Analysis of Acupoint Selection Rules for Electroacupuncture Treatment of Osteonecrosis of the Femoral Head Based on Data Mining Technology

Zhenyao[1] Liu   Yan[2*] Cheng

1 Shaanxi University of Chinese Medicine, Xianyang, 712046, China. E-mail:1535463290@qq. Com

2 *Shannxi Provincial Hospital of Chinese Medicine, Xi'an, 710003, China. E-mail: chy822@163. com

Abstract: Objective: Analysis was focused on the data mining technology of electroacupuncture (EA) of osteonecrosis of the femoral head (ONFH) of the rules and characteristics of point selection in the clinical treatment, to provide a basis for clinical electroacupuncture treatment of ONFH. Methods: The Chinese and English literatures obtained from the CNKI and PubMed database on the treatment of ONFH by electroacupuncture, the Endnote database for the treatment of osteonecrosis of the femoral head by electroacupuncture was established, and the rule of point selection was analyzed by data mining and statistical software Excel ,SPSS,SPSS Modeler. Results: A total of 17 articles were included, and 44 acupoints were selected with a total frequency of 169 times. The most frequently used acupoints in turn are Juliao(GB29),Shenshu (BL23), Biguan (ST31);The selected acupoints mainly belonged to bladder meridian; The acupoints are mainly distributed in the lower limbs, the five shu points are used mostly in the special points, among them, the he-sea points is the most widely used; the dense-sparse waves is mostly used in the electroacupuncture waveform. Cluster analysis can be divided into three categories. The result of correlation analysis showed that "Shenshu(BL23)→Ashi Point" had the highest support degree. Conclusion: electroacupuncture treatment of acupoint selection of Osteonecrosis of the femoral head is centered on Juliao (GB29), Shenshu (BL23), Biguan (ST31), Huantiao (GB30) and Ashi acupoints, with emphasis on selection of acupoints along local points and dialectical matching.

Keywords: Acupuncture; Osteonecrosis of the Femoral Head；Acupoint Selection Rule；Data Mining

Introduction

ONFH is a refractory orthopedic disease characterized by hip pained joint dysfunction [1、2]. The patients' number of ONFH in China is 5 million to 7.5 million [3]. The main causes of ONFH were inappropriate hormone use and alcohol consumption [4]. The main pathological process includes the collapse of the femoral head caused by various factors which destroy the microstructure of the femoral head. Clinically, electro-acupuncture treatment of femoral head necrosis is also a more common clinical means. In order to improve the effectiveness of clinical treatment, the rules of selecting Meridians and acupoints in clinical study of using electro-acupuncture to treat ONFH was discussed and analyzed by using data mining technology.

1.Data and methods

1.1 scope of Literature Retrieval

China National Knowledge Infrastructure Database (CNKI), PubMed. Search Time: from build up to 2021. Type selection of search words: subject words plus free words. The key words are "osteonecrosis of the FEMORAL head" and "acupuncture" and "electroacupuncture", "ELEC troacupunture" and "osteonecrosis of the female head" and "acupunture". Retrieval method: Set the above words as subject words, key words, using the general retrieval strategy of the database.

1.2 literature inclusion criteria

(1) clinical related studies on ONFH; (2) intervention using electro-acupuncture therapy or electro-acupuncture combined with other treatment methods; (3) specific selection of points in electro-acupuncture prescription; (4) literature with significant clinical therapeutic effect.

1.3 criteria for exclusion of the literature

(1) non-clinical trials;(2) intervention did not involve electroacupuncture therapy;(3) complications;(4) full-text Literature was not available; (6) republished literature.

1.4 data extraction and data analysis

The documents retrieved by the computer are stored in the Endnote X9 database and the duplicate documents are excluded. The literatures were sorted according to the inclusion and exclusion criteria, and the relevant data were sieved and extracted. The frequency and regularity of acupoints and meridian are analyzed by establishing a Excel table of the extracted data. SPSS 23.0 is used to cluster the acupoints, and the APRIORI ALGORITHM IN SPSS Modeler subscription 1.0 is used to analyze the association rules of acupoints.

2. Results

2.1 literature search results

The first search included 95 articles, 87 articles are in Chinese and 8 articles are in English, among which 2 duplicate articles were found.17 Chinese literatures and 0 English literatures were selected. The prescriptions of electro-acupuncture points included in the literature are clear.

2.2 Rules of acupoint selection

2.2.1 Results of acupoints selection

The number of acupoints used in 17 articles is 44, the total frequency of acupoints used is 169, the frequency of acupoints used in 5 times or more is 16, accounting for 73.96% of the total number of acupoints, see Table 1.

Table 1 Statistics on acupoints frequency ≥ 5

sequence number	acupoint	frequency	relative frequency	sequence number	acupoint	frequency	relative frequency
1	GB29	14	8.28%	10	ST36	6	3.55%
2	BL23	14	8.28%	11	BL40	6	3.55%
3	ST31	13	7.69%	12	GV3	6	3.55%
4	GB30	10	5.92%	13	BL36	5	2.96%
5	ashi point	8	4.73%	14	LR12	5	2.96%
6	K13	8	4.73%	15	BL60	5	2.96%
7	GB39	7	4.14%	16	GV4	5	2.96%
8	GB34	7	4.14%	17	other acupoints	44	26.03%
9	BL54	6	3.55%				

2.2.2 selected acupoints according to Meridian Analysis and Statistics

10 Meridians were applied in electroacupuncture treatment of ONFH (see table 2).

2.2.3 Analysis of the acupoints selection distribution sites

Distribution analysis of acupoints selected for electro-acupuncture treatment of osteonecrosis of the femoral head were statistically analyzed (see table 3).

table 2 Statistics on the meridian which the acupoints belongs to

Sequence number	Meridians	Frequency statistics		Acupoints		Acupoint include
		frequency	relative frequency(%)	number	relative frequency(%))	
1	bladder meridian	45	26.63	11	25.00	BL23(14)，B L40(6)，BL54(6)，BL36 (6)，BL60(5)，BL18(2)，BL 20(2)，BL32(1),BL17(1)，BL13(1)，BL21(1)
2	gall bladder meridian	41	24.26	5	11.36	GB29 (14)，GB30(10)，GB39(7)，GB34(7)，GB31(3)
3	Stomach Meridian	22	13.02	5	11.36	ST31(13)，ST36(6)，ST3(1)，ST41(1)，ST34(1)
4	governor meridian	13	7.69	4	9.09	GV3(6)，GV4(5)，GV20(1)，GV 14 (1)
5	liver meridian	11	6.50	3	6.82	IR12(5)，LR11(3)，LR 10(3)
6	Spleen Meridian	10	5.92	4	9.09	SP10(4)，SP6(4)，SP9(1),SP 12(1)
7	kidney meridian	8	4.73	1	2.27	K13 (8)
8	ren meridian	5	2.96	3	6.82	CV4(2)，CV6(2)，CV12(1)
9	large intestinal meridian	3	1.78	3	6.82	LI11(1)，LI4(1)，LI5(1)
10	pericardium channel	1	0.59	1	2.27	PC6 (1)

2.2.4 analysis of specific acupoints selected for electroacupuncture treatment of ONFH (see table 4).

Table 3 Statistics on the distribution sites which the acupoints belongs to

Sequence number	distribution sites	Frequency statistics		Acupoints		Acupoint include
		frequency	relative frequency(%)	number	relative frequency(%))	
1	lower limb	80	47.34	16	35.56	ST31(13)，K13(8)，ashipoint(8)，GB39)(7)，GB34(7)，ST36(6)，BL40 (6)，BL60(5)，SP6(4)，SP10(4)，LR10 (3)，LR11(3)，GB31 (3)，SP9(1)，ST34(1)，ST41(1)
2	buttock	39	23.08	7	15.91	GB29 (14)，GB30(10)，BL54(6)，BL36(6)，juliaoxiadian(1)，waichengfu(1)，BL32(1)
3	Lower back	26	15.38	4	9.09	BL23(14)，GV3(6)，GV4(5)，tunshuang(1)
4	Chest back	7	4.14	5	11.36	BL18(2)，BL20(2)，BL13(1)，BL21(1)，BL17(1)
5	abdomen	6	3.55	4	9.09	CV4(2)，CV6(2)，CV12(1)，SP12 (1)
6	groin	5	2.96	1	2.27	LR12(5)
7	Upper limb	4	2.37	4	9.09	PC6(1),LI11(1)，LI4(1)，LI5(1)
8	head and neck	3	1.76	3	6.82	GV14(1)，GV20(1)，GB29(1)

Table 4 Frequency statistics of Specific Acupoints for electroacupuncture treatment of ONFH

Sequence number	Specific Acupoints	Frequency statistics		Acupoints		Acupoint include
		frequency	relative frequency (%)	number	relative frequency(%)	
1	five-shu point	36	32.72	9	20.45	K13(8)，GB34(7)，BL40(6)，ST36(6)，BL60(5)，SP9(1)，ST41(1)，LI 11(1)，LI5(1)
2	Back-shu point	21	19.09	6	13.64	BL23(14)，BL18(2)，BL20(2)，BL13(1)，BL17(1)，BL21(1)
3	lower He point	19	17.27	3	6.82	GB34(7)，ST36(6)，BL40 (6)
4	eight influential points	15	13.64	3	6.82	GB39 (7)，GB34(7)，ST36(6)
5	yuan-primary point	9	8.18	2	4.55	K13(8)，LI4(1)
6	crossing point	4	3.64	1	2.27	SP6(4)
7	front-mu point	3	2.73	2	4.55	CV4(2)，CV12(1)
8	eight convergent points	1	0.90	1	2.27	PC6(1)
9	luo-connecting point	1	0.90	1	2.27	PC6（1）
10	Xi-Cleft acupoint	1	0.90	1	2.27	ST34(1)

2.3 cluster analysis

Cluster analysis was carried out on the first 16 acupoints. The results of Dendrogram showed that the acupoints could be divided into 3 types: Cluster 1 was GB34-GB39-BL54-BL36-BL23-GB29-GB30-ST36-ST31-BL40-SP9-SP10, cluster 2 was Ashi point, cluster 3 was K13-CV4. (see figure 1)
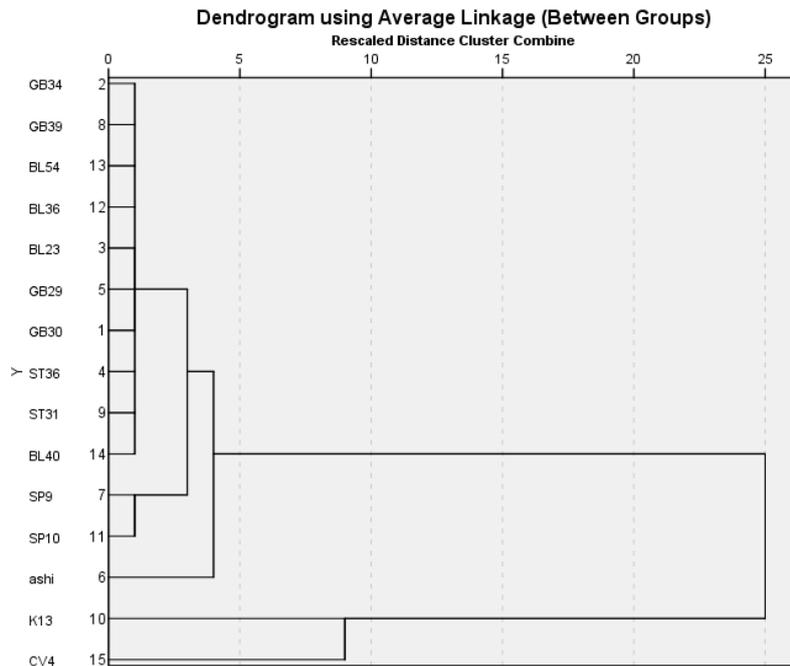

figure 1

2.4 Association Rule Analysis

Association rule analysis to select the 16 acupoints with the highest frequency, and the adjustment parameter is "support degree ≥30% , confidence degree ≥90% ".The Network Graph of association rules can display the correlation of each prescription acupoint in the form of network under the support degree of setting for reference. The results showed that the most common compatibility of acupoints was "Shenyu→Ashi" and "Shenyu→Taixi", the support rate was 47.059% and the confidence rate was 100.0%. (see Table 5, figure 2)

Table 5 Statistical of association analysis of acupoint selection rules for electroacupuncture treatment of ONFH

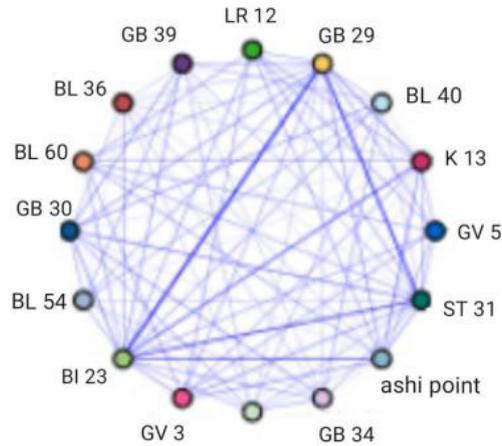| consequent	Antecedent	Support(%)	confidence(%)	Lift
Shenshu(BL23)	ashi point	47.059	100.0	1.308
Shenshu(BL23)	Taixi (K13)	47.059	100.0	1.308
huantiao(GB30)(10)	Weizhong (BL40) (6)	35.294	100.0	1.7
huantiao(GB30)(10)	yanglingquan （GB34）	35.294	100.0	1.7
ashi point	Yaoyangkuan(GV 3)	35.294	100.0	2.125
Biguan(ST31)(13)	Yaoyangkuan(GV 3)	35.294	100.0	1.308
ShenshuBLl23)	Yaoyangkuan(GV 3)	35.294	100.0	1.308

Figure 2. Mesh Graph of association rule analysis

3.Discussing

The concept of "bone erosion", "bone arthralgia" are the understanding of the ONFH in the theory of traditional Chinese medicine, the etiology and pathogenesis are concluded as stagnation of Qi and blood caused by external factors such as blood stasis, cold, etc. [5]. Therefore, the rules of treatment should be based on strengthening the liver and kidney, warming Yang, dispersing cold, supplementing Qi, removing dampness and promoting blood circulation, eliminating phlegm and removing blood stasis.

The results of this study showed that the clinical electroacupuncture treatment of ONFH mainly used Bladder Meridian, Gall baldder Meridian, Stomach Meridian, and the function of the Meridians were matched with the treatment rules of ONFH.

The Bladder Meridian acupoints are selected for the treatment of ONFH by the function of promoting yang and promoting Qi circulation, relaxing the tendons and communicating the meridian, dispersing cold and dampness [6]. It is the main meridian for the treatment of ONFH. Gall bladder meridian can diffuse cold and dampness, communicating Qi and blood. Stomach Meridian can benefit Qi and blood to comfort joints.

In clinical application, the specific acupoints have their unique function. The most commonly used specific acupoints in electro-acupuncture treatment of ONFH are the five-Shu acupoints, of which the he-sea points are the most widely used, it is considered that the combined acupoints have the function of treating cold pathogen Qi entering the interior.

In this study, we found the highest frequency of use of five acupoints for Ju Liao, Shen Yu, Bi Guan, Huan Tiao, Ashi acupoints, which have a general function of comforting joints.

In this study, we analyzed the waveform selection of electro-acupuncture treatment of ONFH. We found that the clinical selection was mainly the dense-sparse waves. According to Xiao Liang [7], dense-sparse waves have better analgesic effect. The main objective of electroacupuncture waveform selection in clinical treatment of ONFH is to relieve pain and promote circulation and metabolism.

The cluster analysis method was used to analyze the results with the theory of TCM. The results can be divided into 3 categories. Cluster 1 is GB34-GB39-BL54-BL36-BL23-GB 29-GB30-ST36-ST31-BL40-SP9-SP10. Cluster 2 was Ashi point, is a point of analgesic effect, cluster 3 was K13-CV4, tonifying the kidney and strengthening the bone.

The results of association rule analysis showed that the combination of acupoints in the order of the top 2 in support degree was "Shenshu → Ashi acupoint" and "Shenshu → Taixi" .Taixi, Shenshu and Ashi acupoints are used together for the purpose of tonifying the kidney and strengthening the bone, dispersing pathogenic factors and relieving pain.

4.Conclusion to sum up,

Electroacupuncture treatment of ONFH takes Ju Liao, Shen Yu, Bi Guan, Huan Tiao and Ashi acupoints as the core acupoints selection; bladder meridian is more used. The selected acupoints are mainly distributed in the lower limbs. The wave form of electroacupuncture usually uess dense-sparse waves, focusing on reducing pain and promote circulation and metabolism. In the treatment, it is important to select the acupoints according to syndrome differentiation by combining the pathogenesis, and to select the acupoints locally around the Meridians and the painful sites.

References

[1] Solomon L. Idiopathic Necrosis of the Femoral Head: Pathogenesis and Treatment[J]. Can J Surg, 1981, 24(6):573-578.

[2] Microrestorative Group of the Orthopaedic Branch of the Chinese Medical Society．Adult femoral head necrosis diagnosis and treatment standard expert consensus(2012)[J]．Chinese Journal of Orthopaedics，2012,32(6):606-610.

[3] Chen Bao-lang.Research Progress of Apoptosis in the Pathogenesis of Glucocorticoid-induced necrosis of the Femoral Head[J].China Modern Medicine,2016,23(19):12-15.

[4] Cui L, ZHUANG Q, LIN J, et al. Multicentric Epidemiologic Study on Six Thousand Three Hundred and Ninety-Five Cases of Femoral Head Osteonecrosis in China[J]. Int Orthop, 2016, 40(2):267-276.

[5] Jia Min,JIANG Rong-xing,XIAO Peng.Talking about the etiology of necrosis of femoral head[J].Inner Mongolia Journal of Traditional Chinese Medicine,2013,32(24):135-136.

[6] Zhang Bin.Discussion on the Treatment of Neck Type Cervical Spondylosis from Taiyang Bladder Channel of Foot[J]. CHINESE MEDICINE MODERN DISTANCE EDUCATION OF CHINA,2020,18(10):43-45.

[7] Xiao Liang,PENG Ha-dong,CAI Qing-ping .Influence of Electroacupuncture Parameters on Acupuncture Analgesia[J].Acupuncture Research,2006(06):372-374.