To Investigate the Mechanism of Hypertension Induced by Chronic Renal Failure-Related Arteriosclerosis and Principles of Treatment and Nursing Care in Traditional Chinese Medicine

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Abstract

Kidney disease is one of the causes of secondary hypertension; there are many mechanisms of hypertension, but the most basic one is arteriosclerosis. Recent studies have indicated a relationship between arteriosclerosis and the formation of advanced glycation end products (AGEs), arterial deposition, and difficulty in removing obstructions. Oxidative stress is one of the causes of AGEs formation. Studies have shown that chronic renal failure (CRF) not only causes an increase in oxidative stress in the body, but also leads to a decreased clearance of advanced glycation end products. CRF-related arteriosclerosis can also be interpreted by the five-phase engendering and restraining theory of pathology in traditional Chinese medicine (TCM). According to five-phase theory, water restrains fire, that is, diseases of the kidney are transmitted to the heart. Moreover, because the heart governs the blood vessels, diseases of the kidney indirectly damage the blood vessels. Therefore, from the principles of treatment and nursing care in TCM, arteriosclerosis treatment and care can be used according to the formation mechanism. Furthermore, treatment that attenuates renal dysfunction progression may improve kidney function and achieve the aim of preventing or reducing the risk of developing arteriosclerosis.

Keywords: Chronic Renal Failure; Advanced Glycation end Products; Arteriosclerosis; Hypertension; Traditional Chinese Medicine

Abbreviations: AGEs: Advanced Glycation End Products; CRF: Chronic Renal Failure; TCM: Traditional Chinese Medicine; CML: Carboxymethyl-lysine; DG: Deoxyglucosone.
Chronic Renal Failure and Hypertension

Hypertension has continually posed a serious threat to human health and life. In generally, hypertension can be categorized into primary hypertension of unknown cause or complicated hypertension with CRF or secondary hypertension diabetes associated with diabetes. Previous studies have suggested that the mechanisms of secondary hypertension due to CRF are as follows Figure 1:

- Sodium and water retention: Increased blood volume in repose to a decline of glomerular filtration rate due to severe CRF will result in an increase in cardiac output and blood pressure.
- Renin-angiotensin-aldosterone system activation: Kidney disease-associated renal vascular disease leads to a decrease in renal blood flow, which increases renin secretion and activates vasoconstrictors. The constriction of the resistant arterioles then leads to hypertension. In addition, angiotensin can also stimulate the secretion of aldosterone, increasing sodium and water reabsorption from renal tubules, and increasing sodium and water retention.
- Renal sympathetic nerves: Norepinephrine released from nerve endings during activation of the renal sympathetic nerves stimulates glomerular cells, which increases renin secretion, and promotes renal tubular reabsorption of sodium and water.
- Decreased in hypotensive substances of the kidney: Renal medullary interstitial cells papilla and renal cortical glomeruli cells induce dilation of blood vessels, inhibit renin, and excrete prostaglandin E2 and I2 with water. When renal tissue damage occurs, the quantity of secreted antihypertensive substances is reduced, which indirectly affects blood pressure.

Mechanism of Chronic Kidney Disease-Related Atherosclerosis

In addition to the above mechanisms, newer studies have found that the incidence of hypertension is related to deposition of advanced glycation end products (AGEs) on the arterial wall. The interaction between AGEs and arterial collagen will lead to arteriosclerosis [1].

Formation of AGEs

The reaction between proteins and sugars in vivo is known as glycosylation and can be classified into two categories according to the type: the first type is an enzyme involved in the catalytic reaction in the endoplasmic reticulum or Golgi apparatus, where the proteins undergo glycosylation. The other one is a non-enzymatic glycation reaction, such as the formation of...
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principles based on these viewpoints, tonify the kidney and blood-activating are the two main focuses. The purpose of tonify the kidney is to improve renal function in order to maintain normal AGEs excretion, whereas the purpose of blood-activating is to promote blood circulation, and subsequently reduce the formation or accumulation of AGEs in the blood vessels, which could delay the onset of arteriosclerosis.

Treatment and Nursing Care Through Tonify the Kidney and Blood-Activating According to TCM Theory

The basic pathology of CRF in TCM is debilitation and vanquishing of the spleen and kidney, which causes internal stagnation of water-dampness and internal static blood obstruction; the course of the disease starts with excess and moves to deficiency [11], therefore the course of treatment should be to treat both the root and tip by reinforce the healthy qi and eliminate the pathogenic factors. Treatment of the root focuses on tonify and replenish the spleen and kidney to maintain remaining kidney function [12], whereas treatment of the tip focuses on draining turbidity and clearing heat to induce diuresis and alleviate edema. Reduction of sodium and water retention are performed in order to avoid hypertension caused by the increased blood volume, and activate blood and resolve stasis is also performed throughout the course of treatment; This not only ameliorates renal blood stasis and increases renal blood supply in order to facilitate the recovery of kidney damage, but also slow the development of arteriosclerosis to ameliorate hypertension [13].

TCM Treatment

Many previous studies have shown that treatment methods to tonify the kidney and activate the blood are effective in improving renal function. For example, when medicinal such as Liu-wei Di-huang pill, which includes the constituents of cooked rehmannia root (shu di huang), cornus (shan zhu yu), root cortex of paeonia (Mu dan pi), alisma orientalis (ze xie), poria cocos (fu ling), dioscorea Alata (yam), are used to treat CRF, blood urea nitrogen and serum creatinine can be effectively reduced, increasing endogenous creatinine clearance, while effectively reducing triglyceride and cholesterol levels [14,15]. Pharmacological research has shown that these medicinals contain many biologically active ingredients. They can not only improve renal function and antioxidant capacity, but also inhibit the formation of AGEs [16-20].

TCM Nursing Care

In addition to pharmacotherapy, correct determination of pattern to elucidate the pathogenesis of the condition can effectively improve kidney function in patients with CRF and reduce oxidative stress. Common clinical care measures are as follows:

Emotional care: Emotions indicate the changes in psychophysiological activities that can directly affect the function of organs. According to TCM theory, inhibition of emotions is an internal cause of diseases. In the Great Treatise on the Correspondences and Manifestations of Yin and Yang in Su Wen of the Huangdi Neijing, states that “anger damages the liver, joy damages the heart, thought damages the spleen, sadness damages the lungs, and fear damages the kidneys.” This explains that when there is a disturbance in emotions, it can lead to disorders of qi, blood, yin, and yang, thereby causing dysfunction of the organs [21]. The results of past pathophysiologic studies have shown that mental stress can cause increased endogenous oxidative stress, resulting in arteriosclerosis-induced hypertension [22]. Therefore, for patients with different conditions, the appropriate method of emotional care for patients should be selected to enlighten patients, dispel doubts, or use diversionary techniques to achieve a resolution of emotional stagnation. When necessary, restrictive or suggestive methods can be used to relieve patient anxiety and tension related to negative emotions, ameliorating the progression of the disease [21].

Diet therapy: The effects of diet are extremely important for patients with CRF. In addition to avoiding a high-sodium, high-fat diet, it is also important to reduce the intake of foods that promote the development of AGEs, such as foods high in sugar, barbecued foods [23], establish good eating habits, and avoid improper diet that leads to spleen deficiency, which increased endogenous oxidative stress [24], therefore reduce the risk of onset of arteriosclerosis. Furthermore, according to the TCM theory of “same origin of Chinese medicines and foods”, foods have the four qi and five flavors, therefore when performing diet therapy, it is advisable to follow the principle of “salt damages the kidney, and bland flavors percolate dampness”, that is, patients should follow a low-sodium, bland diet and increase the intake of foods that tonify the kidney and replenish qi, such as black beans, black rice, black fungus, dates, flowery knotweed, silky fowl, and sea cucumber to improve renal function. Modern medical research has revealed that these foods also have a strong antioxidant capacity [25].
Daily life care: The living environment and living conditions for the health of the body also have a great impact. The living environment should be kept well ventilated and be located in a shady area; By avoiding overexposure to ultraviolet radiation, air pollution and smoking to reduce exogenous oxidative stress, it is possible to reduce the formation of AGEs and reduce the incidence of arteriosclerosis [26]. Irregular lifestyle and staying up late are likely to cause increased endogenous oxidative stress, resulting in damage to internal organs. Therefore health guidance must focus on educating the patient to maintain a regular lifestyle. As it is written in the Treatise of Heavenly Truth from Remote Antiquity in Su Wen of the Huangdi Neijing, "their eating and drinking is moderate, rising and resting had regularity, they do not tax themselves with meaningless work. Hence, they are able to keep their physical appearance and spirit together, and to exhaust the years allotted by heaven. Their life span exceeded one hundred years before they depart from this life." In addition to these points, sexual activity should be limited. According to TCM theory, kidney is the root of earlier heaven and the organs are the storehouses of essence; when kidney essence is sufficient, the bowels and viscera are strong. For this reason, CRF patients should limit sexual activity in order to maintain adequate kidney essence and avoid further exacerbation of the condition.

Conclusion

In CRF patients, the activation of the renin-angiotensin-aldosterone system causes arteries to constrict and increases blood volume, leading to hypertension, the increase in endogenous oxidative stress induced by kidney disease accelerates the formation of AGEs. At the same time, renal failure causes insufficient renal function, excretion of AGEs decreases. When both are present, excessive accumulation of AGEs occurs on the blood vessel walls, leading to the development of arteriosclerosis, which further exacerbates hypertension [27]. Therefore, in considering the methods to prevent the disease, it is necessary to consider the TCM theory of "treating disease before it arises" and the pathogenic mechanisms of the condition as elucidated by pathophysiology to combine treatment using TCM and pathophysiology in order to reduce CRF complicated by arteriosclerosis, which can lead to hypertension. The principles of treatment are based on the five-phase engendering and restraining theory of pathology in TCM. That is, because the kidney invariably transmits the disease to the heart, concomitant treatment of the root and tip is needed to boost qi and nourish the blood, drain dampness and down bearing the turbid, activate blood and resolve stasis, thereby slowing the progression of CRF and ameliorating renal function. Moreover, by combining the emotional care, diet therapy and daily life care of TCM, it is possible to reduce oxidative stress to prevent excessive formation of AGEs, while maintaining the normal excretory mechanism of AGEs, maintaining constant blood volume, and preventing the constriction of shrinkage-resistant arteries in order to achieve the common goal to reduce CRF-induced hypertension.

Conflicts of Interest: None declared.

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