMPK promotes ULK1 phosphorylation, thereby stimulating autophagy. Activated ULK1, in turn, recruits the PI3K class III complex (comprising Beclin-1, Atg14, phosphatidylinositol 3-kinase Vps34, and serine/threonine-protein kinase Vps15), perpetuating autophagy induction<sup>[4]</sup>.

Autophagosome formation, a critical autophagy step, involves distinct phases such as formation, nucleation, elongation, and isolation membrane closure. Autophagy-related genes (Atg) are evolutionarily conserved and are indispensable for autophagosome formation, contributing significantly to autophagy-related signal transduction pathways. Atg9A-containing vesicles supply the membrane structure for autophagosomes, and the extension and completion of the autophagosome membrane involve two ubiquitin-like protein binding systems: firstly, Atg12 binding to Atg5 and Atg16L1, promoting LC3 lipidation by phosphatidylethanolamine (PE); secondly, Atg4B-mediated microtubule-associated protein 1A/1B-light chain 3 (LC3) processing, forming LC3-I, which binds with PE on the membrane to generate LC3-II. This structure adheres to the autophagosome membrane and collaborates with autophagic vesicles, crucially participating in autophagy initiation<sup>[5]</sup>.

PTEN-induced kinase 1 (PINK1), a serine/threonine kinase, with its kinase activity and structural integrity prerequisites, triggers the translocation of E3 ubiquitin ligase Parkin to damaged mitochondria, inducing mitophagy. In response to mitochondrial damage, PINK1 accumulates in the outer membrane, activating and recruiting Parkin. This culminates in Parkin ubiquitin modification of outer membrane proteins, subsequently binding to microtubule-related proteins. This binding process packages affected proteins into autophagosomes, facilitating their combination with lysosomes for the degradation and clearance of damaged mitochondria.

### 2.3. The role of autophagy in ALI: influencing factors and mechanisms

Autophagy's involvement in ALI is multifaceted, triggered by diverse factors encompassing infectious elements like bacteria and viruses, along with non-infectious contributors such as toxic gas inhalation, extensive blood transfusions, and acute pancreatitis. Autophagy, as a contributing mechanism to ALI, exhibits a dual nature. On one hand, it serves a protective function by clearing harmful inflammatory factors from the body, consequently mitigating lung damage. Conversely, autophagy can induce apoptosis, thereby intensifying lung injury. Insufficient, diminished, or excessive autophagy all contribute to the exacerbation of lung tissue damage<sup>[6]</sup>.

In a *Pseudomonas aeruginosa* infection model, CoB1, a novel cochlioquinone B derivative, disrupts the Akt/mTOR pathway by facilitating ubiquitination-mediated degradation of serine/threonine-protein kinase PAK1. This process activates autophagy following CoB1 treatment, resulting in increased mouse survival rates and reduced inflammatory factors. This evidence establishes that autophagy induction holds the potential to diminish lung injury. In a lipopolysaccharide (LPS)-induced acute lung injury model, LPS activation of mTOR reduces autophagy in mouse airway epithelial cells. Contrarily, LC3B, an autophagy protein in human bronchial epithelial cells, experiences reduced autophagy, aggravating the inflammatory response in lung tissue. The inhibition of the mTOR pathway significantly diminishes endotoxin-induced ALI, providing substantial proof that augmenting autophagy is advantageous in reducing ALI.

### 3. Mechanism of dexmedetomidine in regulating autophagy and its protective effect on ACI

Dexmedetomidine (DEX), a highly selective alpha<sub>2</sub> adrenergic receptor agonist, holds broad applications in clinical anesthesia, intensive care units, and other medical domains. Autophagy, recognized as an adaptive catabolic process, has garnered attention due to mounting evidence illustrating DEX's significant protective effects on various organs. Autophagy plays a pivotal role in mitigating organ damage under DEX treatment by influencing diverse signaling pathways and their downstream molecules, such as toll-like receptor 4 (TLR-4), myeloid differentiation primary response 88 (Myd88), nuclear factor- $\kappa$ B (NF- $\kappa$ B), among others. This inhibition results in the suppression of pro-inflammatory factor release, manifesting in anti-inflammatory effects and effective ALI treatment.

In a rat model of lung injury induced by hemorrhagic shock, DEX treatment markedly ameliorated lung tissue congestion, edema, inflammation, and bleeding. Concurrently, the expression of autophagy proteins, including LC3, Beclin-1, and Atg12-Atg5 conjugates, exhibited significant increases, while the expression level of multifunctional protein p62 significantly decreased. When the autophagy inhibitor chloroquine (CQ) was combined with DEX, the protective effect on lung histopathology weakened. Beclin-1 expression was affected and decreased, Atg12-Atg5 conjugate expression was lower compared to the DEX group, and p62 expression was higher<sup>[7]</sup>. CQ was also found to block autophagosomes and lysates in the final stage of autophagy. This underscores the positive correlation between DEX's protective effect on the lungs and autophagy.

In acute myocardial ischemia/reperfusion (MIR) injury, DEX demonstrated its efficacy by upregulating PINK1 transcription to enhance mitophagy. Through the alpha<sub>2</sub> adrenergic receptor, it inhibited the PI3K/Akt/mTOR pathway, thereby increasing the transcription and translation of LC3 and Beclin-1. This led to the restoration of autophagy, reduction in oxidative stress, and mitigation of apoptosis in LPS-induced acute kidney injury. In LPS-induced ALI, DEX exhibited protective effects by potentially mediating TLR-4/NF- $\kappa$ B and PI3K/Akt/mTOR pathways through high mobility group box-1 protein (HMGB1), a potential upstream regulator of TLR-4. Additionally, in subarachnoid hemorrhage (SAH)-induced extracerebral organ dysfunction, DEX treatment reduced autophagic flux and TLR-dependent inflammatory pathways, alleviating subarachnoid ALI

caused by intracavitary hemorrhage. In a ventilator-associated lung injury (VILI) model, DEX pretreatment significantly reduced Bcl-2 homologous antagonist/killer (Bak)/B-cell lymphoma 2 (Bcl-2) ratio, caspase-3 expression levels, epithelial cell death, and inflammatory factor release. This protective effect was associated with the activation of the ERK1/2 signaling pathway, as evidenced by increased phosphorylated ERK1/2 expression. The study suggested that DEX protects alveolar epithelial cells by activating the ERK1/2 signaling pathway, thus mitigating ventilator-induced lung injury<sup>[8]</sup>.

#### 4. Summary

In brief, dexmedetomidine demonstrates the ability to alleviate acute lung injury stemming from diverse factors through various mechanisms. While numerous current studies underscore dexmedetomidine's efficacy in treating acute lung injury by modulating autophagy, it is noteworthy that the majority of these findings are derived from animal experiments and cellular studies. The specific mechanism remains largely unexplored. Future research endeavors will delve into the intricate details of how dexmedetomidine precisely influences autophagy and its integral role in mitigating organ damage.

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The authors declare no conflict of interest.

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# Vascular Access Blood Purification Treatments in Chronic Renal Failure: Impact on Quality of Life

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**Abstract:** *Objective:* To observe the effects of blood purification treatment and assess the prognostic impact of different vascular pathways on patients with chronic renal failure (CRF). *Methods:* A retrospective analysis of clinical data was conducted on 68 CRF cases, categorizing them based on their choice of blood purification vascular access. Group A received an autologous arteriovenous fistula, Group B received an internal jugular vein tunneled polyester sleeve catheter, and Group C received a polytetrafluoroethylene graft vascular fistula. Clinically relevant observation indicators, complication rates, and quality of life scores among the three groups were compared. *Results:* No significant differences were found between the three groups regarding observed values of clinically relevant indicators and quality of life scores ( $P > 0.05$ ). When comparing thromboembolism rates Group A had the highest rate, followed by Group C and Group B; for infection rate comparison, Group C had the highest rate, followed by Group B and Group A ( $P < 0.05$ ). *Conclusion:* In comparison with the other two vascular access methods, although autologous arteriovenous fistula poses a higher risk of thromboembolism, it exhibits a lower infection rate. Therefore, it is recommended as the preferred vascular access form for blood purification in patients with CRF. If this approach is unavailable, careful consideration should be given. The use of an internal jugular vein with a tunneled polyester sleeve catheter is suggested to better ensure the effectiveness and safety of the patient's treatment.

**Keywords:** Different vascular pathways; Blood purification; Chronic renal failure; Quality of life

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## 1. Introduction

Chronic renal failure (CRF) is a globally recognized disease characterized by severe chronic damage to the renal parenchyma. Besides kidney transplantation, blood purification treatment stands out as the most cost-effective therapeutic option. However, its success hinges on the establishment of optimal vascular access to achieve satisfactory treatment outcomes<sup>[1]</sup>. In the contemporary medical landscape, CRF patients have three primary clinical choices for blood purification vascular access. The most prevalent option is the use of autologous arteriovenous fistulas, followed by semi-permanent internal jugular vein tunneled polyester sleeve

catheters, and polytetrafluoroethylene grafts. Each of these grafting vascular fistulas has its unique indications, advantages, and disadvantages<sup>[2]</sup>. This article concentrates on a comparative analysis of these three vascular accesses, aiming to identify the most suitable option for CRF patients to enhance the efficiency of blood purification treatment.

## 2. Materials and methods

### 2.1. General information

A retrospective analysis was conducted on the clinical data of 68 patients with CRFs admitted to the Xinghua City People's Hospital between February 2021 and August 2022. Patients were categorized based on their chosen vascular access into three groups: A, B, and C.

Group A comprised 22 cases, including 14 males and 8 females, with ages ranging from 38 to 66 years old (average age:  $52.51 \pm 9.14$  years). Group B consisted of 23 cases, with 12 males and 11 females, aged between 39 and 68 years (average age:  $52.89 \pm 9.19$  years). Group C included 23 cases, with 13 males and 10 females, aged 38 to 67 years (average age:  $52.74 \pm 9.17$  years). No significant differences were found in the normative comparison of data across the three groups ( $P > 0.05$ ).

Inclusion criteria:

- (1) Patients meeting the relevant diagnostic criteria for CRF in "Internal Medicine"<sup>[3]</sup>.
- (2) Patients meeting the relevant indications for blood purification, with a treatment duration  $> 4$  months and frequency  $> 3$  times a week.
- (3) Medical records without omissions.
- (4) Patients with no previous history of cognitive, psychological, or psychiatric diseases.
- (5) Informed and consenting patients who have signed relevant documents.

Exclusion criteria:

- (1) Patients with severe dysfunction of other vital organs.
- (2) Patients with renal failure cause by infection or trauma.
- (3) Patients with malignant tumors.
- (4) Patients with coagulation disorders and immune system diseases.
- (5) Patients with a history of cardiovascular disease or surgery.
- (6) Patients with severe malnutrition.
- (7) Patients with contraindications related to hemodialysis treatment.
- (8) Patients with extremely low medical compliance behavior.
- (9) Patients who dropped out of the study midway.

### 2.2. Method

Upon admission, each group selected different vascular accesses, yet all received treatment with the B. Braun 710200T hemodialysis machine (registration certificate number: National Machinery Injection 20173100590) and a polysulfone membrane dialyzer, using low molecular weight heparin sodium for anticoagulation. Blood flow was controlled at 200–280 mL/min, and the dialysate flow rate was set to 500 mL/min. The total dialysis duration was approximately four hours, three times a week, spanning over a year.

In the event of catheter infection in any of the three groups, immediate drug sensitivity tests were conducted, and appropriate broad-spectrum antibacterial drugs were administered. Patient medication status was closely monitored, and catheter removal was performed if there was no significant change in body temperature. In cases of insufficient arterial blood flow or thrombus, prompt urokinase application for thrombolysis

and removal of the dissolved blood clot after sealing the tube for 30 minutes were undertaken to prevent exacerbation of the condition.

Group A: For blood purification treatment, autologous arteriovenous fistula was chosen as the vascular access. This involved performing an autologous arteriovenous fistula anastomosis on the patient. A preoperative assessment of the patient's vascular conditions was conducted to confirm that surgical indications were met. During the operation, a transverse incision about 3 cm above the patient's wrist joint was made, freeing and anastomosing the cephalic vein and radial artery. Evaluation of arteriovenous fistula maturity was carried out 8–12 weeks post-operation, following the “Chinese Expert Consensus on Vascular Access for Hemodialysis (2nd Edition)”<sup>[4]</sup>. If the examination reveals that the anastomotic tremor is good, the fistula segment veins are straight, superficial, and even in thickness, easy to puncture, the fistula blood vessel wall has good elasticity, and the measured natural blood flow exceeds 500 mL/min, the inner diameter of the punctured vein is 25 mm and the depth from the skin is less than 6 mm, it indicates that the arteriovenous fistula meets the mature standards and blood purification treatment may be initiated.

Group B: Vascular access involved using an internal jugular vein tunneled polyester sleeve catheter, with the right internal jugular vein as the preferred site. Before catheter placement, identification of the patient's superior vena cava, right atrium, and other locations was done through chest X-ray. A subcutaneous tunnel and Seldinger technique were established in the operating room for Mahurkar catheter (Quinton Company) placement. The Maxid 14.5Fr<sub>x</sub> 36 cm double-lumen semi-permanent hemodialysis catheter with a polyester sheath was left in place, sealed with heparin saline, and a sterile dressing was applied. A post-operative chest X-ray confirmed the catheter tip's position (above the right atrium's opening), and blood purification treatment commenced on the second-day post-surgery.

Group C: Polytetrafluoroethylene graft vascular fistula was chosen as the vascular access, utilizing a polytetrafluoroethylene artificial blood vessel for a “U-shaped” anastomosis with the basilic vein and radial artery (anastomosis diameter 6 mm).

### 2.3. Observation indicators

- (1) Clinically relevant observation indicators: Following the blood purification treatments in the three groups, 4 mL of fasting venous blood was drawn to collect triglycerides (TG), total cholesterol (TC), hemoglobin (Hb), plasma albumin (ALB), C-reactive protein (CRP), blood urea nitrogen (BUN), urea reduction ratio (URR), and urea clearance index (Kt/V). The calculation of Kt/V utilized the Daugirdas urea model formula, where  $\ln$  represents the natural logarithm,  $BUN_{post}$  is the ratio of BUN after dialysis to BUN before dialysis,  $t$  is the duration of dialysis,  $UF$  is the ultrafiltration volume, and  $W$  is the body weight.
- (2) Complication rate: A three-month follow-up of the three groups allowed for the calculation of thromboembolism and infection rates.
- (3) Quality of life: After a 3-month follow-up, the comprehensive Quality of Life Assessment Questionnaire-74 (GQOLI-74) was employed to scientifically evaluate the quality of life among the three groups. The questionnaire comprises four major dimensions with a total of 74 items. Each item utilizes a 5-level scoring method, with a maximum score of 100 points. A higher total score indicates a higher quality of life.

### 2.4. Statistics analysis

Utilizing SPSS 25.0 for Windows software as the statistical foundation, all obtained data are categorized by

nature. If the data falls under measurement data, it will be displayed as mean  $\pm$  standard deviation (SD), and a parallel *t*-test will be conducted. If it pertains to count data, it will be displayed as %, with the addition of the chi-squared test. A final *P* value below 0.05 indicates a statistically significant difference.

### 3. Results

#### 3.1. Comparison of clinically relevant observation indicators among three groups

**Table 1** reveals that, upon observing various clinical indicators in the three groups, there was no statistically significant difference between the groups ( $P > 0.05$ ).

**Table 1.** Comparison of clinically relevant indicator observation results (mean  $\pm$  SD)

	TG (mmol/L)	TC (mmol/L)	Hb (g/L)	ALB (g/L)
Group A ( <i>n</i> = 22)	1.72 $\pm$ 0.63	4.38 $\pm$ 2.05	105.62 $\pm$ 25.42	37.68 $\pm$ 8.52
Group B ( <i>n</i> = 23)	1.68 $\pm$ 0.59	4.34 $\pm$ 2.01	104.99 $\pm$ 24.96	37.38 $\pm$ 8.24
Group C ( <i>n</i> = 23)	1.61 $\pm$ 0.51	4.25 $\pm$ 1.97	105.05 $\pm$ 25.14	37.89 $\pm$ 8.85
<i>F</i>	0.558	0.123	0.052	0.245
<i>P</i>	0.569	0.864	0.946	0.769
	CRP (mg/L)	BUN (mmol/L)	URR (%)	Kt/V
Group A ( <i>n</i> = 22)	12.45 $\pm$ 5.51	6.24 $\pm$ 2.58	0.71 $\pm$ 0.29	1.66 $\pm$ 0.62
Group B ( <i>n</i> = 23)	12.64 $\pm$ 5.60	6.55 $\pm$ 2.62	0.76 $\pm$ 0.33	1.52 $\pm$ 0.57
Group C ( <i>n</i> = 23)	12.92 $\pm$ 5.89	6.75 $\pm$ 2.71	0.73 $\pm$ 0.31	1.45 $\pm$ 0.51
<i>F</i>	0.069	2.498	1.659	2.968
<i>P</i>	0.925	0.079	0.157	0.058

#### 3.2. Comparison of complication rates among the three groups

**Table 2** illustrates that, when comparing the thromboembolism rate and infection rate among the three groups, the difference between the groups was statistically significant ( $P < 0.05$ ).

**Table 2.** Comparison of thromboembolism rate and infection rate [*n* (%)]

	Thromboembolism rate	Infection rate
Group A ( <i>n</i> = 22)	6 (27.27)	0 (0.00)
Group B ( <i>n</i> = 23)	0 (0.00)	3 (13.04)
Group C ( <i>n</i> = 23)	4 (17.39)	6 (26.09)
$\chi^2$	6.868	6.665
<i>P</i>	0.032	0.036

#### 3.3. Comparison of quality of life among three groups

After observation, the GQOLI-74 scores of groups A, B, and C were 78.42  $\pm$  6.98 points, 76.46  $\pm$  6.24 points, and 72.54  $\pm$  5.69 points, respectively. The difference was not statistically significant when comparing between groups ( $F = 0.865$ ,  $P = 0.968$ ).

## 4. Discussion

As widely acknowledged, the fundamental role of the kidneys involves regulating water, electrolytes, and acid-base balance. The presence of CRF signifies an inability to sustain these essential kidney functions, leading to systemic metabolism disruptions. Disease progression induces varying degrees of functional damage across multiple systems, manifesting in clinical symptoms that, in severe cases, pose a direct threat to an individual's life safety<sup>[5]</sup>.

Given that CRF represents the most severe stage of renal insufficiency, relying solely on conventional drug treatments becomes impractical. Kidney transplantation stands as the optimal treatment, yet its limited blood sources, elevated treatment costs, and other constraints impede widespread adoption. Consequently, blood purification treatment emerges as a viable alternative, which is a cost-effective option with practical advantages, offering convenience and notable efficacy. This treatment swiftly eliminates harmful components and retains water in the patient's body, enhancing internal stability. However, a judicious selection of vascular access is imperative to ensure the efficacy and safety of blood purification treatment<sup>[6-7]</sup>.

**Table 1** in this article reveals no variance in clinically relevant indicators among the three groups, affirming the feasibility of all three vascular access types. However, Group A was found to exhibit a lower risk of infection and a higher quality of life score, emphasizing the favorable prognosis and quality assurance associated with autogenous arteriovenous fistula. This vascular access type, known for its simplicity, continuous arterial blood flow provision, and long-term usability, minimizes complications. However, its application is contingent on favorable vascular conditions and the maturity confirmation of the arteriovenous fistula before initiating treatment, making it less suitable for certain critical or vascularly compromised patients. In such cases, long-term indwelling tunneled polyester sleeve catheters are recommended due to their versatility, hemodynamic stability, and lower risk of embolism, albeit with an increased infection risk, hence, it is recommended to combine with high-quality anti-infectious intervention. Polytetrafluoroethylene graft vascular fistula, generally employed when vascular resources are depleted, offers better biocompatibility and convenience for repeated punctures. However, its use is often an alternative due to a relatively higher risk of thromboembolism and infection<sup>[8-10]</sup>.

In conclusion, for CRF patients undergoing blood purification treatment, autologous arteriovenous fistulas are recommended as the primary vascular access, significantly reducing the risk of infection and enhancing overall quality of life. In cases where this access is unfeasible, the use of a tunneled polyester sleeve catheter in the internal jugular vein is suggested to ensure clinical treatment efficiency.

## Disclosure statement

The authors declare no conflict of interest.

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# Evaluating the Efficacy of Interventional Approaches for Cardiac Arrhythmias in Acute Myocardial Infarction

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**Abstract:** *Objective:* To assess the effectiveness of interventional treatments for cardiac arrhythmias in acute myocardial infarction (AMI). *Methods:* Eighty AMI patients admitted between August 2022 and August 2023 were selected and randomly assigned into groups using the random number table method. The control group ( $n = 40$ ) received conventional thrombolytic treatment, while the observation group ( $n = 40$ ) underwent percutaneous coronary intervention (PCI). Clinical effects were compared between the two groups. *Results:* Before treatment, there were no significant differences in heart rate indicators, cardiac function indicators, and physiological indicators between the two groups ( $P > 0.05$ ). After treatment, the observation group showed significantly improved heart rate indicators, cardiac function indicators, and physiological indicators compared to the control group ( $P < 0.05$ ). The adverse reaction rates in the observation group were lower than in the control group ( $P < 0.05$ ). *Conclusion:* PCI treatment demonstrated significant improvements in heart rate, cardiac function, and physiological indicators among AMI patients, leading to a reduced incidence of adverse reactions such as arrhythmia. The overall effect is deemed significant.

**Keywords:** Interventional therapy for acute myocardial infarction; Arrhythmia; Cardiac function; Adverse reactions

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## 1. Introduction

Acute myocardial infarction (AMI) is a critical and severe cardiovascular disease characterized by its sudden onset, rapid progression, and challenging curability. Patients are susceptible to adverse reactions such as arrhythmia, heart failure, and shock following the onset of the disease. The pathological mechanism of AMI involves the rupture of blood vessel intima due to atherosclerosis, leading to the formation of blood clots that embolize local coronary arteries, resulting in vessel obstruction, acute ischemia, and hypoxia, ultimately leading to necrosis <sup>[1]</sup>.

With the aging of the nation's population intensifying, the prevalence of AMI continues to rise, affecting progressively younger demographic groups. This trend significantly impacts patients' quality of life and health. Timely perfusion therapy is essential for AMI patients after disease onset, as it helps preserve normal cardiac

function and reduces the incidence of adverse cardiovascular events, such as arrhythmia.

Percutaneous coronary intervention (PCI) emerges as a crucial intervention, swiftly clearing infarction-related arteries in AMI patients. It improves blood flow in the infarcted myocardium, rescuing dying myocardial tissue and achieving notable results<sup>[2,3]</sup>. This study observed 80 AMI patients to assess the impact of PCI on the treatment of cardiac arrhythmia, aiming to provide a reliable reference for subsequent AMI treatments.

## 2. Materials and methods

### 2.1. General information

Eighty patients undergoing interventional treatment for AMI admitted between August 2022 and August 2023 were selected and divided using the random number table method, with 40 cases in each group. In the observation group, there were 22 males and 18 females, constituting 55.00% and 45.00%, respectively. Their ages ranged from 50 to 78 years with an average of  $57.78 \pm 4.39$  years. Onset time varied from 2 to 6 hours with an average of  $3.87 \pm 0.33$  hours. Common comorbidities included 12 cases of hypertension (30.00%), 13 cases of diabetes (32.50%), and 15 cases of coronary heart disease (37.50%). The AMI locations were distributed as follows: 15 cases on the anterior wall (37.50%), 8 cases on the anteroseptal wall (20.00%), and 17 cases on the inferior wall (42.50%).

In the control group, there were 24 males and 16 females, accounting for 60.00% and 40.00%, respectively. The age range was 51 to 76 years with a mean of  $57.82 \pm 4.41$  years. Onset time was between 3 to 6 hours with a mean of  $3.89 \pm 0.36$  hours. Common comorbidities included 10 cases of hypertension (25.00%), 14 cases of diabetes (35.00%), and 16 cases of coronary heart disease (40.00%). The AMI locations were distributed as follows: 16 cases on the anterior wall (40.00%), 10 cases on the anteroseptal wall (25.00%), and 14 cases on the inferior wall (35.00%). There were no statistically significant differences in the relevant data between the two patient groups ( $P > 0.05$ ).

### 2.2. Inclusion and exclusion standards

Inclusion criteria included all patients diagnosed with AMI requiring PCI surgery<sup>[4]</sup>, time of onset  $\leq 6$  hours, as well as patients and their families agreeing to participate in the study and signing the informed consent.

Exclusion criteria included individuals with organ dysfunction or malignant arrhythmia, those with malignant tumors or immune diseases, those who received thrombolytic therapy before PCI, and those with mental illness or cognitive impairment.

### 2.3. Methods

In the control group, patients received an initial intravenous infusion of recombinant human prourokinase 20 mg, followed by a continued infusion of 30 mg, with the total infusion time controlled within 30 minutes.

Patients in the observation group underwent PCI treatment. They were administered aspirin 300 mg + clopidogrel 300 mg or chewed ticagrelor 180 mg. Coronary angiography precisely located the site of vascular obstruction, and standard percutaneous transluminal coronary angioplasty was performed to swiftly establish a venous circulation pathway. During the procedure, the patient received 100 U/kg heparin four times. A suitable stent was accurately inserted based on the patient's vascular condition. After restoring blood flow, the clinician administered 4000  $\mu$ g of low molecular weight heparin subcutaneously every 12 hours, along with oral aspirin 100 mg and clopidogrel 300 mg once daily.

## 2.4. Observation indicators

Comparison of heart rate indicators [corrected QT interval (QTc), QT interval dispersion (QTd), and heart rate (HR)] before and after treatment, cardiac function indicators [using color Doppler ultrasound to detect left ventricular ejection fraction (LVEF), left ventricular end-diastolic and end-systolic diameters (LVEDD, LVESD)] before and after treatment, physiological indicators [detection of brain natriuretic peptide (BNP) by radioimmunoassay, detection of C-reactive protein (CRP) level by immunoturbidimetry] before and after treatment, and the occurrence of adverse reactions (heart failure, ventricular arrhythmia, cardiogenic shock) post-medication were examined.

## 2.5. Statistical analysis

SPSS 27.0 was employed as the data analysis software. Measurement data were expressed as mean  $\pm$  standard deviation (SD), and a *t*-test was conducted. Count data were expressed as *n* (%), and a  $\chi^2$  test was performed. A significance level of  $P < 0.05$  indicated a significant difference between the data.

## 3. Results

### 3.1. Comparison of heart rate indicators between the two groups

Prior to treatment, there was no statistically significant difference in QTc, QTd, and HR between the groups ( $P > 0.05$ ). However, after treatment, the QTc, QTd, and HR indicators of the observation group demonstrated improvement compared to the control group ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of heart rate indicators before and after treatment (mean  $\pm$  SD)

Group	QTc (ms)		QTd (ms)		HR (times/min)	
	Before	After	Before	After	Before	After
Observation group ( <i>n</i> = 40)	452.78 $\pm$ 40.37	433.42 $\pm$ 48.64	67.14 $\pm$ 5.38	32.63 $\pm$ 3.39	98.55 $\pm$ 8.81	65.69 $\pm$ 6.88
Control group ( <i>n</i> = 40)	452.81 $\pm$ 40.43	400.15 $\pm$ 53.18	67.48 $\pm$ 5.42	34.79 $\pm$ 3.72	98.12 $\pm$ 8.75	60.62 $\pm$ 7.53
<i>t</i>	0.003	2.920	0.282	2.714	0.219	3.144
<i>P</i>	0.997	0.005	0.779	0.008	0.827	0.002

### 3.2. Comparison of cardiac function indicators between the two groups

**Table 2** shows that the evaluation of LVEDD, LVEF, and LVESD between the groups showed no statistical significance before treatment ( $P > 0.05$ ). Nevertheless, post-treatment, the LVEDD, LVEF, and LVESD levels in the observation group exhibited improvement compared to the control group ( $P < 0.05$ ).

**Table 2.** Comparison of cardiac function indicators before and after treatment (mean  $\pm$  SD)

Group	LVEDD (mm)		LVEF (%)		LVESD (mm)	
	Before	After	Before	After	Before	After
Observation group ( <i>n</i> = 40)	66.02 $\pm$ 6.15	51.39 $\pm$ 4.35	35.22 $\pm$ 2.81	46.37 $\pm$ 3.57	56.05 $\pm$ 6.29	42.35 $\pm$ 4.02
Control group ( <i>n</i> = 40)	66.04 $\pm$ 6.27	60.21 $\pm$ 5.42	35.26 $\pm$ 2.85	40.56 $\pm$ 2.45	56.09 $\pm$ 6.27	50.25 $\pm$ 5.12
<i>t</i>	0.014	8.027	0.063	8.487	0.028	7.675
<i>P</i>	0.989	< 0.001	0.950	< 0.001	0.977	< 0.001

### 3.3. Comparison of physiological indicators between the two groups

The evaluation of BNP and CRP levels between groups did not reveal any statistical significance before treatment ( $P > 0.05$ ). However, after treatment, the BNP and CRP levels in the observation group were lower than those in the control group ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of physiological indicators before and after treatment (mean  $\pm$  SD)

Group	BNP (pg/ml)		CRP (mg/L)	
	Before	After	Before	After
Observation group ( $n = 40$ )	464.27 $\pm$ 57.26	340.08 $\pm$ 50.26	12.62 $\pm$ 2.59	5.21 $\pm$ 1.57
Control group ( $n = 40$ )	465.32 $\pm$ 57.39	432.05 $\pm$ 54.49	12.64 $\pm$ 2.58	8.18 $\pm$ 2.55
$t$	0.082	7.847	0.035	6.273
$P$	0.935	$< 0.001$	0.973	$< 0.001$

### 3.4. Comparison of adverse reaction rates between the two groups

**Table 4** shows that the adverse reaction rate in the observation group was significantly lower than in the control group ( $P < 0.05$ ).

**Table 4.** Comparison of adverse reaction rates after treatment [ $n$  (%)]

Group	Heart failure	Ventricular arrhythmias	Cardiogenic shock	Overall incidence
Observation group ( $n = 40$ )	1 (2.50)	1 (2.50)	0 (0.00)	2 (5.00)
Control group ( $n = 40$ )	3 (7.50)	5 (12.50)	1 (2.50)	9 (22.50)
$\chi^2$	-	-	-	5.165
$P$	-	-	-	0.023

## 4. Discussion

Patients with AMI face challenges in maintaining stable vital signs post-onset, increasing the risk of complications such as heart failure and arrhythmia. Early clinical intervention to rapidly reduce myocardial infarction size and ensure blood flow recanalization holds significant importance<sup>[5]</sup>. Clinical treatment of AMI predominantly centers on the timely opening of blocked blood vessels to restore and reperfuse blood in the infarcted myocardium. This approach proves beneficial in salvaging damaged myocardial cells and fostering positive improvements in cardiac function and symptoms. Intravenous thrombolysis, another common treatment for AMI, faces challenges influenced by factors like contraindications and time windows. The clinical efficacy of intravenous thrombolytic therapy varies due to individual differences among patients, leading to inherent limitations and rendering it unsuitable for every AMI patient<sup>[6]</sup>.

In contrast, early PCI treatment swiftly opens obstructed blood vessels, facilitating the restoration of coronary reperfusion. This method boasts advantages such as simplicity, minimal trauma, rapid recovery, and high safety<sup>[7]</sup>. Prior to PCI treatment, a comprehensive evaluation of the AMI patient's condition is necessary, considering factors for complete revascularization. Notably, patients often present with complications such as arrhythmia, and PCI treatment plays a pivotal role in stabilizing hemodynamics. It significantly reduces cardiac afterload and myocardial oxygen consumption while simultaneously enhancing diastolic coronary blood flow. This dual effect significantly improves blood flow and perfusion, thereby safeguarding cardiac function and lowering the incidence of adverse reactions such as arrhythmia<sup>[8]</sup>.

This study reveals that post-treatment, the observation group exhibited higher QTc and HR levels, a lower QTd level, and a significantly better heart rate index compared to the control group ( $P < 0.05$ ). These findings suggest that PCI treatment can enhance the heart rate of AMI patients and contribute to their recovery. Additionally, the observation group demonstrated lower levels of LVEDD and LVESD, along with higher LVEF levels after treatment, all of which were superior to those of the control group ( $P < 0.05$ ). This implies that, in comparison to conventional thrombolytic treatment, PCI treatment is more effective in improving cardiac function and clinical prognosis.

The analysis attributes this efficacy to the use of aspirin, an anti-platelet aggregation drug that clinically inhibits cyclooxygenase, impedes thromboxane A<sub>2</sub> formation, and achieves anticoagulant and antithrombotic effects. Clopidogrel, another antiplatelet drug, effectively inhibits glycoprotein complex activation mediated by adenosine diphosphate, positively influences adenylyl cyclase activity, and inhibits platelet aggregation. It proves significant in treating AMI, promoting cardiac blood circulation during PCI surgery, reducing arterial restenosis, and aiding myocardial blood perfusion. Ticagrelor, with its inhibitory effect on arterial intimal hyperplasia and protective effect on cardiomyocytes, avoids damage to the vascular endothelium and promotes positive improvements in coronary blood flow. It binds organically to the adenosine diphosphate receptor P2Y<sub>12</sub>, inhibiting platelet membrane glycoprotein complex production and platelet aggregation. Importantly, ticagrelor does not require liver metabolism activation, exerting its effect 2 hours after ingestion and maintaining a long half-life for stable drug effects. While inhibiting the antithrombotic mechanism, ticagrelor dilates blood vessels, significantly reducing cardiac load and myocardial oxygen consumption in AMI patients<sup>[9,10]</sup>.

In this study, the combination of aspirin + clopidogrel or chewable ticagrelor in treating AMI achieved noteworthy results. PCI treatment consistently enhanced coronary blood flow in AMI patients, demonstrating robust stability that maximized myocardium rescue and improved cardiac function. Post-treatment, the observation group exhibited lower levels of BNP and CRP compared to the control group ( $P < 0.05$ ). This suggests that PCI treatment has a positive impact on the patient's coronary stenosis, quickly restoring blood supply to the myocardium to effectively relieve cardiac load. Simultaneously, it significantly reduced BNP secretion by ventricular myocytes, improving ventricular function and clinical prognosis. Moreover, PCI treatment reopened blocked infarction-related blood vessels, enhancing myocardial ischemia, collateral circulation, and cardiac function compensatory ability to prevent diseased artery re-occlusion. The study demonstrated that the adverse reaction rate in the observation group was 5.00%, significantly lower than the control group's 22.50% ( $P < 0.05$ ). This suggests that PCI treatment can effectively reduce adverse reactions such as arrhythmia and enhance clinical safety in AMI patients.

In conclusion, PCI treatment shows promise in positively affecting heart rate, cardiac function, BNP, and CRP indicators in AMI patients. Its clinical efficacy, disease prognosis, and reduced adverse reaction rates, especially in arrhythmia, highlight its clinical significance.

## Disclosure statement

The authors declare no conflict of interest.

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# Discussion on the Treatment Methods and Value of the No-Reflow Phenomenon During Percutaneous Coronary Intervention

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**Abstract:** *Objective:* To explore the treatment methods and value of the no-reflow phenomenon during percutaneous coronary intervention (PCI). *Methods:* 180 patients with acute myocardial infarction (AMI) who underwent PCI treatment at the First Hospital of Hebei Medical University from November 2020 to December 2022 were selected and divided into Group A, Group B, and Group C by random number table extraction method, each group included 60 cases. Group A received intracoronary injection of recombinant human urokinase and Group B received intracoronary injection of diltiazem. Group C adopted a targeted drug administration strategy of “front and back pinch method,” where targeted thrombolysis was performed in the target vessel before the stent was released to quickly dissolve the residual thrombus near the lesion and the small distal thrombus; recombinant human urokinase was subsequently injected in the targeted vessel. The incidence of cardiovascular events, cardiac function, and quality of life of the three groups were analyzed. *Results:* After the intervention, the incidence rates of angina pectoris, heart failure, and recurrent myocardial infarction in Group C were lower than those in Group B ( $P < 0.05$ ); the overall incidence rate was the lowest in Group C, followed by Group A and Group B; after intervention, left ventricular end-diastolic diameter, end-systolic diameter, and ejection fraction in Groups A and C were all better than those of group B ( $P < 0.05$ ), and Group C was better than Group A; after intervention, the scores of different dimensions of quality of life in Groups A and C were higher than those of Group B ( $P < 0.05$ ). *Conclusion:* AMI patients are prone to the no-reflow phenomenon after PCI treatment. Using recombinant human urokinase to complete the “front and back pinch method” can effectively improve the no-reflow phenomenon, reduce the incidence of cardiovascular events, optimize cardiac function, and improve the patient’s quality of life and survival rate.

**Keywords:** Percutaneous coronary intervention; Acute myocardial infarction; No-reflow phenomenon; Recombinant human urokinase

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## 1. Introduction

Acute myocardial infarction (AMI) is a disease caused by the sudden interruption of coronary blood flow leading to myocardial ischemia and necrosis. The common cause of the disease is thrombosis or vasospasm

caused by coronary atherosclerosis, resulting in insufficient myocardial blood supply <sup>[1]</sup>. Symptoms such as severe chest pain, dyspnea, nausea, vomiting, and other related symptoms may occur after the onset of the illness. The occurrence of AMI can increase the incidence of complications such as heart failure and arrhythmia, increasing the risks faced by individuals <sup>[2]</sup>. Currently, percutaneous coronary intervention (PCI) is mostly used to treat AMI. The implementation of this method can help reduce patient mortality and disability rates. However, based on the clinical situation, slow blood flow, no-reflow, or other abnormal angiographic results may occur during stent implantation. No-reflow refers to a state of myocardial tissue hypoperfusion after the coronary blood vessels have been opened <sup>[3]</sup>. The existence of no-reflow or slow blood flow can directly affect myocardial horizontal perfusion, causing further damage to the myocardium and impairing cardiac function <sup>[4]</sup>. In response to this situation, certain clinical measures are taken to prevent and treat the no-reflow phenomenon. The use of suction catheters and distal protection devices, vasodilator drugs (nitroglycerin, sodium nitroprusside, adenosine, anisodamine, etc.), and antiplatelet drugs (tirofiban, etc.) can reduce the incidence of no-reflow, but the overall incidence remains high <sup>[5]</sup>. The no-reflow phenomenon can directly affect the patient's prognosis, increase the economic burden on the family and the country, and threaten the recovery of the patient's cardiac function. In order to reduce the incidence of no-reflow during PCI treatment, this study carried out a corresponding analysis, as detailed below.

## **2. Materials and methods**

### **2.1. General information**

180 patients with AMI who underwent PCI treatment at the First Hospital of Hebei Medical University from November 2020 to December 2022 were divided into 3 groups by random number table extraction method: Group A, Group B, and Group C; each group included 60 cases. Group A included 32 males and 28 females, aged 63 to 81, with an average age of  $72.65 \pm 6.88$  years; Group B included 34 males and 26 females, aged 64 to 82 years old, with an average age of  $73.11 \pm 6.93$  years; Group C included 35 males and 25 females, aged 65 to 83 years old, with an average age of  $73.85 \pm 7.01$ . A detailed analysis of the basic information of the patients in the three groups showed no significant differences ( $P > 0.05$ ). Inclusion criteria: (1) All participants in the study have been diagnosed with AMI, meet the relevant indications for PCI treatment, and can tolerate PCI surgery; (2) All patients are aware of the relevant contents of the study, agree to participate in it, and sign an informed consent form. Exclusion criteria: (1) Patients with severe dysfunction of important organs; (2) Patients with mental illness.

### **2.2. Methods**

All patients in the study were given nitroglycerin 100–200  $\mu\text{g}$  1 to 3 times according to their conditions during interventional treatment. Group A: A bolus injection consisting of 20 mg recombinant human prourokinase diluted with saline was given within 5 minutes. Group B: An intracoronary bolus injection consisting of diltiazem hydrochloride diluted with saline was given at 400  $\mu\text{g}$  each time. Group C: 10 mg of recombinant human prourokinase diluted with saline was injected into the relevant blood vessels proximal to the lesion through a suction catheter or punctured balloon. After the stent was released, 10 mg of recombinant human prourokinase was administered again.

### **2.3. Observation indicators**

- (1) Incidence rate of cardiovascular events: The occurrence of angina pectoris, heart failure, and recurrent myocardial infarction in the three groups after the intervention were observed.

- (2) Cardiac function indicators: The left ventricular end-diastolic diameter (LVEDD), end-systolic diameter (LVESD), and ejection fraction (LVEF) indicators were collected from the three groups after the intervention.
- (3) Quality of life: The SF-36 (36-Item Short Form) health survey was used to measure the quality of life of all patients. The survey includes psychological, physiological, physical, and social functions. The individual items are on a hundred-point scale and are positively correlated.

## 2.4. Statistical processing and analysis

The statistical software SPSS 22.0 was used to analyze the data of this study. The counting data were expressed as [ $n$  (%)] and the  $\chi^2$  test was used; the measurement data were expressed as mean  $\pm$  standard deviation (SD) and the  $t$ -test was used.  $P < 0.05$  indicated that the difference was statistically significant.

## 3. Results

### 3.1. Comparison of incidence rates of cardiovascular events between the groups

After intervention, the incidence rates of angina pectoris, heart failure, and recurrent myocardial infarction in Group C were lower than those in Group B ( $P < 0.05$ ); the overall incidence rate was the lowest in Group C, followed by Group A and Group B, as shown in **Table 1**.

**Table 1.** Comparison of incidence rates of cardiovascular events between the groups [ $n$  (%)]

Group	Angina pectoris	Heart failure	Recurrent myocardial infarction	Overall incidence rate
Group A ( $n = 60$ )	3 (8.33)	4 (6.67)	3 (6.67)	10 (21.67)
Group B ( $n = 60$ )	7 (10.00)	5 (10.00)	6 (13.33)	18 (38.33)
Group C ( $n = 60$ )	2 (3.33)	2 (3.33)	1 (1.67)	5 (8.33)*

\* $P < 0.05$  compared with Group B

### 3.2. Comparison of cardiac function indicators between the groups after intervention

After intervention, LVEDD, LVESD, and LVEF in Group A and Group C were all better than those in Group B ( $P < 0.05$ ). The cardiac function indicators of Group C were better than those of Group A, as presented in **Table 2**.

**Table 2.** Comparison of cardiac function indicators between the groups after intervention (mean  $\pm$  SD)

Group	LVEDD (mm)	LVESD (mm)	LVEF (%)
Group A ( $n = 60$ )	51.69 $\pm$ 4.32*	40.27 $\pm$ 2.34*	49.97 $\pm$ 4.54*
Group B ( $n = 60$ )	53.33 $\pm$ 4.26	42.36 $\pm$ 2.39	47.36 $\pm$ 4.39
Group C ( $n = 60$ )	47.36 $\pm$ 3.21 <sup>#</sup> *	36.54 $\pm$ 2.65 <sup>#</sup> *	52.69 $\pm$ 5.65 <sup>#</sup> *

<sup>#</sup> $P < 0.05$  compared with Group A, \* $P < 0.05$  compared with Group B

### 3.3. Comparison of quality of life between the groups after intervention

After the intervention, the scores of different dimensions of quality of life in Group C were higher than those in Groups A and B, and the quality of life indicators in Group A were higher than those in Group B ( $P < 0.05$ ), as displayed in **Table 3**.

**Table 3.** Comparison of the quality of life between the groups after intervention (mean  $\pm$  SD)

Group	Psychological functions (points)	Physiological functions (points)	Physical functions (minutes)	Social functions (points)
Group A ( $n = 60$ )	73.14 $\pm$ 5.32*	72.46 $\pm$ 6.64*	74.97 $\pm$ 5.54*	74.37 $\pm$ 4.77*
Group B ( $n = 60$ )	70.38 $\pm$ 5.34	70.15 $\pm$ 5.36	72.28 $\pm$ 4.65	72.85 $\pm$ 4.26
Group C ( $n = 60$ )	80.28 $\pm$ 5.07 <sup>#</sup> *	79.33 $\pm$ 6.11 <sup>#</sup> *	80.27 $\pm$ 5.37 <sup>#</sup> *	79.55 $\pm$ 4.69 <sup>#</sup> *

<sup>#</sup> $P < 0.05$  compared with Group A, \* $P < 0.05$  compared with Group B

#### 4. Discussion and conclusion

AMI is one of the most common cardiovascular diseases. The occurrence of AMI is closely related to coronary artery stenosis or occlusion, emboli formation, and coronary artery spasm. Under the influence of the above factors, the coronary arteries can be blocked, resulting in stenosis or occlusion, blockage of coronary blood flow, inadequate oxygenation, and myocardial ischemia [6]. The occurrence of AMI can bring serious negative effects to the body. AMI can cause myocardial ischemia and necrosis, leading to myocardial cells being unable to work normally, reducing cardiac contractility, weakening cardiac function, and, in severe cases, causing heart failure [7]; at the same time, AMI can cause cardiac electrophysiological abnormalities, leading to arrhythmias, such as ventricular arrhythmias, ventricular tachycardia, and atrial fibrillation. If AMI is not effectively treated, it can cause myocardial damage, impair the heart's pumping function, reduce cardiac output, and ultimately lead to heart failure, causing symptoms such as shortness of breath, edema, and fatigue [8].

Since AMI can result in significant harm, it is crucial to diagnose AMI as early as possible and take effective treatment measures. PCI is currently a common treatment method for AMI. It is an interventional therapy performed through catheters, which can re-establish the blood supply of the coronary arteries. PCI can restore blood flow as early as possible, limit the expansion of myocardial necrosis, and reduce subsequent complications. Restoration of coronary blood flow can minimize the area of myocardial necrosis, lower mortality rate, alleviate symptoms such as chest pain and dyspnea, reduce myocardial cell necrosis and myocardial damage, and preserve overall myocardial function [9]. However, it is vital to acknowledge that the no-reflow phenomenon is prone to occur during PCI. Poor blood flow recovery can directly reduce cardiac function and quality of life, affect the disease prognosis, and increase the risks of complications.

No-reflow phenomenon refers to the failure of blood flow to recover to the expected level after PCI, resulting in poor myocardial perfusion. The occurrence of this phenomenon is closely related to coronary embolism, ischemia-reperfusion injury, platelet aggregation, and inflammatory response [10]. Following the occurrence of no-reflow due to insufficient blood supply, the myocardium can remain in a state of ischemia, increasing the risk of serious complications such as myocardial infarction. No-flow can also lead to myocardial damage and fibrosis, affect cardiac systolic function, and aggravate the symptoms of heart failure [11]. During emergency PCI surgery, residual thrombi and fragmented atherosclerotic plaques can protrude from the stent mesh into the lumen and rush to the distal microvascular network due to the improved blood flow, causing slow blood flow, reperfusion injury, and reduced cardiac function. Effective clinical measures should be taken for prevention and remediation in response to this phenomenon. In this study, patients with AMI who underwent PCI were selected, and corresponding interventions were given during the implementation of PCI. The results of the study showed that after intervention in Group C, the incidence of angina pectoris, heart failure, and recurrent myocardial infarction was lower than that of Group A and Group B ( $P < 0.05$ ); after the intervention, LVEDD, LVESD, and LVEF in Group C were all better than those of Group A and Group B ( $P < 0.05$ ); after

the intervention, the quality of life scores in different dimensions of Group C were higher than those of Group A and Group B ( $P < 0.05$ ).

It can be seen that the method adopted by Group C can effectively reduce the incidence of no-reflow, optimize patient prognosis, improve cardiac function, enhance quality of life, and reduce the incidence of adverse cardiovascular events. Recombinant human urokinase refers to human urokinase that is produced through genetic engineering technology. The human urokinase gene is introduced into bacteria or other organisms to express and secrete active urokinase, which is then applied to patients undergoing PCI<sup>[12]</sup>. It can dissolve blood clots, restore blood vessel patency, and reduce or prevent complications such as myocardial ischemia and necrosis<sup>[13]</sup>. As recombinant human urokinase exhibits strong thrombolytic activity, it can quickly dissolve thrombus in coronary arteries, restore smooth blood flow, and protect myocardium from ischemia and necrosis. Additionally, it can also improve coronary endothelial cell function, promote vasodilation and expansion, and restore normal blood vessel function<sup>[14]</sup>. Before the stent is released, recombinant human prourokinase is injected in the coronary artery for targeted thrombolytic therapy, which aids in quickly dissolving tiny thrombi; after the stent is released, the angiography time is delayed, and recombinant human urokinase is again injected into the targeted blood vessel. Prourokinase can effectively eliminate new distal microthrombus, fully improve the circulation of distal coronary microvessels, ultimately enhance post-stent blood flow, reduce the incidence of no-reflow or slow blood flow, and maximize cardiac protection function<sup>[15]</sup>.

In summary, the targeted drug delivery strategy of the “front and back pinch method” in PCI treatment can effectively improve patient prognosis.

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The authors declare no conflict of interest.

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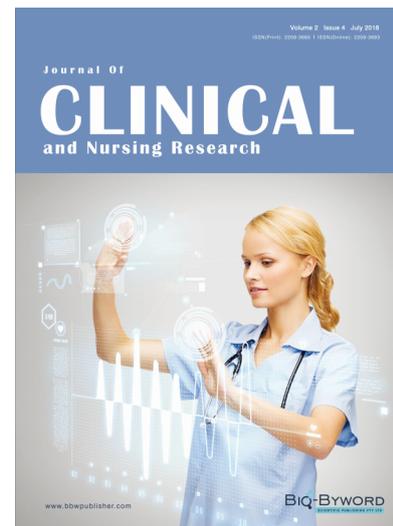
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