

Analysis of the mechanism and efficacy of Chuanxiong in treating gout

Jie Shi

Wuxi Taihu University, Wuxi, China

wuxitaihushijie@outlook.com

Abstract. Gout is a metabolic disease caused by the deposition of monosodium urate, marked by severe pain and inflammation. Globally, its incidence rate is on the rise, and the incidence population is getting younger, which has become a key public health problem. The treatment methods of Western medicine can quickly exert anti-inflammatory and analgesic effects, but cannot cure the disease. Traditional Chinese medicine has become a potential treatment for gout. From the perspective of traditional Chinese medicine's principle of syndrome differentiation and treatment, Chinese medicine can regulate the organs of the body, improve metabolic disorders at the root, reduce the production of uric acid, and promote its excretion from the body. Chuanxiong, as a traditional Chinese medicine, has a synergistic effect of various active ingredients such as ligustrazine and ferulic acid, which can alleviate pain, reduce inflammation, reduce urea, improve microcirculation, and have antioxidant effects. It is used to treat gout. In the future, the mechanism of action of *Ligusticum chuanxiong* in treating gout can be exploited through the development of combination drugs, and a new treatment strategy can be created, providing reference for further research on the pathogenesis of gout and the development of new drugs.

Keywords: Chuanxiong, gout, inflammatory cytokines

1. Introduction

Gout, also known as hyperuricemia, is a joint disease mainly caused by excessive accumulation of uric acid in the blood, disorder of purine metabolism, and reduced excretion of uric acid, resulting in a sustained increase in uric acid levels in the blood. urate crystals deposit in the joints, soft tissues, and kidneys, leading to metabolic diseases characterized by recurrent joint inflammation [1]. The existing research shows that the incidence rate of gout is on the rise worldwide, especially in areas with high purine foods, high sugar drinks, obesity and metabolic syndrome (such as Europe, America and some coastal cities in Asia). In the coastal areas of southern China, the incidence rate of seafood intake is significantly higher than that of inland areas; The northern region also has a higher incidence of illness due to the cold winter and regional drinking habits. At the same time, the probability of male patients suffering from the disease is significantly higher than that of females, mainly due to the promotion of uric acid excretion by estrogen. The peak age of disease onset is between 40-60 years old, but in recent years, there has been a clear trend towards younger onset [2]. As a globally prevalent metabolic disease, gout has become an important public health challenge. It not only

seriously affects the quality of life of patients, but also requires long-term medical intervention—from acute treatment to uric acid lowering management during remission, to the treatment of complications, all of which consume a large amount of medical resources and invisibly increase personal medical expenses and social burden. From the perspective of traditional Chinese medicine characteristics, Chuanxiong has a pungent and warm nature. Its medicinal properties are pungent, dispersing, warming, and promoting circulation. Chuanxiong can activate the qi in the blood, drive blood flow, and unblock the channels of qi and blood flow. It is one of the medicinal herbs in clinical practice that has the effects of promoting blood circulation, regulating qi, and relieving pain. In the treatment of limb joint pain, Chuanxiong can be combined with medicines such as Qianghuo, Duhuo, and Danggui to dispel wind and dampness, promote blood circulation, and unblock collaterals, effectively relieving pain fundamentally.

At present, although Western medicine is the main treatment for gout, its limitations are obvious. In the acute phase, although nonsteroidal anti-inflammatory drugs, colchicine and other drugs can quickly relieve pain, they can cause side effects such as gastrointestinal discomfort and liver and kidney function damage. Some patients may interrupt treatment because they cannot tolerate it. The uric acid lowering drugs used during the remission period, such as allopurinol and benzbromarone, need to be taken for a long time to maintain stable uric acid levels. After stopping the medication, there may be a rebound, leading to recurrent attacks of gout [3]. Based on the "holistic concept" and the principle of "syndrome differentiation and treatment" in traditional Chinese medicine, Chuanxiong, as a commonly used medicine for "promoting qi and blood circulation" and "reducing swelling and pain", can alleviate pain, regulate organ function, improve metabolism, and have relatively low side effects from the root cause of the disease.

2. The pathogenesis of gout

Bi syndrome "and" Li Jie disease "were ancient names for gout. The concept of "Bi syndrome" first appeared in the Yellow Emperor's Inner Canon, Su Wen, Bi Lun. The book proposes that "wind, cold, and dampness are mixed together to form Bi syndrome", and is divided into "Xing Bi (wind pathogen imbalance, pain wandering)", "Tong Bi (cold pathogen imbalance, severe pain)", and "Jiao Bi (dampness pathogen imbalance, heavy limbs)" according to the dominance of disease pathogens. Traditional Chinese Medicine believes that the etiology and pathogenesis of gout are based on the core principle of "deficiency of the essence and excess of the substance", that is, the deficiency of organ function is the foundation, and dampness heat, phlegm stasis, and turbidity toxin are the criteria.

Traditional Chinese medicine treatment for gout can be based on the differentiation and treatment of disease stages. Due to long-term intake of high oil, high salt, and high sugar foods in the human body, the transport and metabolism of food in the body deteriorates, leading to the accumulation of dampness and heat in the body. There are a large amount of turbid substances in the body that cannot be excreted from the body. This can lead to poor circulation of qi and blood. The treatment method mainly focuses on "purging and solidifying", using cold and refreshing drugs that can quickly eliminate pathogenic factors. The key to the pathogenesis of the remission period lies in the deficiency of spleen and kidney, and the accumulation of dampness and turbidity. Spleen deficiency leads to dysfunction of water and dampness function, resulting in endogenous dampness and turbidity; Kidney qi deficiency leads to unfavorable gasification, making it difficult to eliminate turbid toxins. The medication mainly focuses on calming and nourishing. The treatment method is supplemented by "attacking and supplementing simultaneously" or "supplementing as the main approach". Take traditional Chinese patent medicines and simple preparations Rusimiao Pill and Danggui Niantong Pill orally. Acupuncture treatment often uses acupoints such as Zusanli, Yinlingquan, Fenglong, Sanyinjiao, and

Neiting to clear the turbid substances in the body and make blocked blood vessels unobstructed through the method of guiding and expelling them. It can also be paired with classic formulas such as Simiao San and Fangji Huangqi Tang.

Chuanxiong is known as the "blood qi medicine" and plays a crucial role in the traditional Chinese medicine system. Its nature is pungent and warm, and it belongs to the liver, gallbladder, and pericardium meridians. Commonly used to treat menstrual disorders, chest pain, and other illnesses. Based on the efficacy of Chuanxiong in promoting blood circulation, dispelling wind, and relieving pain, it plays a crucial role in treating joint redness, swelling, and pain caused by gout dampness heat, turbid toxins, blood stasis obstructing meridians, and poor circulation of qi and blood.

3. The mechanism of action of Chuanxiong in treating gout

The main active ingredients of Chuanxiong include phthalates and phenolic acids. Tetramethylpyrazine (TP) is a unique nitrogen-containing compound (tetramethylpyrazine) and the most important alkaloid active ingredient. Phenolic acid compounds include Ferulic Acid (FA), Caffeic Acid (CA), Sinapic Acid (SA), etc. Among them, FA is a hydroxycinnamic acid that exists in the cell wall of *Ligusticum chuanxiong* plants. Phthalide compounds include Ligustilide (LS), Butylphthalide (BP), and Neocnidilide (ND). These active ingredients constitute the pharmacological basis of Chuanxiong in treating gout. Research has shown that the main components of Chuanxiong, such as lignans, phenylpropanoids, esters, and ferulic acid, can inhibit xanthine oxidase and reduce the production of uric acid in the body, thereby reducing the probability of gout. Yang et al.'s study found that certain compounds in Chuanxiong rhizome have significant anti XOD activity, thereby reducing blood uric acid levels [4].

The core mechanism of acute gout attacks is the activation of NLRP3 inflammasome triggered by monosodium urate crystals (MSU), which in turn induces the release of inflammatory factors such as IL-1 β and TNF- α . The active ingredients in Chuanxiong exhibit significant anti-inflammatory activity and can reduce the expression of these inflammatory factors. It is possible to achieve the goal of anti gout by inhibiting the activation of NLRP3 inflammasome. Zhang X et al.'s research shows that natural products can alleviate the inflammatory response caused by gout by inhibiting the NLRP3 pathway [5]. Chuanxiong, as a natural product, achieves anti-inflammatory and analgesic functions mainly by inhibiting the activation of pro-inflammatory signals and promoting the secretion of anti-inflammatory related substances, thereby rebuilding signal homeostasis. The transcriptional regulation of inflammatory response is mainly controlled by the key factor NF- κ B, which is the "core regulator" of inflammatory response. Chuanxiong achieves analgesia through multi-target anti-inflammatory effects, and the molecular mechanism has been elucidated. Research has shown that ligustilide A, Z-ligustilide, and new snake bed lactone are its core anti-inflammatory components, with the 95% ethanol extract having the strongest activity. These components synergistically act on key targets such as COX-2, JAKs, IKK β , TNF- α , and PI3K, inhibiting inflammatory signaling through multiple pathways and exerting anti-inflammatory effects, revealing the pharmacological basis of the multi-component multi-target approach of Chuanxiong [5].

Chuanxiong can expand the hepatic vascular pathway, regulate blood viscosity, block the formation of hepatic sinusoidal microthrombi, and ensure the oxygen and nutritional needs of liver cells [6, 7]. It can induce vascular smooth muscle relaxation, reduce blood viscosity, enhance the deformability and adaptability of red blood cells, effectively improve the microcirculation efficiency of liver and kidney organs, and indirectly optimize the biosynthesis and excretion of urea. The validation of the long-term regulation effect of Chuanxiong is reflected in two aspects: on the one hand, phenolic acid compounds, as natural antioxidants,

release electrons from phenolic hydroxyl groups to scavenge free radicals, inhibit chain oxidation, and slow down cell membrane and protein oxidation [8]. Moreover, red blood cells can smoothly pass through small-diameter capillaries through mechanisms, improving blood perfusion in microcirculatory areas.

4. Analysis of the therapeutic effect of Chuanxiong in treating gout and optimization strategies

Western medicine usually only targets a single target when treating gout, such as relieving pain or reducing uric acid levels, and cannot simultaneously reduce uric acid levels in the body while relieving pain. Chuanxiong inhibits the inflammatory signaling pathway through multi-target synergistic effects while reducing the activity of xanthine oxidase, promoting the excretion of uric acid by the kidneys and exerting a uric acid lowering effect. As a traditional Chinese medicine, Chuanxiong has relatively low side effects and is more easily accepted by patients. Chuanxiong has the effects of relieving swelling, limb numbness, and anti-inflammatory and antioxidant effects, which can help stabilize the condition and reduce the frequency of acute gout attacks, making it more advantageous compared to Western medicine. Research has confirmed that preparations containing Chuanxiong can alleviate hyperuricemia and gouty nephropathy in animal models by inhibiting XOD activity, improving kidney function, and regulating uric acid transporters [9]. This mechanism suggests that Chuanxiong may exert its effects through multi-target synergy in compound formulations, but more clinical evidence is still needed to support it. Existing studies have shown that the combination of Chuanxiong and Shaoyao can achieve anti-inflammatory and anti apoptotic effects through the TLR4/MyD88/MAPK/NF- κ B pathway [10]; Compound Chuanxiong Capsules (CCC) also use the PI3K/Akt/NF- κ B pathway to reduce the expression of IL-6 and TNF- α in animal models [11].

The dosage of Chuanxiong should be adjusted rationally for different stages of gout. During the acute and severe stages of the disease, the dosage can be appropriately increased, while during the recovery period, the dosage should be reduced and more combined with tonics to achieve the effect of both attacking and supplementing. For patients with weak or deficiency syndrome, it is recommended to start with a small dose (such as 3-6 g) and adjust it according to changes in the condition. These studies indicate that the combination or preparation of Chuanxiong with other drugs is beneficial for the rational regulation of its therapeutic effect. When treating damp heat syndrome, the focus should be on clearing heat and removing dampness. Chuanxiong, as an adjunctive medicine, should not be used in excessive amounts (such as 6-9 g), with the aim of promoting blood circulation and relieving pain, and assisting the main medicine in clearing joint obstruction. These strategies provide guidance for the clinical application of Chuanxiong.

5. Conclusion

The therapeutic effect of Ligusticum chuanxiong does not rely on a single mechanism, but on the synergistic operation of substances such as Ligusticum chuanxiong and ferulic acid to achieve analgesic and anti-inflammatory effects, promote capillary circulation, and antioxidant defense. In the future, clinical treatment can focus on developing intervention measures that complement each other's strengths and weaknesses. Western medicine can be used to control symptoms in a timely manner during acute attacks of pain, and Ligusticum chuanxiong can be used for recuperation during the remission period. In the acute phase, treatment with colchicine, nonsteroidal anti-inflammatory drugs, or glucocorticoids can quickly suppress inflammation and relieve pain, but this can only alleviate the surface condition and cannot achieve a decrease in uric acid, and the side effects are difficult to accept. After rapid intervention of initial symptoms, the clinical focus

should be on preventing recurrence, adjusting the overall state, and continuously managing uric acid levels. At this point, the multi mechanism advantages of Chuanxiong can be fully utilized. By using traditional Chinese medicine combined with Chuanxiong for regulation, the problem of inflammation can be fundamentally solved by inhibiting uric acid production and promoting excretion through a dual pathway of mild uric acid reduction [7]. Chuanxiong can effectively improve limb numbness and promote joint function recovery by improving microcirculation. Compared to the potential liver and kidney function effects of long-term use of uric acid lowering drugs, Chuanxiong is safer at a reasonable dosage and is suitable as a long-term medication for remission.

At present, the research on the treatment of gout with traditional Chinese medicine has a small sample size, insufficient design rigor, and mostly single center studies, resulting in insufficient persuasiveness of experimental evidence. Suggestions for conducting prospective, multicenter, large sample randomized controlled trials in the future are the "gold standard" for testing drug efficacy and safety; It is necessary to consider implementing it in multiple hospitals in multiple regions, quickly admitting sufficient patients, ensuring that the research has sufficient statistical basis, and comparing the actual therapeutic effects between the Chuanxiong group and the control group. The traditional use of Ligusticum chuanxiong faces problems such as low utilization efficiency of active ingredients, short duration of drug efficacy, and frequent administration. In the future, active ingredient sustained-release tablets can be developed to allow active ingredients such as Ligusticum chuanxiong and ferulic acid to be slowly and uniformly released in the body, maintaining the stability of blood drug concentration for a long time. At the same time, targeted formulations can be developed using nanotechnology, liposomes, microspheres and other delivery carriers to accurately deliver the active ingredients of Ligusticum chuanxiong to the affected area, improving treatment efficiency. The ultimate goal is to establish a long-term regulation and prevention treatment mode using new Ligusticum chuanxiong preparations, providing safer, more effective, and reliable treatment methods for gout patients.

References

- [1] Bai, X., Wang, M., Wang, Y. (2025). Analysis of Traditional Chinese Medicine Application in Gout Combined with Osteoarthritis. *Chinese Pharmacovigilance*, 22(03), 258-262.
- [2] Lin, Z. J., Huang, Z. K., Wang, Y. (2021). Construction and application of a research platform for the efficacy mechanism of traditional Chinese medicine in gout. *World Journal of Traditional Chinese Medicine*, 16(01), 41-45.
- [3] Song, R. T., Ma, K., Pang, X. Y.(2025). Screening of pharmacological effects and mechanism of action of different extracts of Chuanxiong on gout. *Chinese Journal of Modern Traditional Chinese Medicine*, 27(03), 535-545.
- [4] Yang, M. L., Yang, H. D., Tang, Z. S., Hu, X. H., Zhou, R., Xue, T. T., Ma, K., Ji, C., & Xu, H. B. (2023). Lignan and phthalide derivatives from the rhizome of Ligusticum chuanxiong (Rhizoma chuanxiong) and evaluation of their anti-Xanthine Oxidase Activities. *ACS Omega*, 8(42), 39855-39864.
- [5] Zhang, X., Wang, Z., Zheng, Y., Yu, Q., Zeng, M., Bai, L., Yang, L., Guo, M., Jiang, X., & Gan, J. (2023). Inhibitors of the NLRP3 inflammasome pathway as promising therapeutic candidates for inflammatory diseases. *International Journal of Molecular Medicine*, 51(4), 35.
- [6] Ma, N. N., Song, L. L., Fan, S. S. (2018). Screening of anti-inflammatory substances in Chuanxiong and analysis of its mechanism of action. *Chinese Journal of Experimental Formulary*, 24(18), 7.
- [7] Li, H. Q. (2008). Current status of modern basic research and clinical application of traditional Chinese medicine Chuanxiong. *Modern Medicine and Health*, 24(13), 1999-2001.

- [8] Li, W. M., Liu, H. T., Li, J. J., Zhang, J., Shi, L., & Yu, C. (2010). In vitro antioxidant study of active ingredients in Chuanxiong. *Chinese Journal of Food and Biotechnology*, 29(1), 64-70.
- [9] Ma, K., Zhou, R., Yang, H. D., Pang, X. Y., Li, N., Song, Z. X., Tang, Z. S., & Xu, H. B. (2025). Chuanxiong Rhizoma extracts alleviate hyperuricaemia-induced renal injury by reducing serum UA levels and renoprotection. *Fitoterapia*, 182, 106456. <https://doi.org/10.1016/j.fitote.2024.106456>
- [10] Gu, J. F., Su, S. L., Guo, J. M., Zhu, Y., Zhao, M., & Duan, J. A. (2018). Anti-inflammatory and anti-apoptotic effects of the combination of Ligusticum chuanxiong and Radix Paeoniae against focal cerebral ischaemia via TLR4/MyD88/MAPK/NF- κ B signalling pathway in MCAO rats. *Journal of Pharmacy and Pharmacology*, 70(2), 268-277.
- [11] Kang, Q., Liu, W., Liu, H., & Zhou, M. (2015). Effect of Compound Chuanxiong Capsule on Inflammatory Reaction and PI3K/Akt/NF- κ B Signaling Pathway in Atherosclerosis. *Evidence-Based Complementary and Alternative Medicine*, 2015, 584596. <https://doi.org/10.1155/2015/584596>