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Original Article

Clinical analysis of traditional Chinese medicine acupuncture treatment of pain in patients with diabetic peripheral neuropathy

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Abstract: Objective: To investigate the clinical efficacy of acupuncture in the treatment of patients with diabetic peripheral neuropathy (DPN). Methods: The clinical data of 96 patients with DPN were retrospectively analyzed. Among them, 46 patients received routine treatment (the control group) and 50 patients received acupuncture treatment in addition to conventional treatment (the observation group). A visual analog scale (VAS) was used to evaluate the pain symptoms; the Toronto Clinical Scoring System (TCSS) was used to evaluate the symptoms, the deep sacral reflex and the sensory function of the right toe; a nerve conduction velocity measurement device was used to detect the motion and sensory nerve conduction velocity of the median nerve and the common peroneal nerve; and the total effective rate before and after treatment was compared. The SF-36 scale was used to score the quality of life and bodily pain (BP) before and after treatment. Results: The VAS and TCSS scores of the observation group were significantly lower than those of the control group ($P < 0.05$). The motor nerve conduction velocity and sensory nerve conduction velocity of the median nerve and common peroneal nerve in the observation group were significantly higher than the scores in the control group ($P < 0.05$). The total effective rate of the observation group was significantly higher than that of the control group ($P < 0.05$). The BP scores of the quality of life in the two groups were significantly higher than the scores before treatment ($P < 0.05$). The BP score of quality of life in the observation group was significantly higher than in the control group ($P < 0.05$). Conclusion: Acupuncture treatment of DPN can effectively reduce the VAS and TCSS scores, improve the motor nerve and sensory nerve conduction velocity of the median nerve and the common peroneal nerve, alleviate the patient's somatic pain, and effectively improve the patient's quality of life and total treatment efficiency. This provides certain new ideas and theoretical references for the treatment of DPN, and is worthy of clinical promotion.

Keywords: Chinese acupuncture, diabetes, peripheral neuropathy, pain

Introduction

Diabetes is one of the top three chronic non-communicable diseases in the world [1]. According to statistics, there are more than 92.4 million diabetic patients in China over the age of 20 and under 79 years old, which is 25% of the total number of diabetic patients in the world [2, 3]. According to some studies, the number of deaths due to diabetes in the world reached 3.96 million in 2010 [4]. As diabetes progresses, different degrees of neuropathy occur, and the incidence of diabetic peripheral neuropathy (DPN) is 60%-91% [5]. The clinical symptoms of this disease are mainly numbness of the limbs, pain, and even body atrophy and necrosis, which greatly increases the severity of the disease [6].

The pathogenesis of DPN is not yet fully understood, but a large number of studies have shown that DPN is a microcirculatory abnormality and metabolic disorder caused by long-term hyperglycemia [7, 8]. Therefore, the basic treatment for the prevention and treatment of DPN is to control blood glucose [9]. Since no specific drug treatment for DPN has been found, strict control of blood glucose can alleviate the symptoms in patients, but it cannot completely control the process of neuropathy [10]. Therefore,

neurotrophic drugs and anti-oxidant drugs are most commonly used in clinical practice; however, these drugs have certain side effects [11].

Acupuncture is a highly respected medical procedure dating back thousands of years in China, and it can treat many complicated diseases, especially neurological diseases; for this reason, acupuncture has gained global recognition [12]. In recent years, the use of acupuncture for DPN treatment has been given much more attention; moreover, it is not a drug treatment and therefore has few side effects on patients [13-15].

Therefore, this study aimed to investigate the clinical efficacy of acupuncture in the treatment of patients with DPN, and compare the pain level, clinical symptom score, nerve conduction velocity, and total treatment efficiency and quality of life before and after treatment; to provide the possibility of a long-term and effective method for clinical treatment of DPN, and lay a foundation for clinical promotion.

Methods and materials

Normal information

The clinical data of 96 patients with DPN were retrospectively analyzed. The age range was from 45 years old to 75 years old, and there were 45 males and 51 females. Among them, 46 patients received routine treatment (the control group) and 50 patients had acupuncture treatment in addition to conventional treatment (the observation group). All cases met the diagnostic criteria for diabetes and were diagnosed with peripheral neuropathy by pathology. Patients included in the study were not pregnant or lactating; had no heart, liver, or kidney dysfunction; had no coagulopathy, neuropathy, or pain caused by other diseases; and had no clinical data insufficiency. The study was rigorously reviewed by the Medical Ethics Committee. The subjects were informed and agreed to participate in the clinical study; all patients and their families signed the informed consent form.

Treatment method

The patients in the control group were treated with enhanced hypoglycemic, psychological, and nutritional therapy; controlled blood glucose, blood lipids, and blood pressure; and took 0.5 mg mecobalamin tablets (Eisai (China) Pharmaceutical Co., Ltd, National medicine permission number: H20030812) after each meal (i.e., 3 times per day) every day for 2 months.

Patients in observation group were treated with acupuncture treatment base on above treatment. Acupuncture was made continuously for 2 months, and acupuncture every other day, using a disposable acupuncture needle with dimensions of 0.30 mm × 25 mm or 0.30 mm × 40 mm. First, acupoints were selected for the patients, including major acupoints such as epigastric lower *shu* and *wei shu*; lung *shu* and *shen shu*; upper limb points such as *yangchi*, *neiguan*, *quchi*, and *hegu*; and lower limb points such as *zusanli*, *taichong*, *yangling quan*, and *sanyin* cross. Before acupuncture, 75% alcohol was used to disinfect the acupoints and surrounding skin, and the 25 mm or 40 mm acupuncture needles were selected according to the patients' physical differences. After accurate positioning, the needle was inserted into the twist-changing needle rapidly and vertically. The depth was about 1.0-1.5 inches, and the needle was kept in place for 30 minutes. Acupuncture treatment was performed for 2 months, and the sessions took place once every other day.

Observation index

The visual analog scale (VAS) was used to evaluate the pain symptoms before and after treatment. The scores were 0-10, and the greater the score, the more severe the pain.

The Toronto Clinical Scoring System (TCSS) was used to assess the symptoms, squat reflexes, and sensory function of the right toe before and after treatment. The corresponding symptoms of the above examinations were scored, with 0 points for normal and 1 point for abnormal, up to a total of 19 points [16].

A nerve conduction velocity measurement device was used to detect the motion and sensory nerve conduction velocity of the median nerve and the common peroneal nerve before and after treatment, and the patient's neuromuscular electrogram was presented [17].

The total effective rate of treatment was compared. There are different standards of recov-

Table 1. Comparison of general data between the two groups of patients [n (%)]

Factors	Observation group (n=50)	Control group (n=46)	t/x^2	P
Gender			3.489	0.069
Male	28 (56.00)	17 (36.96)		
Female	22 (44.00)	29 (63.04)		
Average age	60.28±8.74	61.64±7.33	0.822	0.413
Mean course of disease	5.35±2.86	5.38±2.79	0.052	0.959
Blood sugar value (mmol/L)	14.36±2.51	14.92±2.68	1.057	0.293
Glycosylated hemoglobin (%)	9.05±0.67	9.13±0.85	0.514	0.608
High blood pressure			4.174	0.065
Yes	30 (60.00)	18 (39.13)		
No	20 (40.00)	28 (60.87)		
Hyperlipidemia			2.803	0.105
Yes	23 (46.00)	29 (63.04)		
No	27 (54.00)	17 (36.96)		
Diabetes			1.399	0.304
I type	3 (6.00)	6 (13.04)		
II type	47 (94.00)	40 (86.96)		

ery that were used to score the severity of the syndrome. A patient was considered "cured" if their syndrome score was reduced by more than 90%. Treatment was scored as "markedly effective" if the patient's syndrome score was reduced by more than 70%, and patients were considered "improved" if their syndrome score was reduced by more than 30%. Finally, treatment was considered "invalid" (i.e., ineffective) if the syndrome score of the patient was reduced by less than 30%.

Total effective rate of treatment = (number of recovery cases + number of markedly effective cases + number of effective cases)/total number of patients × 100%.

The SF-36 scale [18] was used to score the quality of life before and after treatment. The SF-36 scale included a total of 8 aspects. This study only scored patients with bodily pain (BP). The scores were 0-10, and the greater the score, the better the health.

Statistical analysis

The data were analyzed using SPSS 20.0 (Shanghai Kabe Information Technology Co., Ltd.). The chi-square test was used for the count data, the t-test was used for the measurement data, and the paired t-test was used for the comparison before and after the treatment. $P < 0.05$ was statistically significant.

Results

Comparison of general data between the two groups

There were no significant differences in gender, mean age, mean disease duration, blood glucose, glycosylated hemoglobin, hypertension, number of patients with diabetes, and hyperlipidemia between the two groups ($P > 0.05$) (**Table 1**).

Comparison of VAS and TCSS scores before and after treatment in two groups of patients

The VAS scores after treatment were significantly lower in the two groups than the scores before treatment ($P < 0.001$). There was no significant difference in the VAS score between the observation group and the control group before treatment ($P > 0.05$). After treatment, the VAS score of the observation group was significantly lower than that of the control group ($P < 0.05$).

The TCSS scores after treatment were significantly lower in the two groups than the scores before treatment ($P < 0.001$). There was no significant difference between the observation group and the control group before treatment ($P > 0.05$). After treatment, the TCSS score of the observation group was significantly lower than that of the control group ($P < 0.05$) (**Figure 1** and **Table 2**).

Comparison of nerve conduction velocity n before and after treatment in two groups of patients

The motor nerve conduction velocity and sensory nerve conduction velocity of the median nerves in the two groups after treatment were significantly higher than the velocities before treatment, and the difference was statistically significant ($P < 0.05$). There was no significant difference in motor nerve conduction velocity

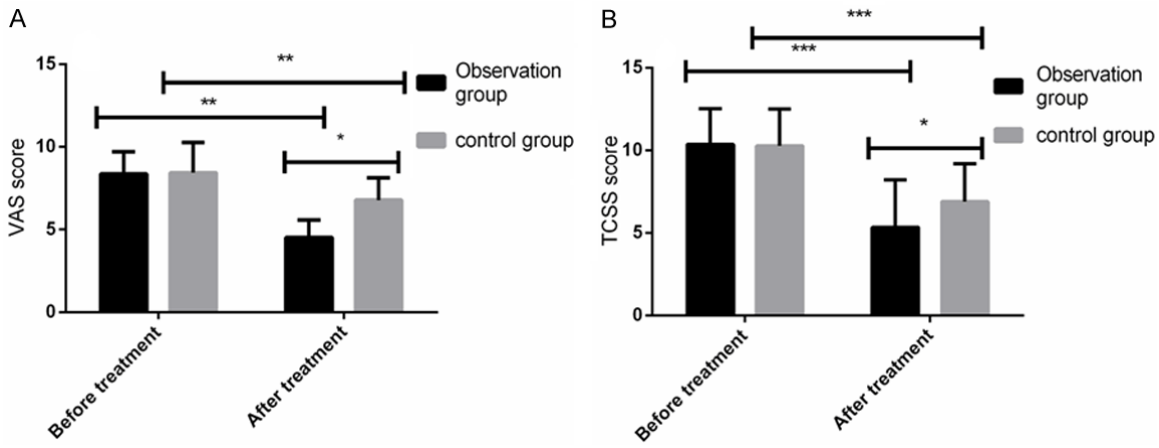

Figure 1. Comparison of VAS and TCSS scores between the two groups before and after treatment. A. The VAS scores of the two groups after treatment were significantly lower than those before treatment ($P < 0.01$). The VAS score of the observation group after treatment was significantly lower than that of the control group and the difference was statistically significant ($P < 0.05$). B. The TCSS scores of the two groups after treatment were significantly lower than the scores before treatment ($P < 0.001$). The TCSS score of the observation group after treatment was significantly lower than that of the control group and the difference was statistically significant ($P < 0.05$). *p < 0.05, **p < 0.01, ***p < 0.001.

Table 2. Comparison of visual analog scale (VAS) and Toronto Clinical Scoring System (TCSS) scores before and after treatment between the two groups

Group	n	Time	VAS	TCSS
Observation group	50	Before treatment	8.36±1.34	10.36±2.16
		After treatment	4.52±1.06*	5.35±2.87*
		t	15.890	9.862
		P	< 0.001	< 0.001
Control group	46	Before treatment	8.43±1.82	10.27±2.23
		After treatment	6.78±1.35	6.89±2.31
		t	4.939	7.140
		P	< 0.001	< 0.001

Annotation: *compared with the control group after treatment, $P < 0.05$

and sensory nerve conduction velocity between the observation group and the control group before treatment ($P > 0.05$). After treatment, the motor nerve conduction velocity and sensory nerve conduction velocity of the median nerve in the observation group were significantly higher than the velocities of the control group, and the difference was statistically significant ($P < 0.05$).

The motor nerve conduction velocity and sensory nerve conduction velocity of the common peroneal nerve in the two groups after treatment were significantly higher than the velocities before treatment, and the difference was statistically significant ($P < 0.05$). There was no significant difference in motor nerve conduction velocity and sensory nerve conduction velocity between the observation group and the control group before treatment ($P > 0.05$). After treatment, the motor nerve conduction velocity and sensory nerve conduction velocity of the common peroneal nerve were significantly higher in the observation group than in the control group, and the difference was statistically significant ($P < 0.05$) (**Figures 2** and **3**, **Tables 3** and **4**).

Comparison of total effective rate between the two groups

In the observation group, there were 25 patients (50.00%) who were considered "cured" based on their syndrome score. Another 11 patients (20.00%) benefited from treatment in a markedly effective manner. Only 6 patients (12.00%) were improved. The remaining 8 patients (16.00%), did not see any benefits from the treatment and their treatment was therefore regarded as "invalid" (i.e., ineffective). In the control group, 16 patients (34.78%) were considered "cured". Treatment was markedly effective for 7 patients (15.22%). There were 4 improved patients (8.70%), and 19 patients (41.30%) showed a syndrome score re-

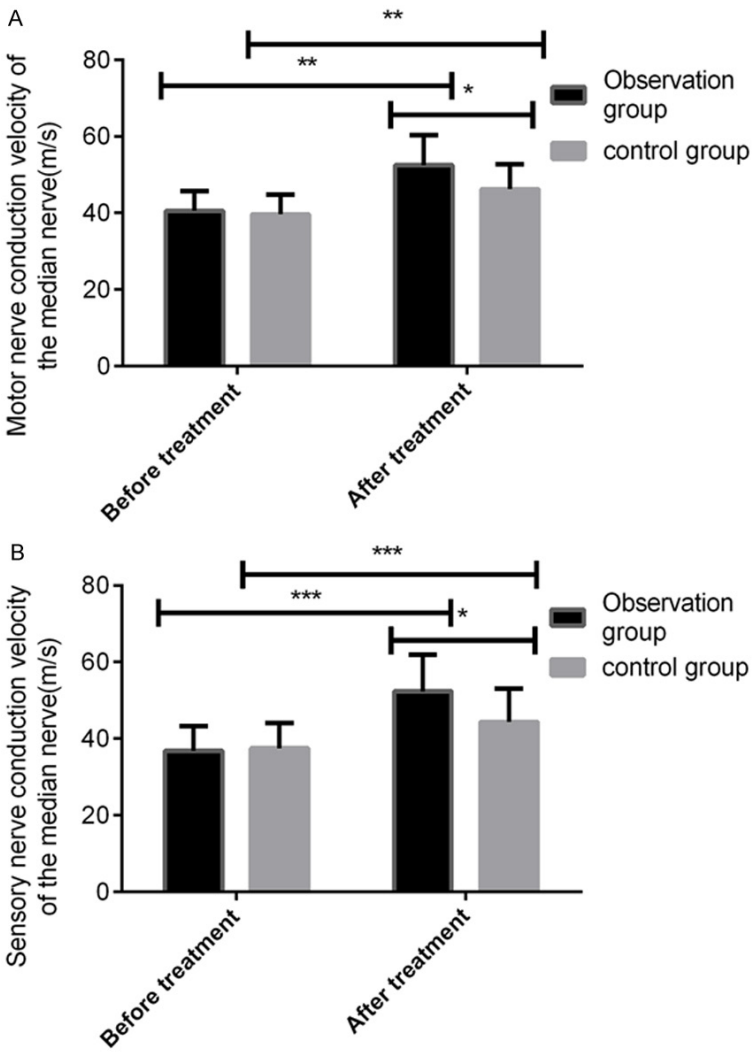

Figure 2. Conduction velocity of the median nerve in the two groups of patients before and after treatment. A. The motor nerve conduction velocity of the median nerve in the two groups after treatment was significantly higher than the velocity before treatment and the difference was statistically significant ($P < 0.01$). The motor nerve conduction velocity of the median nerve in the observation group after treatment was significantly higher than in the control group ($P < 0.05$). B. The sensory nerve conduction velocity of the median nerve in the two groups after treatment was significantly higher than the velocity before treatment and the difference was statistically significant ($P < 0.001$). The sensory nerve conduction velocity of the median nerve in the observation group after treatment was significantly higher than velocity in the control group ($P < 0.05$).*p < 0.05, **p < 0.01, ***p < 0.001.

duction of less than 30%, indicating that the treatment was ineffective (**Table 5**).

Comparison of BP scores of quality of life between the two groups

The BP scores of quality of life after treatment in the two groups were significantly higher than the scores before treatment ($P < 0.05$). After treatment, BP scores of quality of life in the observation group were significantly higher than that of the control group ($P < 0.05$) (**Table 6**).

Discussion

Diabetes is a systemic disease that endangers human health and usually causes eye diseases, kidney diseases, and peripheral neuropathy. DPN is the disease with the highest incidence and the greatest threat to the health and life of patients. DPN can damage the patient's nervous system, causing stinging, numbness of the limbs, and severe abnormalities in the foot. Some patients may have limb necrosis and will eventually need amputations in order to save their lives [19]. In the clinical treatment of DPN, most patients use the western drug mecobalamin, which can provide nutrition to the nerves, repair the nerves, and relieve the clinical symptoms; however, mecobalamin still cannot meet the needs of the patients [20]. Therefore, the combination of Chinese and Western treatment of this disease has become a subject of intensive research in recent years, in order to enable patients to obtain a better curative effect.

Chinese medicine believes that DPN is caused by deficiencies of the liver and kidneys, and blockages of veins, resulting in an imbalance of meridians, which causes neurological disturbance, pain, numbness, etc. Muscle atrophy and complications may occur over time [21, 22]. DPN involves the kidneys, lungs, stomach, and other organs; consequently, acupuncture treatment was performed on the relevant acupoints of patients [23].

VAS is a symptom assessment scale that is widely used to describe mood or sensation and is the most reliable and sensitive method for

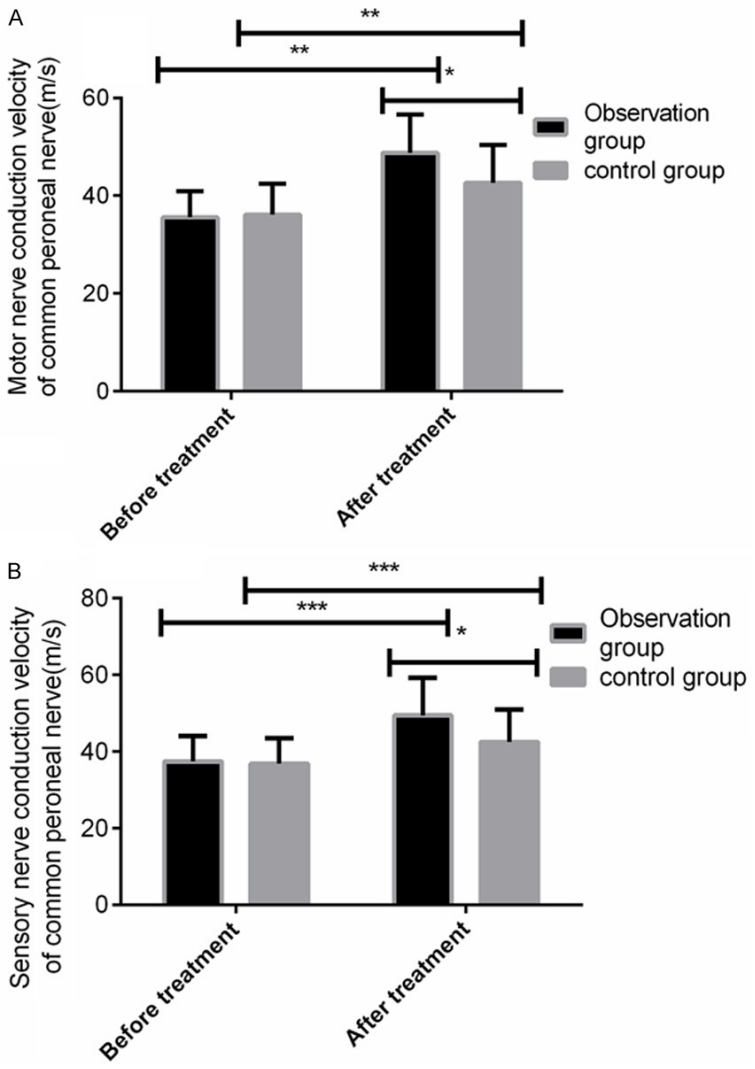

Figure 3. Conduction velocity of the common peroneal nerve before and after treatment in the two groups. A. The motor nerve conduction velocity of the common peroneal nerve in the two groups after treatment was significantly higher than the velocity before treatment ($P < 0.01$). The motor nerve conduction velocity of the common peroneal nerve in the observation group was significantly higher than the control group after treatment ($P < 0.05$). B. The sensory nerve conduction velocity of the common peroneal nerve of the two groups after treatment was significantly higher than the velocity before treatment and the difference was statistically significant ($P < 0.001$). The sensory nerve conduction velocity of the common peroneal nerve in the observation group was significantly higher than the control group after treatment ($P < 0.05$). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

assessing pain in the medical field [20]. According to reports in the literature, TCSS is a comprehensive scoring system customized according to the characteristics of DPN, and is mostly used in DPN epidemiological investigations [24]. TCSS has the advantages of comprehensiveness and simplicity, which can evaluate the severity of DPN and is a safe, fast, simple, and effective screening method [25]. This study showed that the VAS and TCSS scores of the two groups after treatment were significantly lower than the scores before treatment ($P < 0.001$). There were no significant differences in the VAS and TCSS scores between the observation group and the control group before treatment ($P > 0.05$). After treatment, however, the VAS and TCSS scores in the observation group were significantly lower than those of the control group ($P < 0.05$). This result indicates that the use of acupuncture for the treatment of DPN can effectively reduce VAS and TCSS scores, reduce pain, and relieve clinical symptoms. Since the use of acupuncture to treat DPN and the evaluation of clinical efficacy using VAS and TCSS has not been found, the accuracy of our results cannot be confirmed.

Many Chinese physicians believe that the gold standard for detecting DPN is neuroelectromyography, which can clarify whether the response-related indicators are improved and whether the treatment is effective; therefore, neuroelectromyography has extraordinary significance in the diagnosis of DPN [26]. Related literature shows that an electromyographic nerve conduction velocity examination is a useful tool for clinical diagnosis [27]. The present study showed that the motor nerve conduction velocity and sensory nerve conduction velocity of the median nerve and common peroneal nerve were significantly higher in the two groups after treatment than the velocities before treatment, and the difference was statistically significant ($P < 0.05$). There was no significant difference in motor nerve conduction velocity and sensory nerve conduction velocity between the obser-

Table 3. Comparison of median nerve conduction velocity between the two groups before and after treatment

Group	n	Time	Median nerve conduction velocity (m/s)	
			Motor nerve conduction velocity	Sensory nerve conduction velocity
Observation group	50	Before treatment	40.56±5.14	36.58±6.42
		After treatment	52.53±7.82*	52.34±9.54*
		t	9.045	9.691
		P	< 0.001	< 0.001
Control group	46	Before treatment	39.62±5.23	37.53±6.57
		After treatment	46.21±6.52	44.38±8.69
		t	5.347	4.265
		P	< 0.001	< 0.001

Annotation: *compared with the control group after treatment, P < 0.05.

Table 4. Comparison of common peroneal nerve conduction velocity between the two groups before and after treatment

Group	n	Time	Common peroneal nerve conduction velocity (m/s)	
			Motor nerve conduction velocity	Sensory nerve conduction velocity
Observation group	50	Before treatment	35.57±5.34	37.43±6.57
		After treatment	48.76±7.84*	49.46±9.75*
		t	9.832	7.235
		P	< 0.001	< 0.001
Control group	46	Before treatment	36.13±6.27	36.85±6.68
		After treatment	42.68±7.71	42.51±8.46
		t	4.470	3.561
		P	< 0.001	0.001

Annotation: *compared with the control group after treatment, P < 0.05.

vation group and the control group before treatment (P > 0.05). After treatment, the motor nerve conduction velocity and sensory nerve conduction velocity of the median nerve and common peroneal nerve in the observation group were significantly higher than the velocities in the control group, and the difference was statistically significant (P < 0.05). Some studies shown that the Meta-analysis of acupuncture treatment on DPN patients revealed it can improve the nerve conduction velocity and sensory nerve conduction velocity of the sacral nerve, which is consistent with our results [28]. The main cause of infection in the lower limbs of diabetic patients and the occurrence of amputation is DPN, which seriously affects the quality of life of diabetic patients [29]. According to the literature, various quality of life scales have been widely used in foreign studies, but the most commonly used for various diseases is the SF-36 quality of life scale; in particular, this is one of the most widely used quality of life scales for diabetes patients [30]. Generally, the SF-36 quality of life scale assesses the following eight aspects: the physical role, physical function, physical pain, vitality, emotional function, social function, mental health, and overall health [31]. Since the main clinical symptom of DPN is pain, this study only evaluated the physical pain in the quality of life score. The results showed that the quality of life BP score after treatment was significantly higher than before treatment, and the difference was statistically significant (P < 0.05). Before treatment, there was no significant difference in the quality of life BP score between the observation group and the control group (P > 0.05). After treatment, the quality of life BP score in the observation group was significantly higher than in the control group (P < 0.05). It has been reported in the literature that the nerve conduction velocity and quality of life BP score after acupuncture treatment for DPN is significantly higher than those scores before treatment [32]. This shows that acupuncture can effectively improve the nerve conduction velocity of patients with DPN, reduce the pain of patients, and improve the quality of life, which is basically consistent with our results.

These previous results are basically consistent with the results of the present study. In the observation group, there were 25 cases

Table 5. Comparison of total effective rate between the two groups [n (%)]

Group	Cure	Remarkable effect	For the better	Invalid	Total effective rate (%)
Observation group (n=50)	25 (50.00)	11 (22.00)	6 (12.00)	8 (16.00)	42 (84.00)
Control group (n=46)	16 (34.78)	7 (15.22)	4 (8.70)	19 (41.30)	27 (58.70)
χ^2	2.267	0.723	0.280	7.589	7.589
P	0.152	0.442	0.743	0.007	0.007

Table 6. Comparison of bodily pain (BP) scores of quality of life between the two groups

Group	n	Time	BP scores
Observation group	50	Before treatment	23.74±10.85
		After treatment	60.05±12.12*
		t	15.780
		P	< 0.001
Control group	46	Before treatment	23.04±11.06
		After treatment	40.26±7.53*
		t	8.729
		P	< 0.001

*P < 0.01 compared with that before treatment within the same group.

(50.00%) of "cured" patients; treatment was "markedly effective" for 11 patients (22.00%); 6 patients (12.00%) were "improved"; and 8 patients (16.00%) did not see beneficial results from treatment, so it was considered "invalid" (i.e., ineffective). In the control group, there were 16 "cured" patients (34.78%); 7 cases (15.22%) were treatment was "markedly effective"; 4 patients (8.70%) who "improved"; and 19 cases (41.30%) where treatment was "invalid" (i.e., ineffective). The total effective rate of the observation group was significantly higher than that of the control group, and the dif ference was statistically significant (P < 0.05). Studies have shown that the total effective rate of acupuncture combined with mecobalamin in the treatment of DPN is 92.8%, which is significantly better than the 75.0% total effective rate of taking mecobalamin only; this is basically consistent with our findings [33].

A large number of related studies have shown that acupuncture can reduce the abnormalities of blood vessels, bioactive substances, and nerve nutrition, accelerate the metabolism of nerve tissue, and promote the recovery of nerve function [34]. It can accelerate cell depolymerization and reduce blood viscosity, which plays an important role in the treatment of diabetic DPN [35].

However, there are certain deficiencies in the use of acupuncture treatment. There are few clinical observation indicators before and after DPN treatment, and the biochemical, genetic, immunological, molecular biological indicators are missing, which interferes with DPN diagnosis and efficacy. Although acupuncture treatment is the same, the dialectical treatment of acupuncture is not uniform, and the conclusions of the study cannot be accurately compared. DPN is a disease that frequently leads to skin infection, and acupuncture often cannot avoid such problems; however, this study did not discuss and analyze this related issue. We hope that we can further improve and solve the above problems in future research, pay more attention to the science and accuracy of the data in evaluating the efficacy of the treatment, strengthen the research of clinical mechanisms, and improve the examination of laboratory biochemical indicators. At the same time, we hope to be able to objectively evaluate the long-term effects and efficacy of acupuncture therapy on the patient. Finally, in future research, we would like to explore and explain the mechanism of action of acupuncture treatment, so that the advantages of acupuncture will be fully and completely utilized.

In summary, the use of acupuncture treatment for DPN can effectively reduce the VAS and TCSS scores, improve the conduction velocity of the motor and sensory nerves of the median and common peroneal nerves, relieve the patient's physical pain, and effectively improve the quality of life of the patients and the overall effectiveness of treatment for patients with DPN. This provides new ideas and theoretical references for the treatment of DPN, which are worthy of clinical promotion.

Disclosure of conflict of interest

None.

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