

Analysis of acupoint selection and prescription rules of acupuncture for treatment of stable angina pectoris based on a Traditional Chinese Medicine inheritance calculation platform

A systematic review

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Abstract

The use of acupuncture to treat stable angina pectoris is increasing popularity. Based on the prevalence of this treatment over the past 20 years, the rule of acupoint selection and prescription were summarized in this study. The China National Knowledge Infrastructure, China Academic Journal Database, Chinese Science and Technology Periodical Database, PubMed and Web of Science were used for literature search clinical studies on acupuncture in the treatment of stable angina pectoris conducted over the past 20 years were identified, 225 studies were included. Prescriptions were entered into the Traditional Chinese Medicine heritage calculation platform and association rule analysis and complex entropy clustering analysis were performed. Of the sixty-seven acupoints were regularly used and PC6, BL15 and RN17 were the most common. Commonly used meridians were the foot sun bladder meridian, Renmai and hand Shaoyin pericardium meridian; Get the basic prescription of PC6, RN17 and BL15 and have two new prescriptions: BL15, ST36 and GB39; DU10, DU11 and RN17. All acupoints act on the heart through neural regulation mechanism. There are many clinical practice guidelines worldwide for writing acupuncture into the recommended therapy. Acupuncture has a clear therapeutic effect on stable angina pectoris. In the treatment of stable angina pectoris, all acupoints directly or indirectly act on the heart, dredge meridians and relieve angina symptoms.

Abbreviations: C6 = sixth cervical vertebra, C7 = seven cervical vertebra, L2 = second lumbar vertebra, L4 = fourth lumbar vertebra, S1 = first sacral vertebra, S3 = third sacral vertebra, S4 = fourth sacral vertebra, T1 = first thoracic vertebra, T4 = fourth thoracic vertebra, T5 = fifth thoracic vertebra, T7 = seventh thoracic vertebra.

Keywords: acupuncture, selection and prescription rules, stable angina pectoris, Traditional Chinese Medicine Inheritance calculation platform

1. Introduction

Stable angina pectoris, caused by myocardial ischemia, results in discomfort in the chest and surrounding structures and can be accompanied by cardiac dysfunction. Typically brought about by exertion, most stable angina pectoris events occur behind the sternum, potentially radiating to the anterior and ulnar sides of the left arm, to the lateral side of the right arm, to both arms, or to the neck and mandible. Usually lasting for several minutes. Stable angina pectoris often dissipates rapidly after rest or administration of sublingual nitroglycerin.^[1-3]

Angina pectoris is a clinical symptom of myocardial ischemia, which is caused by a temporary imbalance in myocardial oxygen supply and demand.^[4,5] Stable angina is the most common type of angina in China, accounting for 49.4% of all types of angina.^[6] This disease is an indication for acupuncture therapy and clinical reports on acupuncture treatment of stable angina pectoris are increasing in number and recognition. Acupuncture is an external therapy of Traditional Chinese Medicine. A large number of studies have shown that acupuncture treatment of stable angina has significant effect.^[1,7,8] It is necessary to summarize the criteria for acupoint selection

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The datasets generated during and/or analyzed during the current study are publicly available.

No human participants were involved in this study, so there is no ethics involved.

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and prescription based on the complex compatibility of acupoints to provide theoretical direction for future clinical practice.^[9,10]

Neurophysiology has proven that organ function is regulated by the corresponding spinal ganglion segment. The heart is controlled by the nerves from fourth lumbar vertebra (L4)-fourth sacral vertebra (S4).^[11] Modern studies have shown that nerves lie deep to the acupoints. The related ganglion segments are stimulated by acupuncture, thus playing a role in the treatment of visceral diseases. Among the selected acupoints, all have their own ganglion segments, among which the PC6 and sixth cervical vertebra (C6)-first thoracic vertebra (T1) median nerves pass deeper,^[12] with the intercarpal artery distributing the forearm medial cutaneous nerve and forearm lateral cutaneous nerve. The ulnar nerve from seventh cervical vertebra (C7)-T1 in the ulnar nerve and ulnar artery pathways,^[13] BL14, distributed from fourth thoracic vertebra (T4) thoracic nerve hind limbs, accessory nerve, BL15, distributed from fifth thoracic vertebra (T5) thoracic nerve hind

limbs, accessory nerve; BL17, distributed from seventh thoracic vertebra (T7) thoracic nerve, thoracic dorsal nerve; the common peroneal nerve of L4-S1 (first sacral vertebra (S1)) was distributed in ST36 and the tibial nerve from L4-S3 (third sacral vertebra (S3)) was deep; ST40, distributed common peroneal nerve from L4-S3; SP6, distributed from the second lumbar vertebra (L2)-4 morning saphenous nerve, from the L4-S3 tibial nerve.^[14]

2. Materials and methods

2.1. Search strategy

The China National Knowledge Infrastructure, China Academic Journal Database, Chinese Science and Technology Periodical Database, PubMed and Web of Science were searched from January 2000 to December 2021, utilizing the terms stable angina pectoris, acupuncture and acupoint.

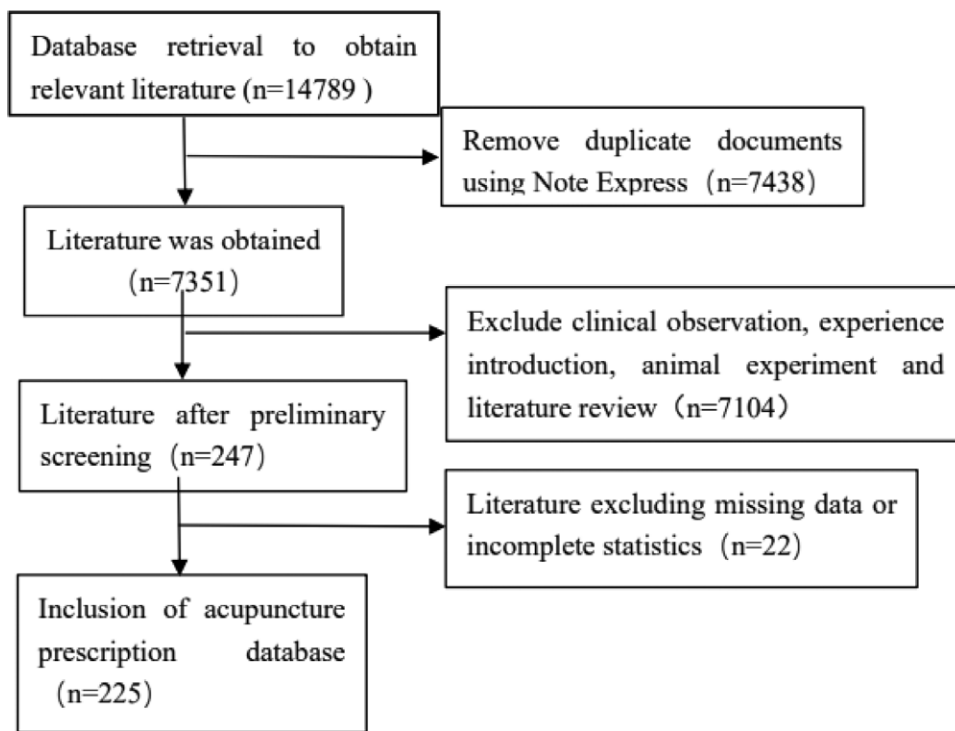


Figure 1 . Flow chart of clinical literature screening for acupuncture treatment of stable angina pectoris.

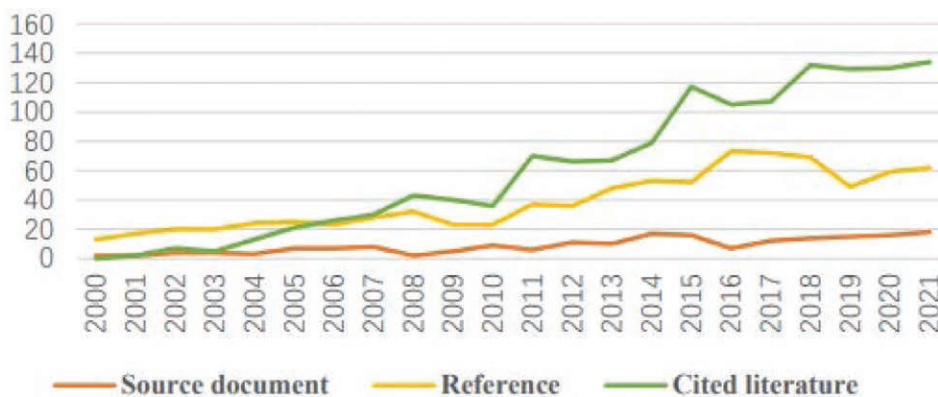


Figure 2 . Trend chart of acupuncture treatment for stable angina pectoris from 2000 to 2021.

2.2. Inclusion and exclusion criteria

Studies were selected according to the following criteria: randomized trials with more than 40 patients, treatment method of acupuncture or acupuncture combined with other treatments, identified prescription for treatment and curative results. The search was not limited to studies conducted in China. Initially, 14,789 studies were identified and screened. Studies reporting individual case studies, literature reviews, animal studies and duplicate studies (those published in more than one journal) were all excluded. As a result of screening, 225 studies were included.

2.3. Specification for acupoint names

The name of acupoints refers to the name and location of acupoints and standardizes the acupoints in the journal literature.

2.4. Data collection and analysis

2.4.1. Data management. The retrieved literature was screened according to the inclusion and exclusion criteria. To ensure accuracy, the selected literature and corresponding acupoint prescriptions were entered into Excel by two reviewers to establish a database, as shown in Figure 1.

2.4.2. Frequency analysis. Microsoft Excel 2021 was used to count the frequency of acupoints, the meridian of acupoints and the usage of specific acupoints.

2.4.3. Citation network analysis. With the help of citation network, users can see the relationship between original documents, reference documents and citing documents and the number of citations. The denser the lines, the more related the literatures; the longer the lines extend, the higher the attention to the topic and the deeper the research level in the China National Knowledge Infrastructure.

2.4.4. Association rule analysis. Traditional Chinese Medicine inheritance calculation platform software was used for modeling and Apriori algorithm was used to quantitatively analyze the closeness of acupoints. This included using support and confidence to study the acupoint combinations with high correlation in acupoint compatibility. In this review, support refers to the frequency of occurrence of anterior and posterior acupoints in the prescription and confidence refers to the probability of occurrence of posterior acupoints in cases using of anterior acupoints.

2.4.5. Entropy clustering analysis. In the new acupoint prescription function of the Traditional Chinese Medicine inheritance calculation platform, the correlation degree was set to eight and the punishment degree was set to two. Unsupervised

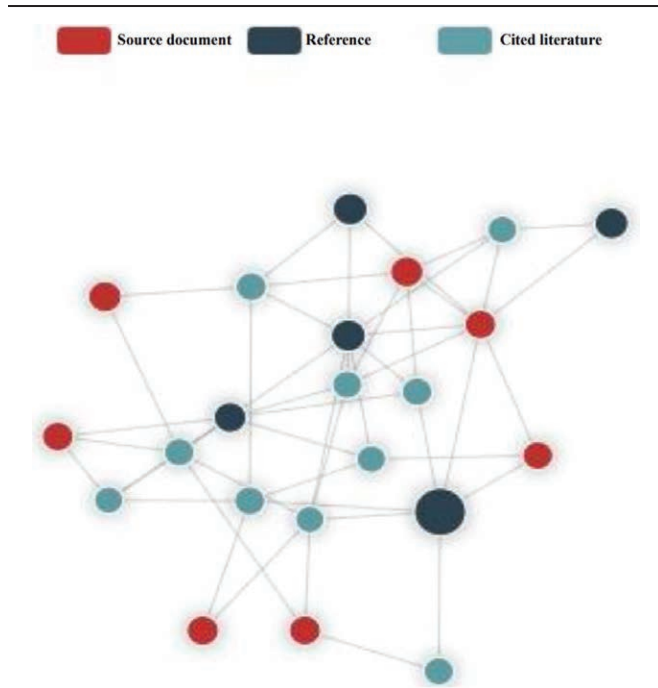


Figure 3 . Analysis of literature inter-citation network.

Table 1
Statistical table of the top 10 acupoints used frequency.

Serial number	Acupoints	Frequency of occurrence	Serial number	Acupoints	Frequency of occurrence
1	PC6	182	6	BL14	37
2	BL15	122	7	HT7	31
3	RN17	95	8	SP6	29
4	ST36	50	9	HT5	27
5	BL17	37	10	T40	27

Table 2
Statistical table of specific acupoints frequency.

Serial number	Special acupoints	Total frequency	Specific acupoints frequency
1	Luo points	245	PC6(182) HT5(27) ST40(27), SP4(4) SJ5(2) LU7(2) LI6(1)
2	Back-shu points	236	BL15(122) BL17(37) BL14(37) BL18(15) BL23 (12) BL20 (7) BL21(3) BL13(2) BL25(1)
3	Eight confluence points	157	PC6 (182) SP4(4) SI5 (2) LU7 (2) GB41(1) SI3 (1) BL62(1)
4	Five-shu point	157	ST36(50) HT7(31) LR3(21) KI3(11)
5	Eight hui points	104	RN17 (95) RN12(2) LR3(2) GB34 (2) GB39(2) LU9(1)
6	Original point	70	HT7(31) LR3(21) KI3(11) PC7(4) LI4(2) LU9(1)
7	Crossing point	55	SP6(29) RN4(15) RN12(2) LR3(2)
8	Lower confluent point	52	ST36(50) GB34(2)
9	Front-mu points	41	RN14(22) RN4(15) LR3(2) GB34(2) GB39(2) LU9(1)
10	Xi points	33	PC4(18) HT6(12) SP8(SP3)

Table 3
Statistical table of acupoint selection frequency of meridians.

Serial numbers	Name of meridians	Frequency of occurrence	Support (%)
1	The urinary bladder meridian of foot-taiyang	237	26.07
2	Pericardium channel of hand-jueyin	215	23.65
3	Ren channel	155	17.05
4	The stomach meridian of foot-yangming	78	8.58
5	The heart meridian of hand-shaoyin	76	8.36
6	The spleen channel of foot-taiyin	52	5.72
7	Du Mai	28	3.08
8	The liver meridian of foot-jueyin	24	2.64
9	The kidney meridian of foot-shaoyi	14	1.54
10	Triple energizer meridian	10	1.10
11	The gall bladder channel of foot-shaoyang	7	0.77
12	Large Intestine channel of hand-yangming	6	0.66
13	The lung meridian of hand-taiyin	5	0.55
14	The small intestine meridian of hand-taiyang	1	0.11

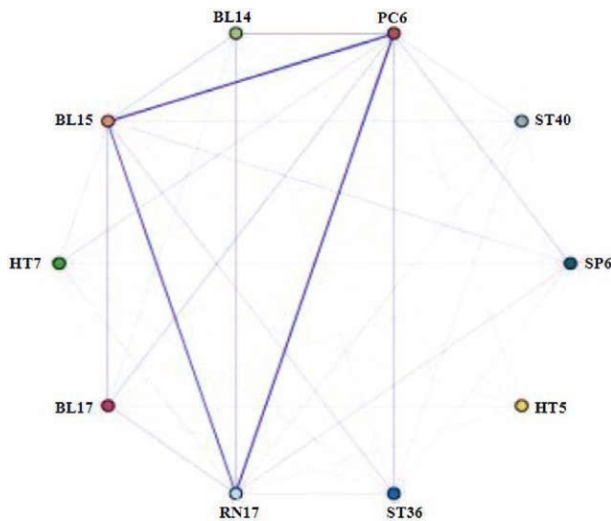


Figure 4 . Network diagram of main acupoints association rules in acupuncture treatment of stable angina pectoris.

entropy clustering analysis was performed using clustering and extraction combination functions.

2.5. Ethics

Because this study does not involve patient privacy, there are no ethical requirements.

3. Results

3.1. Results of the search

A total of 225 articles were included in this study. The number of documents published from 2000 to 2021 increased year by

year, as shown in Figure 2. The citation network analysis shows that in the statistics of relationship strength ≥ 10 , the citation frequency of chronic stable angina pectoris diagnosis and treatment guidelines is the highest, reaching 2445 times, as shown in Figure 3.

3.2. Frequency analysis

3.2.1. Frequency statistics of acupoints. Within the 225 included studies, 916 acupoints and were used. Nearly all consisted of 67 specific points. The 10 most commonly selected points for the treatment of stable angina pectoris were PC6, BL15, RN17, ST36, BL17, BL14, HT7, SP6, HT5 and ST40, as shown in Table 1.

3.2.2. Frequency statistics of specific acupoints. Sixty-seven acupoints selected for the treatment of stable angina pectoris using acupuncture and moxibustion were classified and counted. The results showed that the top three acupoints in total frequency were collateral points, back-shu points and eight-vessel intersection points. PC6 is both a collateral point and eight-vessel intersection point.^[15] The mean frequency was 182, as shown in Table 2.

3.2.3. Frequency statistics of meridians. The meridians associated with the 67 commonly used acupoints were identified. The top three meridians used were the urinary bladder meridian of foot-taiyang, Ren and pericardium channel of hand-jueyin,^[16,17] as shown in Table 3.

3.3. Association rule analysis

Of 225 prescriptions, 67 acupoints were selected. Support and confidence were used as the relevant evaluation indices of acupuncture point compatibility in the treatment of stable angina pectoris.^[18] Association support analysis of the first 10 acupoints was used to obtain the network of association rules, as shown in Figure 4. When the support was 20% and confidence was 80%, the association rules of 18 acupoints were obtained, as shown in Table 4.

3.4. Entropy clustering analysis

In the new acupoint prescription function of the Traditional Chinese Medicine inheritance calculation platform, the correlation degree was set to eight and the punishment degree was set to two. Unsupervised entropy clustering analysis was performed using clustering and extraction combination functions. The results showed that the cluster classifications of acupuncture and moxibustion in the treatment of stable angina pectoris were PC6 - BL15 - RN17, ST36- BL17-BL14, HT7-SP6- HT5-ST40, RN14- LR3 - DU9 - PC4, RN6 - BL18- RN4 and BL23-HT6-KI3-SP10, as shown in Figure 5. Through cluster analysis, acupoints in the treatment of stable angina pectoris by acupuncture and moxibustion were divided into two categories: one category was PC6, RN17, BL15^[19] and other acupoints were classified into another category, as shown in Figure 6. The group evolved 10 core combinations and three new combinations, as shown in Tables 5 and 6.

4. Discussion

In the recent years, acupuncture treatment of stable angina pectoris has been increasingly reported and shown to have a specific effect.^[20,21] Based on the statistical analysis of existing clinical studies conducted over the past 20 years, treatment of stable angina pectoris includes 67 acupoints. This reflects both the extent of experience using acupuncture in the treatment of

Table 4
Association rules of main acupoints.

Serial number	Organization rules	Support (%)	Degree of confidence (%)
1	PC6→BL15	71.20	89.89
2	BL15→RN17	68.00	80.00
3	PC6→RN17	68.00	89.41
4	BL15→RN17、PC6	60.80	81.58
5	RN17→BL14	28.80	80.56
6	PC6→BL14	28.80	94.44
7	RN17→BL17	25.60	81.25
8	BL15→BL17	25.60	96.88
9	PC6→BL17	25.60	84.38
10	RN17→BL17、BL15	24.80	80.65
11	PC6→BL17、BL15	24.80	83.87
12	PC6→SP6	23.20	89.66
13	BL15→BL14、RN17	23.20	82.76
14	PC6→BL14、RN17	23.20	93.10
15	RN17→BL17、PC6	21.60	81.48
16	BL15→BL14、RN17 、PC6	21.60	85.19
17	PC6→BL17、BL15 、PC6	20.80	80.77
18	PC6→HT7	20.00	80.00

Spectrum diagram using centroid connection

The rescaled distance clustering combination

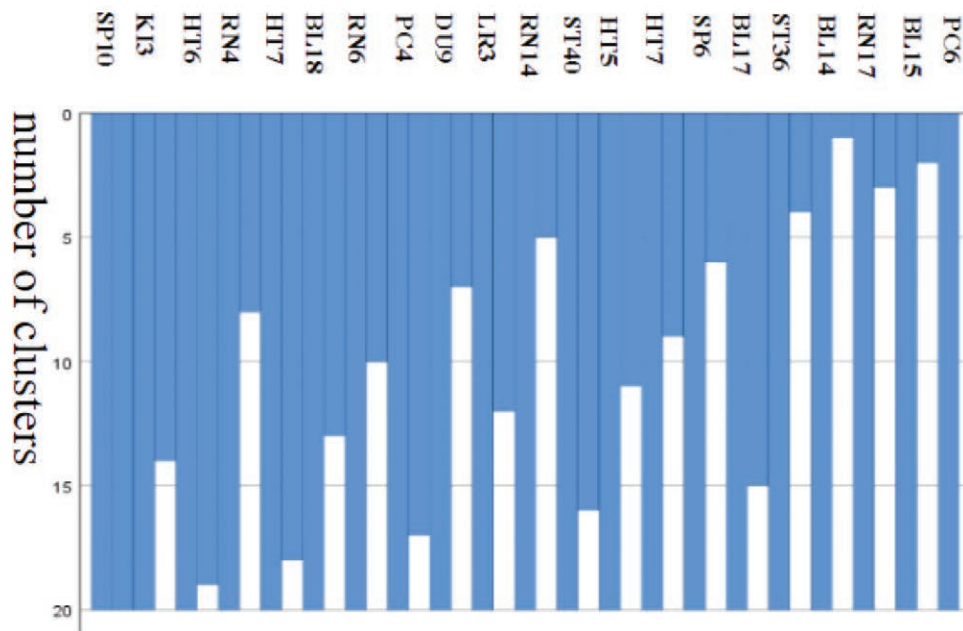


Figure 5 . Cluster ice figure of main acupoints in acupuncture treatment of stable angina pectoris.

stable angina pectoris, as well as the lack of general consensus on treatment protocols. This study found that of the 67 acupoints, the most commonly used acupoints are PC6, BL15, RN17, ST36, BL20, BL14, HT7, SP6, HT5 and ST40.^[10,19] Of the 14 meridians identified, the most frequently used were the urinary bladder meridian of foot-taiyang, pericardium channel of hand jueyin and Ren meridian.

In the analysis of association rules,^[1] the combinations with the highest support were PC6–BL15, BL15–RN17 and PC6–RN17 and the acupoints involved are PC6, BL15 and RN17. PC6 is a pericardium meridian point that reduces sympathetic

excitability and provides cardiac reperfusion function.^[22] The BL15 is the back-shu point of the heart meridian of hand-shao-yin, which is located near the thoracic cavity. Acupuncture at PC6, BL15 and RN17 can improve coronary blood flow in patients, improve symptoms of myocardial ischemia and relieve symptoms of stable angina pectoris.^[23]

Acupoint selection and prescription rules for stable angina pectoris: all acupoints act on the heart through neural regulation mechanism. As a result of the cluster analysis,^[24] the acupoints were divided into two categories a core combination of PC6- RN17- BL15 and when combined with the analysis of

Spectrum diagram using centroid connection

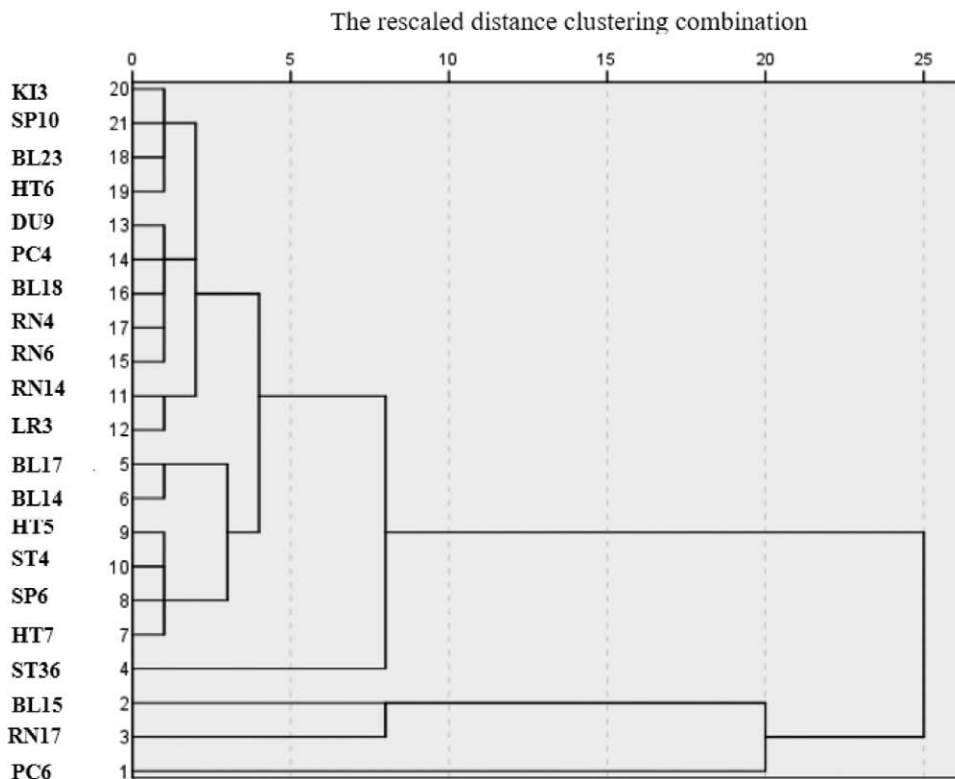


Figure 6 . Cluster tree of main acupoints in acupuncture treatment of stable angina pectoris.

Table 5
Core combinations.

Serial number	Core combinations
1	PC6、BL15、RN17
2	RN17、PC6、SP6
3	PC6、ST36、ST40
4	PC6、SP10、BL17
5	BL15、BL14、PC4、HT6
6	PC6、ST36、SP6
7	RN17、ST36、RN14
8	BL15、PC6、SP6
9	BL15、RN6、ST36、SP6
10	PC6、LR13、BL18、LR3

Table 6
new prescription combinations.

Serial number	New prescription combinations
1	BL15、ST36、PC7
2	DU10、DU11、RN17

association rules, the treatment of stable angina pectoris using the PC6 - RN17 - BL15 combination is selected over all other combinations. The efficacy of DU11 and DU10 was similar to that of BL15 and BL16. Two new formulas were derived from this group: BL15, ST36, PC7, DU10, DU11, RN17. Several points in these combinations are known to have therapeutic

benefits when used in treatment. Among them, ST36 which has positive effects on bone marrow, stamina, meridians flow and pain.^[25] DU11 is located at the spinous process depression of T5. DU10 is located at the sixth thoracic spine spinous process. Back-shu points are used to treat visceral disease. Acupuncture DU11, DU10 stimulate T5-6 spinal nerve posterior branch, the spinal ganglion T5-6 along the visceral branch to the heart. Studies have shown that acupuncture at these points can effectively improve coronary heart disease in patients with asymptomatic myocardial ischemia ECG and hemodynamics by reducing acute myocardial infarction or sudden cardiac death.^[26] Acupuncture at PC7 significantly improves left ventricular fractional shortening (FS%), stroke volume (SV), cardiac output(CO), cardiac index (CI), ejection fraction (EF%) and other cardiac function indexes in patients with coronary heart disease, thus improving the pumping function of the heart.^[27]

This paper systematically identifies the rules of association rule analysis for acupuncture and moxibustion in the treatment of stable angina pectoris. There are, however, some shortcomings: the literature collected in this paper addresses clinical studies from the past 20 years and therefore does not emphasize the more pertinent issues raised in recent years. Among the studies included in this paper, the quality of the literature is inconsistent; however, this study did classify the syndrome types of stable angina pectoris. Considering the above problems, additional quality studies are necessary.

The use of acupuncture for the treatment of stable angina pectoris is an established modality. Its efficacy, however, remains unclear.^[28] While documented extensively, acupoint selection and prescription are relatively complex. As a result of this review, the compatibility of BL15, PC6 and RN17, as the primary points for acupuncture and moxibustion in the treatment of stable angina pectoris appears to be the most effective, providing theoretical and empirical support for future clinical treatment with acupuncture therapy.

Author contributions

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Validation: Kaiwei Yang.

Visualization: Kaiwei Yang.

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