

# Advances in the Diagnosis and Treatment of Cardiogenic Shock in Chinese Medicine and Research

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## Abstract

Cardiogenic shock belongs to a group of acute and critical illnesses in cardiovascular medicine with a high mortality rate and poor prognosis. Traditional Chinese medicine, as the crystallization of traditional wisdom of Chinese medicine, has made certain progress in the treatment of cardiogenic shock and in improving the prognosis of such patients. This article reviews the latest research results and related reports on the treatment of cardiogenic shock in Chinese medicine, intending to provide front-line clinical workers with treatment ideas and references.

**Keywords:** cardiogenic shock, traditional Chinese medicine diagnosis, traditional Chinese medicine treatment, research progress

## 1. Introduction

Cardiogenic shock (CS) is a group of syndromes in which cardiac output is significantly reduced. Acute circulatory failure occurs due to extreme decompensation of cardiac function caused by various acute cardiac diseases. The clinical manifestations of CS have two major elements: persistent hypotension and tissue hypoperfusion, commonly characterized by wet

and cold extremities and oliguria. The extreme manifestation of heart pump failure is cardiogenic shock, which causes severe ischemia and hypoxia in the body due to persistent hypovolemia, and even leads to the failure of vital organs. Acute Myocardial Infarction (AMI), which is often the cause of CS, has shown that about 5%-15% of AMI patients have a combination of CS (Sheng Zhaoxue, Liu Chen,

Zhou Peng, et al., 2018), with an alarming 60% mortality rate in the short term (Furer A, Wessler J & Burkhoff D., 2017). Although the current emergency interventions to open the offender vessels and mechanical systemic circulation support can effectively improve the clinical symptoms of patients with cardiogenic shock, 50% of patients still have in-hospital or within 1 month of death (Liang F, Hu DY, Fang Q et al., 2021), which greatly reduces the quality of survival of patients. Thus, the correct understanding of the disease and further effective clinical interventions can effectively improve the clinical symptoms of patients, which can improve the long-term prognosis of these patients to a certain extent. The long-term prognosis of these patients can be improved to some extent. The results of several studies have shown that TCM has a positive effect on reducing mortality and improving the prognosis of CS patients, so this paper will elaborate on the theoretical understanding and therapeutic progress of TCM in cardiogenic shock.

## 2. CS Overview

### 2.1 Definition

CS is a clinical syndrome characterized by ischemia, hypoxia, and even vital organ failure due to the acute onset of various underlying cardiac diseases resulting in left and/or right heart insufficiency, dramatic reduction in cardiac blood output leading to hypotension and severe tissue perfusion deficit (Chinese Society of Cardiovascular Diseases, Cardiovascular Emergencies Group, Chinese Journal of Cardiovascular Diseases Editorial Board, 2019).

### 2.2 Diagnostic Criteria

#### 2.2.1 Clinical Criteria

(1) hypotension: systolic blood pressure <90 mmHg or mean arterial pressure <65 mmHg for

more than 30 min with adequate blood volume; or systolic blood pressure maintained >90 mmHg with the need for vasoactive drugs and/or circulatory assistance device support

(2) signs of inadequate organ perfusion (at least one): mental status changes excluding other causes, early euphoria, late atrophy; extremity clammy, florid skin; oliguria or anuria; metabolic acidosis, LAC > 2.0 mmol/L (Chinese Society of Cardiovascular Diseases, Cardiovascular Emergencies Group, Chinese Journal of Cardiovascular Diseases Editorial Board, 2019; Ponikowski P, Voors AA, Anker SD, et al., 2016; Ibanez B, James S, Agewall S, et al., 2018).

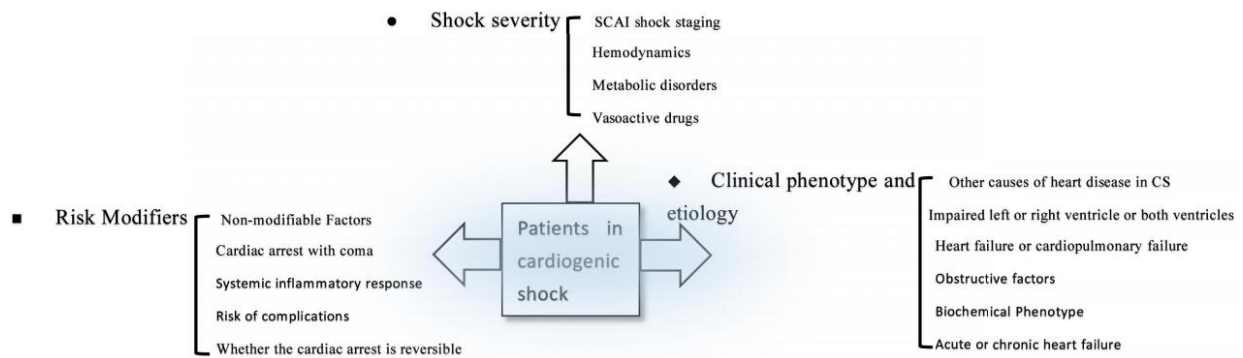
#### 2.2.2 Invasive hemodynamic diagnostic criteria

(1) cardiac index  $\leq 2.2$  L/min/m<sup>2</sup>;

(2) elevated ventricular filling pressure: pulmonary capillary wedge pressure (PCWP)  $\geq 18$  mmHg (Chinese Society of Cardiovascular Diseases, Cardiovascular Emergencies Group, Chinese Journal of Cardiovascular Diseases Editorial Board, 2019; Ponikowski P, Voors AA, Anker SD, et al., 2016; Ibanez B, James S, Agewall S, et al., 2018).

### 2.3 Assessment and Forecasting

Since several factors determine the severity of clinical symptoms in patients with CS, such as clinical signs and symptoms, number of risk factors, and grading of shock, Reynolds (Reynolds HR & Hochman JS., 2018) et al. proposed and published an expert consensus on the "triaxial model" in the journal *Circulation*, which is useful for the assessment and prediction of CS. (Figure 1). This model incorporates and integrates shock severity, clinical presentation, and etiologic and risk modifiers to greatly enhance individualized management of CS patients.



**Figure 1.** “Three-axis model”

### 3. Chinese Medicine Theory Research

#### 3.1 Understanding the Evolution

However, based on clinical evidence, CS can be associated with “syncope” and “syncopal disorder”. Syncope means fainting, and desiccation means sweating profusely and the fluids coming out wildly. The Yellow Emperor’s Classic of Internal Medicine says: “Those who have violent convulsions do not know what to say to others”, which is the earliest elaboration and recognition of syncope. Later, classical writings such as the Treatise on Typhoid Fever, the Danxi Xinfu, and the Classic of Classical Chinese Medicine have further recognized syncope, namely, that people with syncope have a sunken pulse, blue lips and mouth, and wet and cold hands and feet. Therefore, various Chinese medicine scholars have pointed out that this disease has the characteristics of rapid onset and extremely dangerous conditions. With the unrelenting efforts of successive generations of Chinese medicine practitioners, people gradually understood the disease’s symptoms. Although the name of syncope is not unified in modern Chinese medicine, there is still a unanimous agreement on the syncope and syncope. In the clinical treatment of patients with acute myocardial infarction combined with cardiogenic shock, Zhao Yanhui (Zhao Yanhui, 2020) et al. concluded that the main pathogenic mechanism of these patients was persistent hypotension and systemic microcirculatory disorders, which belonged to the TCM pathogenesis of “true heart pain and syncope”, and the truth of Yang Qi failure and blood vessels blockage. According to Li Linwei (Li Linwei & Cheng Xianwu, 2022) et al., CS patients have clinical symptoms such as oliguria

and cold extremities due to cardiac pump failure. The above belongs to the TCM category of “syncope, decompensation, dead yin and dead yang”.

#### 3.2 Disease Mechanism

“Qi is closely related to the development of syncope. (Yang Geyan & Wang Xiaolong, 2021). The “qi reversal” is the first point of the disease mechanism in the Nei Jing, where the evil qi reverses, and the yang qi is disordered, causing the patient to have insufficient qi and blood supply and become unconscious suddenly. Later, Jing Yue Quan Shu pointed out that the pathogenesis of the disease was “the separation of yin and yang”, that is, the upward movement of qi and blood and the downward movement of yin, resulting in syncope and easy death. In modern times, most physicians still adhere to the viewpoint mentioned above. He Zhiling (He Z L & Wang Y., 2021) et al. believe that the pathogenesis of the disease is the exhaustion of yang and yin, the separation of yin and yang, and the loss of both qi and blood, which is related to the serious illness of the heart.

#### 3.3 Identification and Typing

In 1983, the National Syncope Research Collaborative Group formulated corresponding treatment norms for syncope, which divided syncope into six major types of evidence, namely qi and yin deficiency, yang qi violent loss, true yin depletion, evil poison incandescence, heart qi deficiency, and qi stagnation and blood stasis. On the contrary, researchers in modern medicine have subdivided CS according to their unique insights. Some researchers have subdivided CS according to the vital signs and pulses of the

patients, such as “yin exhaustion within and yang extinction outside” and “internal closure and external detachment” (Liao J. J., Chen K.J. & Shi Zaixiang, 1990).

#### 4. Treatment

##### 4.1 Chinese Herbal Formulas

With the increasing maturity of Chinese medicine purification technology, many Chinese herbal tonics have been applied to patients with cardiogenic shock on a large scale. More and more studies have confirmed that the relevant Chinese medicinal preparations combined with standard western supportive therapy can effectively improve patients' clinical symptoms, reduce the related adverse effects, and improve the survival prognosis of patients to a certain extent. Ginger nourishes the middle jiao and dispels cold, while ginseng may significantly restore vital energy, return the yang, fight rebellion, and perform the impact of fixing detachment. Radix et Rhizoma is warm, performing the effect of analgesia and dispelling cold. Therefore, this soup can achieve the effect of benefiting qi and returning yang with the above ingredients. In order to conclude that the use of ginseng and herb soup treatment can significantly improve the treatment effect for patients with acute myocardial infarction combined with cardiogenic shock, Xia Zhihua (Xia Zhihua, 2022) included 60 patients with acute myocardial infarction combined with cardiogenic shock as the study subjects and gave the ginseng and herb soup group as the observation group. The main active component of ginseng is ginsenoside, and modern pharmacological studies have shown that ginsenoside has positive effects on the physiological regulation of patients suffering from heart disease, including antioxidant, vasodilator, inflammatory factor inhibitor, and ion channel regulator (LUO H, ZHU D, WANG Y, et al., 2018); epiphyllum can accelerate heart rate and inhibit platelet aggregation to achieve antithrombotic effects. (Zhang X.C., Zheng Q.G., Yang J.H., et al., 2020)

He Zhiling (He Z L, Zhao X J & Xie W W., 2021) et al. found that the active ingredients in Ginseng Injection could inhibit the upregulation of the NF- $\kappa$ B pathway and the accumulation of extracellular matrix (ECM) and reduce the expression of inflammatory factors. This could alleviate myocardial injury and protect cardiac function by constructing a cardiogenic shock (CS)

animal model and investigating the effects of Ginseng Injection on cardiac function indexes in animals. Tao Zhu (Tao Zhu, Zheng Weiqing & Huang Weijian, 2021) et al. applied Broken Heart Soup to the clinical treatment of patients with acute myocardial infarction (AMI) with CS after percutaneous coronary intervention. By observing the clinical treatment effect and serum indexes, they concluded that Broken Heart Soup could effectively improve the cardiac function of patients when combined with Western medicine. Liu Juncheng (Liu Juncheng, Xie Qing, Chen Yao & Zhou Desheng, 2020) et al. conducted a clinical study of intractable hypotension in CS patients. They observed that using Guduo Fang could consolidate fluid and restore the pulse through the same treatment of yin and yang. This could provide a therapeutic basis for the gradual reduction of dobutamine.

##### 4.2 Chinese Herbal Injection

Raw pulse injection belongs to a sterilized injection that originated from the ancient formula of raw pulse san and was scientifically processed (Liang Dongyong, Wu Zhimin, Su Qiongxin, et al., 2014). (Feng Y, Wang Y & Hao XY., 2016) By comparing the systolic blood pressure and cardiac index of the two groups, we found that the treatment with Shengvei injection significantly reduced the mortality rate of patients with AMI combined with CS and facilitated the repair of myocardial cell damage, which deserves further clinical study. Yiqi and Revive Pulse Injection also originated from the ancient classical formula Shengve San, which mainly contains ginsenoside, maiden saponin, schisanol and other active ingredients. Previous studies have shown that combining Yiqi and Fuxue injections can achieve good clinical efficacy. Wang Jingyue (Wang Jing Yue, Shen Botao, Feng Xiao Xing, et al., 2021) et al. retrospectively included 79 patients with CS, and the control group was given only conventional western medical treatment, while the observation group was given Yiqi Fuxue injection intravenously on top of the control group. By comparing the clinical mortality rate and related clinical indexes such as heart rate, systolic blood pressure, lactate, etc., it was confirmed that the combination of Yiqi Fuxue treatment in the clinical treatment of patients with cardiogenic shock is effective and safe, and can be further promoted in clinical practice. Danshin is the main active ingredient in Salvia injection. Modern



pharmacology has confirmed that Danshin can inhibit platelet aggregation and activation, and promote nitric oxide production, thus achieving anticoagulation and improving coronary blood flow. Further studies have proved that cryptotanshinone is the anti-platelet aggregation substance in Danshin. (Feng Ke-Ran, Li Wei-Xia, Wang Xiao-Yan, et al., 2022), and Tanshinone IIA contained in Danshin can inhibit lipopolysaccharide (LPS). Lipopolysaccharide (LPS)-induced degradation of inhibitory protein- $\alpha$  of nuclear factor- $\kappa$ B (I $\kappa$ B- $\alpha$ ) and activation of nuclear factor- $\kappa$ B (NF- $\kappa$ B), thus exerting a powerful anti-inflammatory activity. (Jang S I, Kim H J, Kim Y J, et al., 2006). Zhang Jian (Zhang K., 2017) in a study on the interventional treatment of Danshen injection in patients with AMI combined with CS to observe its regulatory effects on inflammatory factors IL-6 and TNF- $\alpha$ , it was found that Danshen injection could improve the clinical cure rate of patients with AMI combined with CS and reduce the expression of inflammatory factors IL-6 and TNF- $\alpha$  to suppress the inflammation of the body, which is worthy of further clinical promotion.

#### 4.3 Herbs to Benefit Qi and Activate Blood

##### 4.3.1 Astragalus

Astragalus is sweet and slightly warm and can tonify qi, raise yang, consolidate the surface and stop sweating, promote water retention, reduce swelling, produce fluid and nourish blood, promote stagnation and paralysis, support toxicity and drain pus, and astringent sores and muscles (Dai YUTING, Zhang XUEYAN, Wang YIXUAN, et al., 2022). Modern pharmacology has shown that Astragalus can protect ischemic cells from myocardial injury and increase the number of  $\beta$  receptors on the myocardial cell membrane to achieve a cardiotonic effect. It can positively regulate blood pressure and blood viscosity (Zhang Shujuan, Zhang Yugui, Niu Jiangtao, et al., 2022). It can positively regulate blood pressure and blood viscosity (Zhang Shujuan, Zhang Yugui, Niu Jiangtao, et al., 2022). In a study aimed at evaluating the efficacy, duration of action, and safety of Astragalus injection in the treatment of patients with cardiogenic shock (CS) complicated by acute myocardial infarction (AMI), Mi Zhiyong et al. (Mi ZY, Li YX & Zhang DYB., 2009) et al. found that Astragalus can resist shock, stabilize blood pressure, and improve left ventricular systolic function, making it a suitable adjunctive

medicine for the treatment of cardiogenic shock.

##### 4.3.2 Angelica and Chuanxiong

Both can reduce blood rheological indexes, significantly prolonged prothrombin time, and activate partial thromboplastin time. Modern pharmacological studies have found that angelica acts to benefit qi and replenish blood, reduces myocardial oxygen consumption, and to some extent, improves cardiac function after infarction. Luan Haiyan (Qin Xuepeng, 2015) et al. used 80 patients with AMI as study subjects and took angelica tonic blood soup as an observation group to investigate the effect of the soup on ventricular remodeling and cardiac function in AMI patients. The results showed that the soup could effectively intervene in ventricular remodeling after AMI and reduce the occurrence of adverse cardiovascular events. A further study by Fan Zhiwen (Fan Zhiwen, Zhao Yisui, Ling Long, et al., 2017) et al. suggested that the cause of improved ventricular remodeling might be related to the expression of miR-34a in myocardial tissue. Modern pharmacological studies have confirmed that Chuanxiong can expand the coronary artery and clear stagnation, while scavenging oxygen free radicals in the body, relieving vasospasm and protecting the myocardium (Wang Ruo-Tao, Wu Min-School & Wang Kai-Yu, 2019). In a study conducted by Huang Jia-Zhong (Huang J. C., 2022) to investigate the clinical effects of Danshen Chuanxiong injection combined with aspirin in the treatment of 80 elderly patients with coronary artery disease combined with AMI, it was concluded that these patients were well treated with Danshen Chuanxiong injection combined with aspirin, which not only effectively relieved the clinical symptoms of the patients, but also further reduced the level of inflammatory factors, promoted the improvement of vascular endothelial function, and enhanced the antithrombotic efficacy.

#### 5. Acupuncture

In patients with AMI combined with CS, although there are various clinical measures such as intra-aortic balloon pump (IABP), left ventricular assist device, ECMO, etc., the morbidity and mortality rate of these patients has not been effectively improved, so other clinical treatment measures need to be tried. Acupuncture is widely used in the treatment of

various clinical diseases because of its low invasiveness, high controllability, and ease of operation. Some medical practitioners have tried to apply it to patients with CS and achieved good therapeutic results. Li Heung (Li H, Liu H X, She J, et al., 2022) et al. performed acupuncture treatment on patients with refractory CS, acupuncture points such as Hegu, Neiguan, Taichong, Gongsun, Tianshu, Sansanli, Tanzhong and Zhonggui on both sides of the patient, and the temperature of Shenqu acupuncture point was kept at about 40 °C during 20 min of waking up with an infrared therapy instrument, aiming to regulate qi and blood, open the channels and activate the channels, harmonize the spleen and stomach, and warm the stomach and middle, with good clinical treatment results. In patients with refractory CS who were unable to maintain normal hemodynamics, combined acupuncture treatment improved the shock state and improved the long-term prognosis of the patients to some extent. Acupuncture has not been reported for the treatment of CS, which may be the next step in the concerted efforts of front-line clinical workers, and further research and evaluation are needed.

## 6. Conclusion

In conclusion, cardiogenic shock patients can receive multi-channel and multi-target treatment with traditional Chinese medicine. Numerous experimental studies have confirmed the efficacy of Chinese medicine in alleviating the symptoms of cardiogenic shock and improving the clinical prognosis and quality of life for patients. This suggests that its use in clinical treatment is worthy of promotion. However, there is limited research on acupuncture for this condition. Scholars should use this as a starting point for further objective and standardized research into the treatment of cardiogenic shock with traditional Chinese medicine to advance the treatment field and introduce new treatment approaches.

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