Clinical Observations

Observations on Curative Effect of High-frequency Electric Sparkle and Point-injection Therapy on Knee Osteoarthritis

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Objective: To observe the curative effect of high-frequency electric sparkle and point-injection therapy (HESPT) on knee osteoarthritis (KOA).

Methods: Two hundred and five patients were randomly divided into a warming needle moxibustion group (68 cases), a HESPT group (68 cases) and a point-injection group (69 cases). In the warming needle moxibustion group, the main points of Xuehai (SP 10), Neixiyan (EX-LE4), Waixiyan (EX-LE5), Dubi (ST 35), Zusanli (ST 36) and Yanglingquan (GB 34), and the adjunct points of Yinlingquan (SP 9) and Sanyinjiao (SP 6), on the affected side, were chosen for stimulation. In the HESPT group, tenderness points, the main points of Liangqiu (ST 34), Xuehai (SP 10), Neixiyan (EX-LE4), Waixiyan (EX-LE5) and Zusanli (ST 36), and the adjunct points of Yinlingquan (SP 9), Weizhong (BL 40) and Chengshan (BL 57), were chosen. After proper manipulation, Corydalis decumbens Pers. liquid was injected into the points and a high-frequency electric sparkle was applied to stimulate the needles for 30 seconds. In the point-injection group, point injection was performed with the same method, but the patients did not receive electric stimulation. The Western Ontario and McMaster University Osteoarthritis Index (WOMAC), the Lysholm Knee Score Scale (LKSS) and the ROM (Range of Motion) scale were used to evaluate the severity of KOA and the function of knee joints before treatment and 4 weeks after treatment. Finally, the Nimodipine method was used to assess the total curative effect.

Results: After HESPT treatment, the scores for pain, morning stiffness and swelling were significantly lower ($P<0.01$) and LKSS index and ROM were much higher ($P<0.01$ and $P<0.05$ respectively) compared to the two other groups. The obviously effective rate and total effective rate were also significantly higher in the HESPT group than in the two other groups ($P<0.01$ or $P<0.05$).

Conclusion: HESPT can improve joint function in KOA patients, and the curative effect is better than for warming needle moxibustion or point-injection only.

Keywords: *high-frequency electric sparkle and point-injection therapy; knee osteoarthritis*

Knee osteoarthritis (KOA), also called retrograde arthritis, is one of the most frequently encountered diseases among middle-aged and old people. KOA is mainly manifested as pain, stiffness, swelling and dysfunction of knee joints, and is accompanied by pathological degeneration of joint cartilage and secondary hyperosteogeny. With the coming of the aging society, KOA incidence is rising. The Rehabilitation Research Centre of Three Gorges University have achieved good curative effects in the treatment of KOA, using high-frequency electric sparkle and point-injection therapy (HESPT), from January 2007 to December 2009. The observation and analysis of these findings are summarized in this article.

METHODS

General Data

Two hundred and five KOA outpatients at the Rehabilitation Research Centre of Three Gorges University were randomly divided into a warming needle moxibustion group (68 cases), a HESPT group (68 cases) and a point-injection group (69 cases). There were no obvious differences in sex, age, course of illness, or affected joint among the 3 groups ($P>0.05$; Table 1). This study was approved by the Ethical Committee of China Three Gorges University, and all subjects signed the informed consent forms before treatment.

Criteria for Selecting Cases

The diagnostic standard was according to *The KOA-diagnosis* recommended by the American Rheumatism Association in 1986.[1] 1) Pain in knee joints lasts 14 days or more within one month before treatment. 2) Friction sound can be heard in joint motion. 3) Morning stiffness of knee joints lasts 30 min or more. 4) The patients are 40 years old or older. 5) Widespread tenderness is felt in knee joints with strangulation and swelling. 6) Roentgenogram (when the patient takes a standing or weight-carrying position) shows that knee

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joint gap becomes narrow with bony spurs formed along the edge of bony tip. Patients fulfilling criteria for points 1), 2), 3), 4) and 5) or 1) and 6) can be diagnosed as suffering from KOA.

Inclusion criteria: 1) Patients who conformed to the diagnostic standard. 2) Patients who were willing to accept the 2-week treatment and examination. 3) Patients who had not been taking any hormone drugs within one month before treatment and during treatment. 4) Patients with a Visual Analogue Score (VAS) of pain less than or equal to 7. 5) Patients who agreed to sign an informed consent form.

Exclusion criteria: 1) Patients who could not finish the treatment plan or accepted other therapies (preventing accurate judgment of curative effect). 2) KOA patients who had severe diseases, such as cardio- or cerebrovascular diseases, liver diseases, kidney diseases, gastrointestinal diseases, tumors, etc., who had obvious genu varum or valgum, or who had a history of injury of blood vessels and nerves in the affected limb. 3) Patients who had rheumatic arthritis, rheumatoid arthritis, acute sprain of knee joint or fracture. 4) Patients who, in the past 3 months, had an injection of corticosteroid or hyaluronic acid into the articular cavity (joint operation or local medication). 5) Patients who had an adverse reaction to the drug used in this research. 6) Patients who had a tendency for bleeding or were taking an oral anticoagulant.

Therapeutic Methods

In the warming needle moxibustion group, the main points selected were Xuehai (SP 10), Neixiyan (EX-LE4), Waixiyan (EX-LE5), Dubi (ST 35), Zusanli (ST 36), and Yanglingquan (GB 34) on the affected side. The adjunct points were Yinlingquan (SP 9) and Sanyinjiao (SP 6). With the patient in a dorsal position, stainless steel needles 0.35×50 mm were inserted into routinely sterilized skin. At Neixiyan (EX-LE4), Waixiyan (EX-LE5) and Dubi (ST 35), needles were shallowly inserted until a needling sensation was felt. At Zusanli (ST 36), the needle was deeply inserted with the reinforcing method of lifting, thrusting and twirling the needle. After needling sensation, the needle handle was sleeved with a moxa cone, about 2 cm in diameter. Then the moxa cone was ignited to perform warming needle moxibustion, 2 cones each time. The base of the moxa cone was about 2 cm above the skin. A thick piece of cardboard was placed on the point to prevent burning of the skin.

In the HESPT group, in reference to the manipulation in High-frequency Electric Sparkle and Point-injection Therapy written by Professor Cheng Chuanguo,[2] patients were placed in a dorsal or prone position, with the knee joint at a 70° angle. The manipulator pressed his fingers on the knee joint with hyperplasia or bony spurs to carefully look for tenderness points, which were then marked with methyl violet. The skin was sterilized and needles were swiftly inserted into the tenderness points as well as the main points of Liangqiu (ST 34), Xuehai (SP 10), Neixiyan (EX-LE4), Waixiyan (EX-LE5) and Zusanli (ST 36), and the adjunct points of Yinlingquan (SP 9), Weizhong (BL 40) and Chengshan (BL 57). The needle tips at the tenderness points were manually gently moved to and fro 5-6 times. After withdrawal of the needle and in the absence of bleeding, 8 mL of Corydalis decumbens Pers. liquid mixed with 2 mL 0.2% lidocaine was slowly injected, and a high-frequency electric sparkle was applied to the needle handle for 30 s. After the needle was pulled out, a sterilized cotton stick was pressed on the point for a while. After HESPT, tuina massage manipulation of rolling, pressing, plucking, grasping and kneading was performed around the quadriceps and knee cap until local heat was felt.

In the point-injection group, points, injected drugs, dosages and massaging manipulations were the same as in the HESPT group but without electric sparkle stimulation.

The treatments were carried out once every other day 10 times, over 2 courses of treatment with a 2-day interval between courses. Two weeks after treatment, the curative effect was evaluated.

Curative Effect Evaluation Method and Index

The Western Ontario and McMaster University Osteoarthritis Index (WOMAC) was used to evaluate the Lequesne index (mainly evaluates pain of knee joint, morning stiffness and swelling) 4 weeks before and after treatment. WOMAC is the most commonly used scale in the world at present.[3] A one hundred millimeter visual analogue scale was used to evaluate pain, morning stiffness and swelling. The total WOMAC score ranges from 0 to 100. Higher total scores indicate more severe illness.

The Lysholm Knee Score Scale (LKSS)[4] was used to evaluate the severity of KOA and the total function of joints. This scale mainly evaluates lameness, need for support, strangulation, instability, pain, swelling, going up and down stairs, and squat. The score of each item ranges from 0 to 5, 10, 15 or 25. A score exceeding 85 indicates normal joint function. 66–84 indicates moderately impaired joint function. A score of less than 65 indicates poor joint function.

In addition, the ROM scale was used to measure the bending range of knee joints and evaluate the bending and stretching function of knee joints.

Evaluation of Total Curative Effect

The Nimodipine method {index of curative effect = ((accumulated score of symptoms before treatment − accumulated score of symptoms after treatment) ÷

accumulated score of symptoms before treatment) × 100%} was used to evaluate curative effect. A clinical cure is indicated by an index of ≥80%, an obvious effect is indicated by an index of <80% and ≥50%, effectiveness is indicated by an index <50% and ≥25%, and ineffectiveness is indicated by an index of <25%.

Statistical Method

The SPSS 15.0 statistical software package was used to analyze data. Paired *t* tests were used to compare data before and after treatment in the same group. Analysis of variance with Student-Newman-Keuls post-hoc tests was used to compare data among different groups. A χ^2 test was used to compare enumeration data among different groups. $P<0.05$ indicated statistical significance.

RESULTS

Comparison Before and After Treatment

WOMAC scores showed that pain, morning stiffness and swelling were obviously alleviated in the 3 groups ($P<0.01$), and that the LKSS index and ROM degree were significantly increased ($P<0.01$).

Comparison between Groups

There were no differences in the various indices among the three groups before treatment. After treatment, the accumulated scores for pain, morning stiffness and swelling in the HESPT group were much lower than those in the two other groups, and LKSS index and ROM degree in the HESPT group were much higher than those in the two other groups ($P<0.01$ and $P<0.05$, respectively) (Table 2).

Comparison of Comprehensive Curative Effect

The treatment resulted in cure in 11.76% of patients (8 cases) in the warming needle moxibustion group, in 8.82% of patients in the HESPT group, and in 1.45% of patients in the point-injection group. There was an obvious effect in 47.06% of patients (32 cases) in the HESPT group, 26.47% in the warming needle moxibustion group, and 20.29% in the point-injection group. The total effective rate was 94.12% in HESPT group, 86.76% in the warming needle moxibustion group and 72.46% in the point-injection group (Table 3).

Table 1. Comparison of the general condition of patients between the 3 groups

Group	Cases (knees)		Age (years)	One side	Two sides	Illness course (months)
	Male	Female				
Warming needle moxibustion group	22 (30)	46 (61)	61.32±7.81	45	23	19.6±5.42
HESPT group	30 (55)	38 (43)	58.64±6.33	38	30	22.2±6.78
Point-injection group	26 (48)	43 (50)	60.45±5.95	40	29	21.4±5.06

Table 2. Comparisons of changes in symptoms before and after treatment (mean ± SD)

Group		Change in symptoms				
		Pain	Morning stiffness	Swelling	LKSS index	ROM degree
Warming needle moxibustion group	Before treatment	58.93±6.81	45.25±12.33	66.24±14.33	56.33±6.01	104.05±11.43
	After treatment	32.47±7.88$^{*\#}$	26.74±9.67$^{*\#}$	35.65±9.41$^{*\#}$	69.47±7.16$^{*\#}$	120.54±10.38*§
HESPT group	Before treatment	60.08±7.11	47.58±14.47	65.08±12.47	54.35±5.69	100.22±10.69
	After treatment	27.44±8.86*	23.98±8.63*	28.69±7.76*	76.42±8.65*	121.67±10.51*
Point-injection group	Before treatment	57.94±7.04	45.69±11.82	63.37±12.85	55.45±6.04	102.38±10.27
	After treatment	35.66±6.62$^{*\#}$	30.85±10.17$^{*\#}$	38.77±9.05$^{*\#}$	67.77±7.25$^{*\#}$	119.73±9.89*§

Notes: $^{*}P<0.01$ as compared with the datum before treatment; $^{\S}P<0.05$ and $^{\#}P<0.01$ as compared with the datum in the HESPT group.

Table 3. Comparison of comprehensive curative effect after treatment (%)

Group	Cases	Cure	Obvious effect	Effectiveness	Ineffectiveness	Total effective rate
Warming needle moxibustion group	68	8(11.76)	18(26.47)*	33(48.53)	9(13.24)	86.76§
HESPT group	68	6(8.82)	32(47.06)	26(38.24)	4(5.88)	94.12
point-injection group	69	1(1.45)	14(20.29)*	35(50.72)	19(27.54)	72.46*

Notes: $^{*}P<0.01$ and $^{\S}P<0.05$ compared with the HESPT group.

DISCUSSION

KOA belongs to the TCM category of bony rheumatism. TCM mainly attributes the disease to insufficiency of *qi* and blood, dysfunction of liver and kidney, and invasion of bones by wind, cold and dampness. Lingering *qi* deficiency and blood stasis causes malnutrition of muscles and bones, leading to inflexible motion or hyperplasia and distortion of joints. Invasion of channels, collaterals, muscles, bones and joints by cold causes swelling, pain, inflexibility, and limited functional activities. Modern medicine believes that injury of cartilage and bones caused by joint imbalance and stress is an important cause for the disease, together with cartilage cell apoptosis and injury of cartilage cells by nitrogen oxide and oxygen free radicals. Non-surgical treatments of the disease mainly include oral or topical

Chinese drugs, acupuncture and moxibustion, massage, small needle knife, oral Western medicines, and injection into joints. Surgical treatment mainly includes joint irrigation, arthroscopy, osteotomy, and joint replacement.[5]

As shown by this research, warming needle moxibustion, HESPT and point injection had a good curative effect on KOA. The curative rate in the warming needle moxibustion group was higher than that in the HESPT group and point-injection group. The obviously effective rate and total effective rate in the HESPT group were higher than those in the warming needle moxibustion group and the point-injection group. These clinical observations are consistent with the result of our previous animal experiments, through which we discovered that both HESPT and point-injection could enhance the activity of superoxide dismutase (SOD) in the synovium of rabbits with osteoarthritis, reduce the content of malondialdehyde (MDA) and nitrogen oxide (NO), and inhibit apoptosis of the cartilage cells, with the curative effect in the HESPT group being much greater than that in the point-injection group.[6,7] We speculate that HESPT may reduce pressure in bones, eliminate free radicals of oxygen, help synthesize cartilage matrix and improve KOA. The better curative effect in the warming needle moxibustion group may be related to an improvement in the circulation and viscosity of blood around the focus, a reduction of interleukin-1β at the inflammatory site, activation of matrix metalloproteinase 1, reduction of the levels of tumor necrotic factor α,[8,9] enhancement of hyaluronic acid in synovial fluid, and reduction of hyaluronic acid in serum.[10]

HESPT is an integrative therapy combining drug injection, needle knife and high-frequency electric sparkle.[2] The high-frequency electromagnetic field formed around the focus by the high voltage and low current released by the DCH-2000 instrument, developed for treating bone pain, can make charged granules in the range of the focus and even produce concussion with benign proliferation. It can improve blood circulation at the site of pathological changes, improve local ischemia and hypoxia, and promote the relief of inflammation and absorption of stripped tiny pieces of tissue. In addition, traditional acupuncture can relieve the oppression of nerves in injured joints, eliminate swelling, clear channels, and slowly restore the dynamic balance of joints and muscles. The active ingredients of Corydalis decumbens Pers. extract are mainly alkaloids. Modern pharmacological studies have confirmed that Corydalis decumbens Pers. can prevent inflammation, stop pain and inhibit thrombus, platelet adhesiveness, the release of inflammatory exudation and inflammatory media, and the hyperplasia of granulation tissues.[11] Moreover, previous research has also found that the total base of Corydalis decumbens Pers. has beneficial anti-ischemic and anti-hypoxic effects.[12] Clinical observations have discovered that the compound Corydalis decumbens Pers. has a stable curative effect on KOA.[13] Under the influence of the electricity, magnetism and heat produced by the high-frequency electric sparkle, the active ingredients of Corydalis decumbens Pers. can be quickly absorbed by local tissues, and rapidly improve ischemia and hypoxia in the knee joint and inhibit local aseptic inflammatory reactions.

It is worth noting that the point selection method used in this study, which takes the main points of Liangqiu (ST 34), Xuehai (SP 10), Neixiyan (EX-LE4), Waixiyan (EX-LE5) and Zusanli (ST 36), and the adjunct points of Yinlingquan (SP 9), Weizhong (BL 40) and Chengshan (BL 57), on the affected side, is identical to that of a systematic bibliometric analysis of 98 articles on treating KOA with acupuncture and moxibustion by Li et al.[14] The points Xuehai (SP 10), Sanyinjiao (SP 6) and Yinlingquan (SP 9) belong to the Spleen Meridian of Foot-Taiyin. Xuehai (SP 10) can transform blood into *qi* and transport spleen blood. Sanyinjiao (SP 6), a convergence point of the three yin Meridians of the liver, spleen and kidney, can soothe the liver and strengthen the kidney, spleen, muscles and bones. Yinlingquan (SP 9) can clear away heat, strengthen the spleen and kidney, regulate qi and menstruation, clear channels and activate collaterals. Liangqiu (ST 34) and Zusanli (ST 36) are important points of the Stomach Meridian of Foot-Yangming. Liangqiu (ST 34) can regulate *qi* and the stomach, clear channels and activate collaterals. Zusanli (ST 36), an important point for treating numbness in the lower limbs, can nourish *qi* and blood, strengthen the spleen, supplement deficiencies, relax muscles, clear channels, dispel wind, remove dampness, promote *qi* flow and stop pain. Acupuncture at the points Weizhong (BL 40) and Chengshan (BL 57), belonging to Urinary Bladder Meridian of Foot-Taiyang, can regulate *qi*, stop pain, relax muscles, clear channels, and strengthen waist and bones. Neixiyan (EX-LE4) and Waixiyan (EX-LE5) are the most commonly used points to treat KOA. HESPT applied to the above-mentioned points can strengthen muscles and bones, nourish the liver, warm channels, disperse cold, clear channels, stop pain, promote blood circulation, and remove blood stasis.

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