

# *Data Mining Medicine Law of Chinese Medicine Fumigation in the Treatment of Hemiplegia after Stroke*

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**Abstract:** To summarise the prescription pattern of Chinese medicine fumigation for hemiplegic patients after stroke by applying data mining techniques. Clinical literature on Chinese medicine fumigation for post-stroke hemiplegia from China Knowledge Network (CNKI), China Academic Journal Library (Wangfang), Chinese Science and Technology Journal Library (VIP), and Chinese Biomedical Journal Library (CBM) from the year of establishment to 2022 was collected. Sexual flavour, attribution, efficacy analysis and association rules, systematic clustering, and complex network analysis were performed using Excel 2019, SPSS Modeler 18.0, and SPSS Statistics 25.0. Total literature 151 articles, 159 Chinese herbal compound prescriptions, mostly using warm medicines, the taste of the medicines were mostly pungent and bitter, mostly using liver, pungent and spleen meridians, commonly used to activate blood circulation and remove blood stasis, followed by expectorants of wind-dampness and antidote to epidemiology, the association rules obtained 3 sets of associations. Chinese medicine fumigation for post-stroke hemiplegia is mostly based on activating blood circulation and removing blood stasis, dispelling wind and removing dampness and relieving surface as the key therapeutic factors, which can be applied opportunistically in clinical research.

Stroke is a common and frequent disease in the elderly population and the second leading cause of death in the population, and can be broadly divided into haemorrhagic and ischaemic strokes [1]. Stroke patients have increasing survival rates after treatment, but are often associated with severe disabilities such as hemiparesis, swallowing disorders, loss of voice and cognitive impairment [2]. Timely care and rehabilitation after stroke can help to enhance neurological and physical recovery and add to the quality of life of patients [3]. Stroke is a great financial burden to the family and society, and surgery is used in clinical practice, but there are still limitations and other active treatment modalities should be sought [4].

In current studies, Chinese medicine has been used throughout the course of stroke patients, with

herbal tonics, acupuncture and massage having significant efficacy [5, 6]. In particular, Chinese herbal fumigation, which combines the potency of the drug with heat through decoction, increases the penetrating power of the drug and allows it to work better on the muscles, mucous membranes and nerve tissues, thus activating blood circulation and removing blood stasis and activating the meridians [7, 8]. The number of studies on the treatment of post-stroke hemiplegia through herbal fumigation is increasing, with outstanding clinical results [9]. In this study, we used Apriori's association rule and systematic clustering method to organize and summarize the Chinese herbal remedies for post-stroke hemiplegia and further explain them using the theoretical system of Chinese medicine, in order to provide ideas for clinical treatment and to find effective and economical ways of treatment.

## 1 Data and methods

### 1.1 Data sources

The databases of China Knowledge Network (CNKI), WanFang Data (WangFang), VIP Chinese journals (VIP) and China Biomedical Journal Library (CBM) were used to conduct advanced searches for "hemiplegia + motor dysfunction + hemiplegia + hemiplegia + paralysis" and "Chinese herbal fumigation + fumigation " as topics (titles and keywords). Time: The database was built up to 13 November 2022.

### 1.2 Inclusion and selection criteria

Inclusion criteria:①the literature met the diagnostic criteria for stroke and stroke disease;②the herbal compound had clear dosage and drug composition;③the clinical efficacy was clearly shown to be effective;④it was herbal fumigation alone or in combination with other therapies (acupuncture, primary care, western medicine).

Screening criteria:①articles on animal experiments, reviews, bibliometrics,②the same prescriptions were entered only once;③single herbs and non-internal therapies.

### 1.3 Data cleaning

The names of the entered Chinese medicines were standardized by referring to the Chinese Pharmacopoeia[10] (2020 Edition I) and Traditional Chinese Medicine<sup>[11]</sup> (9th Edition), e.g., "Mai Men Dong" was standardized as "Mai Dong", "Bai Shao Yao" for example, "Mai Men Dong" was standardized as "Mai Dong", "Bai Shao Yao" was standardized as "Bai Shao", "Fa Xian Xia" was standardized as "Xian Xia", etc.

### 1.4 Data entry

After being entered into Notexpress by two persons respectively for checking and deletion, the valid herbal combinations were extracted and entered into Excel 2019 software, which was reviewed by two persons after entry.

### 1.5 Data analysis

After the data were entered into Excel 2019 software and checked for errors, the frequency, taste and taste, and efficacy of the drugs were classified using Excel 2019 software, and the association rules were analysed using SPSS Modeler 18.0.

## 2 Results

### 2.1 Literature search results

A total of 1067 literatures were obtained after the search, 215 from Zhiwang, 161 from Vipshop, 306 from Wanfang and 385 from China Biomedical Journal Library. 151 literatures were included after checking and screening, with 159 valid prescriptions.

### 2.2 Frequency of drug use

A total of 182 drugs were included, with a cumulative frequency of use of 1591 times, of which a total of 10 Chinese medicines were used  $\geq 10$  times, with safflower, cinnamon stick and stretching herb being the main ones, with a frequency of use of more than 50% (Table 1).

Table 1: High-frequency medication (frequency  $\geq 10$ ) prescribed for hemiplegia after stroke by Chinese herbal fumigation

No.	Chinese medicine	frequency	Frequenc y/%	No.	Chinese medicine	frequency	Frequenc y/%
1	honghua	97	64.24	6	jixueteng	60	39.74
2	Guizhi	89	58.94	7	tougucao	55	36.42
3	shenjingcao	88	58.28	8	niuxi	46	30.46
4	danggui	64	42.38	9	ruixiang	42	27.81
5	chuanxiong	60	39.74	10	sangzhi	42	27.81

Note: Frequency = frequency of medication use/total frequency of medication use x 100%

### 2.3 Analysis of association rules

The association rule analysis was performed on 182 Chinese herbal medicines, with a set support of  $\geq 10\%$ , confidence  $\geq 50\%$  and boosting power  $\geq 1$ . The most frequently used pairwise association, horn medicine association and 4-flavor association were Gui Zhi-Safflower, Gui Zhi-Xinzhu Cao-Safflower and Chuan Wu-Xinzhu Cao-Tuo Biao Cao-Safflower respectively (Table 2, Table 3).

Table 2: Distribution of flavour profiles of Chinese herbal medicine prescriptions for the treatment of post-stroke hemiplegia by fumigation

No.	Chinese medicine	frequen cy	Frequency/%	No.	Chinese medicine	frequency	Frequency/ %
laborious	94	1005	63.17	surna me en	78	990	62.23
bitter	100	813	51.10	calm	37	286	17.98
sweet	63	575	36.14	Cold	51	209	13.14
Sour	11	118	7.42	Hot	6	76	4.78
Salty	15	114	7.17	cold	10	30	1.89
light	5	14	0.88				
Astringent	5	5	0.31				

Table 3: Distribution of prescriptions attributed to Chinese medicine fumigation for the treatment of post-stroke hemiplegia

No.	Chinese medicine	frequency	Frequency/%
liver	105	1136	71.40
Spleen	68	665	41.80
Heart	46	660	41.48
Kidney	52	515	32.37
Lung	66	386	24.26

Stomach	46	157	9.87
Bladder	16	152	9.55
Gallbladder	9	77	4.84
Pericardium	3	67	4.21
Large Intestine	16	59	3.71
San Jiao	3	6	0.38
Small Intestine	5	5	0.31

## 2.4 Distribution of drug effects

The drugs were classified according to their efficacy, and there were 17 types of efficacy. Among them, the efficacy of the first four drugs corresponded to activating blood circulation and removing blood stasis (23 flavours, 472 times), dispelling wind-dampness drugs (24 flavours, 373 times), antidepressants (16 flavours, 198 times), and tonifying the deficiency (17 flavours, 172 times), etc., with a cumulative frequency of use of 29.67%, 23.44%, 12.45%, and 10.81%, respectively (Table 4).

Table 4: Classification of the efficacy of Chinese medicine fumigation in the treatment of post-stroke hemiparesis prescription

Efficacy Classification	quantities	frequency	Frequency/%	Efficacy classification	quantities	frequency	Frequency/%
Drugs for activating blood circulation and removing blood stasis	23	472	29.67	Water-inducing and Dampness-expelling Medicines	5	16	1.01
Dispelling wind-dampness	24	373	23.44	Qi regulating drugs	9	15	0.94
Exopathogens	15	198	12.45	Opening the orifices	2	14	0.88
Nourishing drugs for deficiency	17	172	10.81	Astringent	3	6	0.38
Clearing heat	15	55	3.46	Dampness-reducing	3	6	0.38
Stopping bleeding	3	45	2.83	Eliminating food	2	2	0.13
Calming Liver Wind	6	44	2.77	Tranquilisers	1	1	6.50
Warming the interior of the body	6	41	2.58	Laxatives	1	1	0.06
Resolving phlegm, relieving cough and asthma	12	22	1.38				

## 2.5 Association rule analysis

Association rule analysis was performed on 182 Chinese herbal medicines, with support set at  $\geq 10\%$ , confidence level  $\geq 50\%$ , and enhancement power  $\geq 1$ . The most frequently used pair-medicine associations, angular-medicine associations, and 4-flavour-medicine associations were gui zhi - safflower, gui zhi - xin zhi qiao - safflower, and chuan wu - xin zhi qiao - tuo biao qiao - safflower, respectively (Tables 5).

Tables 5: Prescription-to-drug association rules for Chinese medicine fumigation for post-stroke hemiparesis

No.	eventualities	antecedent	Support/%	Confidence/%	Enhancement
1	guizhi	honghua	61.01	57.73	1.03
2	shenjingcao	honghua	61.01	64.95	1.2
3	guizhi	Shenjingcao-honghua	39.62	68.25	1.22
4	tougucao	guizhi-Shenjingcao	35.22	50	1.45
5	honghua	guizhi-Shenjingcao	35.22	76.79	1.26

6	honghua	shenjingcao	54.09	73.26	1.2
7	chuanxiong	tougucao-guizhi-shenjcao	17.61	53.57	1.42
8	danggui	tougucao-guizhi-shenjcao	17.61	53.57	1.33
9	danggui	tougucao-guizhi-honghua	17.61	53.57	1.33
10	honghua	tougucao-guizhi-shenjcao	17.61	75	1.23

### 3 Discussion

Modern clinical medicine treatment of post-stroke hemiplegia includes motor imagery therapy, mirror therapy, physical factor injection therapy, and neurodevelopmental promotion therapy, etc.[14], which belongs to ‘hemiplegia’ and ‘paralysis’ in traditional Chinese medicine. The human body is often caused by external and internal injuries, resulting in qi stagnation and blood stasis, phlegm and toxicity, the brain qi and blood reverse, phlegm and blood stasis paralysis blockage of the veins and collaterals, resulting in hemiplegia, hemiparesis and other symptoms [15]. The origin and symptoms of all diseases’ believes that “people or in the evil wind, rarely does not lead to death, so it is difficult to cure into the dirty, such as its meridian emptiness and injury, hemiplegia, paralysis of the hands and feet.” Chinese medicine fumigation treatment directly contacts the lesion site, avoiding metabolic and biological barrier obstruction, which greatly enhances drug utilisation and promotes functional regression of hemiplegia site [16].

High-frequency medication use showed that saffron was the most frequently used Chinese medicine. Saffron is pungent and warm in nature, attributed to the heart and liver meridians, and belongs to the medicines that activate blood circulation and remove blood stasis. According to the Compendium of Materia Medica, ‘Saffron is also a medicine to break blood, move blood, harmonise blood and regulate blood.’ Modern research also believes that saffron's active ingredient saffron yellow pigment can dilate blood vessels, anticoagulant, protect neurons and reduce brain damage, and also regulate peripheral vascular and microcirculation, with neuroprotective effects[17], and a study has also proved that saffron can increase the degree of vascular filling, improve the success rate of venous puncture[18], and promote hemodynamics of hemiplegic side of the limbs to increase the efficacy of the effect of the drug. Gui Zhi sweats and relieves muscles, warms the meridians and channels, and has obvious effects of vasodilatation, promotion of sweating, and improvement of vascular function, which helps hemiplegic limb swelling to subside [19]. Elongation herb soothes the tendons and activates the collaterals, which is a commonly used medication in traditional Chinese medicine fumigation, with obvious effects of anti-inflammation, swelling reduction, neuromuscular improvement, and excitation of the central nervous system [20], and it has a significant improvement in the muscle tone and the mobility of limb joints in hemiplegic patients. *Angelica sinensis* activates blood and replenishes blood, and pharmacological studies have shown that *Angelica sinensis* can protect blood vessels, enhance the body's haematopoietic ability, and improve immunity, which helps to speed up the recovery of hemiplegic limbs and enhance the immunity of hemiplegic patients [21].

Drug flavour attribution indicates that most of the TCM compound medicines are warm medicines, mainly with pungent and bitter flavour. Post-stroke hemiparesis is mostly caused by gas stagnation and blood stasis, phlegm paralysis, and the overall evidence of this deficiency [21]. According to the Internal Canon, ‘Blood moves when it is warm.’ Therefore, warm medicines are used to warm the meridians, help blood circulation, resolve phlegm and paralysis. The addition of pungent drugs to make the effect of the drug can be dispersed, bitter drugs to clear the heat, so that the warm drugs are not too nourishing and greasy, breeding other diseases. Drugs to the meridian for the liver, spleen, heart meridian, ‘Nei Jing’ ‘there are injuries to the tendons, longitudinal, if it is not allowed, sweating partial frustration, so that people partial withered.’ Suwen ‘food gas into the stomach, scattered essence in the liver, obscene gas in the tendons.’ Chinese medicine theory of five

elements in the body for the tendons, in the organs for the liver, liver tonic drugs can activate blood stasis, nourish the tendons, soft tendons, hemiplegic patients after stroke, most of them have a deficiency of qi and blood stasis phenomenon, except for liver tonic, nourishing the heart and spleen meridians is also very common. Since the heart can generate blood and move blood, and the spleen is the foundation of the latter, tonifying the heart and spleen can benefit qi and blood, generate essence and fill in the marrow, which is beneficial to improving the disease mechanism of qi and blood deficiency and the emptying of the medulla oblongata. Some studies have used the self-formulated Vitalising and Softening Tendon Soup externally to achieve the purpose of nourishing and activating blood, dredging the meridians, and ultimately improving the quality of life of the caller [22].

The association rules showed that the most frequently used pair of drug associations was Gui Zhi - Saffron, the most frequently used angular drug association was Gui Zhi - Elixir of Tendons - Saffron, and the most frequently used 4-flavour drug association was Chuan Wu - Elixir of Tendons - Turbinaria - Saffron. The selection and use of Chinese medicines can be seen that the overall therapeutic ideas are not far from warming the meridians, activating blood circulation, removing blood stasis, relaxing the tendons and eliminating wind and dampness. Explanation of the medicinal properties of Leigong's concoction, says 'Saffron goes down to the sea of blood, and it is appropriate to enter the foot syncopal and expel blood.... Therefore, it also enters the Shaoyin of the hand to tonify blood.' After stroke, patients have deficiency of positive qi and stagnation of blood, which is often manifested as hemiparesis in the limbs, therefore, patients mostly have the symptom of qi stagnation and blood stasis, and blood stasis over a long period of time gives rise to phlegm and evil toxins, therefore, treatment should focus on replenishment of qi and activation of blood, and clearing away heat and resolving phlegm, therefore, in addition to safflower, cinnamon sticks, chuanwu, extensin herb, and transcending herb are added in order to open up the qi and blood and to activate the channels and ligaments, which is proved in a clinical study that application of cinnamon sticks, safflower, and other herbs can effectively improve the patients' hemiplegic side. A clinical study confirmed that the application of cinnamon sticks, safflower and other traditional Chinese medicines can effectively improve the clinical symptoms of the hemiplegic side of the limbs and promote the recovery of limb function [23].

In conclusion, this paper collects and arranges the Chinese herbal medicinal formulae for the treatment of post-stroke hemiplegia by fumigation, and finds that the Chinese herbal medicines are mainly pungent, bitter and warm in taste, and are mainly attributed to the meridians of the liver, heart, and spleen, with the main effects of activating blood circulation and removing blood stasis, and relaxing tendons and collaterals, and the selection of medicines centred on safflower, cinnamon, elongation, transcending bones, angelica, and so on, so as to make clear the prescription correlation among the Chinese herbal medicines, and provide new thoughts on the further Chinese herbal medicinal formulae for the use of medicines and the research and development of new clinical medicines. This paper has some limitations. There are some limitations in this paper, the amount of selected clinical data is limited, and the prescriptions obtained by the data algorithm need to be further verified by experiments and clinical observation, and it is hoped that high-quality and large-scale clinical studies can be carried out.

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