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Analysis of the Effect and Efficiency of Transcutaneous Acupoint Electrical Stimulation in the Treatment of Chronic Pelvic Pain in the Sequelae of Pelvic Inflammatory Diseases

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Abstract: *Objective:* To analyze the effect of transcutaneous acupoint electrical stimulation in the treatment of chronic pelvic pain following sequelae of pelvic inflammatory diseases. *Methods:* Fifty cases of chronic pelvic pain patients with sequelae of pelvic inflammatory diseases, who visited the hospital between June 2022 and June 2023, were selected and randomly divided into the experimental group and control group using a computerized lottery method. The control group received treatment with painkillers, while the experimental group underwent transcutaneous acupoint electrical stimulation. Symptoms, signs, and pain levels were observed before and after the treatment, and clinical effects between the two groups were compared. *Results:* Patients in the experimental group exhibited lower PPI, VAS, PRI, and other pain scores compared to the control group ($P < 0.05$). Moreover, symptoms and signs scores in the experimental group were lower than those in the control group ($P < 0.05$). Following treatment, the quality-of-life scores for patients in the experimental group were higher than those in the control group ($P < 0.05$). The experimental group had a higher overall treatment effective rate of 96% as compared to the control group (76%; $P < 0.05$). *Conclusion:* The application of transcutaneous acupoint electrical stimulation significantly reduced the degree of pelvic pain in patients with sequelae of pelvic inflammatory diseases. This intervention enhanced the overall clinical effect and promoted an improvement in the patient's quality of life.

Keywords: Pelvic inflammatory disease; Chronic pelvic pain; Transcutaneous acupoint electrical stimulation; Pain level; Quality of life

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1. Introduction

Pelvic inflammatory disease (PID) is a well-known condition affecting a significant number of women. Delaying its treatment can result in prolonged inflammatory stimulation of the body, potentially leading to local tissue adhesions, fluid accumulation, and edema. This, in turn, increases the complexity of treatment. The

delayed management of PID is a key factor contributing to chronic pelvic pain. Chronic pelvic pain is defined as non-cyclical pain persisting for more than six months in areas such as the buttocks, lower back, and pelvis. This condition profoundly impacts women's lives, with clinical treatment aiming to alleviate pain and enhance overall quality of life. Commonly, treatment methods involve medication and physical therapy [1,2].

Acupuncture, a frequently employed external treatment in traditional Chinese medicine (TCM), is known for its effectiveness in pain relief. However, traditional acupuncture methods involve invasive procedures, often causing discomfort and reducing patient compliance. Transcutaneous electrical stimulation of acupoints, on the other hand, entails stimulating specific acupoints through pulsed electric currents. This method mirrors the effects of acupuncture and aids in pain reduction [3,4]. This study aims to analyze the effects and efficiency of transcutaneous acupoint electrical stimulation in treating chronic pelvic pain resulting from pelvic inflammatory disease sequelae.

2. Materials and methods

2.1. General information

The study enrolled 50 cases of patients with chronic pelvic pain and sequelae of pelvic inflammatory diseases who visited the hospital between June 2022 and June 2023. All patients were randomly assigned to either the experimental group or the control group using a computerized lottery method. The test group comprised 25 patients, aged between 20 and 48 years, with a mean age of 38.29 ± 3.09 years. The duration of the disease in this group ranged from 6 months to 3 years, with a mean duration of 1.19 ± 0.23 years. In the control group, there were 25 patients aged 21–49 years, with a mean age of 39.36 ± 3.26 years. The duration of the disease in this group ranged from 6 months to 4 years, with a mean duration of 1.46 ± 0.23 years. Statistical analysis revealed no significant difference in basic demographic data between the two groups ($P > 0.05$) after comparing all relevant parameters.

2.2. Methods

The control group received ibuprofen (extended-release tablets) for chronic pelvic pain at a dose of 0.2 g per application, taken orally, and administered twice a day.

In the treatment group, transcutaneous acupoint electrical stimulation was added to the regimen. The specific methods involved detailed pre-treatment education to ensure patients understood the effects, safety, and necessary precautions of transcutaneous acupoint electrical stimulation treatment. This was crucial for maintaining patients' cooperation levels. The HKTENS-T300 therapeutic instrument, manufactured by Hanfei Medical Instrument Co., Ltd (Shanghai), was selected for treatment. Acupoints such as Shuidao (waterway point), Zigong (uterus point), Jiusao, and Renyu were chosen for stimulation. The local skin at each acupoint was sterilized, and electrode sheets were carefully applied. The left and right side acupoints of the same name constituted four therapeutic channels, connected to the therapeutic instrument. The instrument parameters were adjusted to the current strength of 10–30 mA, 250 mA, 250 mA, and 250 mA, respectively. The current intensity was set at 30 mA, pulse width at 250 μs, and stimulation frequency at 2/100 Hz, forming sparse and dense waves. The mode was transcutaneous electrical nerve stimulation, and adjustments were made based on patient feedback to achieve a tingling sensation at the acupoints without inducing pain. The treatment duration was 40 min, administered once a day. Patients initiated treatment on the third day of menstrual cleansing, continued for two weeks, and underwent treatment for three cycles.

2.3. Observation index

Before and after the treatment, the patient's pain level was assessed using the short-form McGill pain questionnaire (SF-MPQ), scoring present pain intensity (PPI), visual analog scale (VAS), and pain rating index (PRI). Higher scores indicated more severe pain [5].

Patients were also assisted in evaluating symptoms and signs points before and after treatment. Symptom scores were assigned for fever and fatigue, menstrual disorders, lumbosacral and lower abdominal pain, and leukorrhea volume. Sign points involved determining the degree of localized swelling, adnexal thickening, uterine tenderness, and adnexal pressure pain. Each item was scored from 0 to 3 points, totaling 12 points. Higher scores indicated more serious symptoms and signs.

The World Health Organization Quality-of-Life Scale (WHOQOL **-** BREF) was used before and after treatment to score patients' quality of life. Evaluation indexes covered the environment, social relations, physiology, psychology, and other indicators. Higher quality-of-life scores indicated better overall well-being [6].

Clinical effect criteria were applied as follows: the disappearance of disease-related symptoms and signs after treatment with no abnormalities in examination results, classified as "cured"; noticeable improvement in related symptoms and signs with significant improvements in examination indicators, considered as "very effective"; reduction in related symptoms and signs with improved examination indicators, categorized as "effective"; no change in the patient's condition and examination results, labeled as "ineffective" [7].

2.4. Statistical analysis

The data gathered in this study underwent processing and analysis using SPSS 22.0 statistical software. Measured data were expressed as mean ± standard deviation (SD), and the *t*-test was applied. Count data were presented as percentages, with the χ^2 test employed. A significance level of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Pain level before and after treatment in both groups

As shown in **Table 1**, comparing patients in the experimental and control groups before treatment, there were no significant differences in PPI, VAS, and PRI ($P > 0.05$). After treatment, both groups exhibited a decrease in PPI, VAS, and PRI scores compared to pre-treatment levels ($P < 0.05$). Notably, post-treatment scores in the experimental group were lower than those in the control group ($P < 0.05$).

Table 1. Pain level before and after treatment (mean ± SD, points)

Group	Period	PPI	VAS	PRI	
				Psychological	Physical
Experimental group (n = 25)	Before	3.42 ± 0.52	5.33 ± 1.09	4.65 ± 1.45	8.28 ± 1.35
	After	1.36 ± 0.27	2.21 ± 0.62	1.73 ± 0.34	3.03 ± 0.54
Control group (n = 25)	Before	3.57 ± 0.55	5.28 ± 1.18	4.71 ± 1.52	8.41 ± 1.46
	After	2.39 ± 0.42	3.36 ± 0.75	2.58 ± 0.63	5.24 ± 0.86
t		3.274	3.104	3.445	3.782
P		< 0.05	< 0.05	< 0.05	< 0.05

3.2. Symptom and sign scores before and after treatment in both groups

Before treatment, there were no significant differences in symptoms and signs between the two groups ($P > 0.05$). Post-treatment, both groups experienced a reduction in symptoms and signs compared to pre-treatment levels ($P < 0.05$). Importantly, post-treatment scores in the experimental group were lower than those in the control group ($P < 0.05$), as shown in **Table 2**.

Table 2. Symptom and sign scores before and after treatment (mean ± SD, points)

Group	Period	Symptom score	Sign score
Experimental group ($n = 25$)	Before	9.46 ± 1.28	9.17 ± 1.24
	After	1.72 ± 0.51	1.26 ± 0.46
Control group ($n = 25$)	Before	9.32 ± 1.36	9.13 ± 1.22
	After	3.23 ± 0.58	2.85 ± 0.76
t		4.843	3.029
P		< 0.05	< 0.05

3.3. Quality of life scores before and after treatment in both groups

Table 3 shows the difference in the quality of life scores between patients in the experimental and control groups before treatment was not significant ($P > 0.05$). Following treatment, both groups showed an increase in quality of life scores compared to the pre-treatment period ($P < 0.05$). Significantly, post-treatment scores in the experimental group were higher than those in the control group ($P < 0.05$).

Table 3. Quality of life scores before and after treatment (mean ± SD, points)

Group	Before treatment	After treatment
Experimental group ($n = 25$)	67.09 ± 4.23	92.08 ± 7.46
Control group ($n = 25$)	67.17 ± 4.24	80.11 ± 5.37
t	0.293	11.273
P	> 0.05	< 0.05

3.4. Total effective rate of treatment for both groups

The total effective rate after treatment was 96.00% in the experimental group, significantly higher than the 76.00% in the control group ($P < 0.05$), as shown in **Table 4**.

Table 4. Total effective rate of treatment

Group	Cured	Very effective	Effective	Ineffective	Total effective rate
Experimental group ($n = 25$)	13	8	3	1	96.00%
Control group ($n = 25$)	7	8	4	6	76.00%
χ^2					6.835
P					< 0.05

4. Discussion

Chronic pelvic pain as a sequela of PID is a multifaceted and intricate condition. This pain can stem from

various factors, primarily rooted in persistent pelvic inflammation that leads to prolonged inflammatory infiltration within the pelvic cavity. This state stimulates pain receptors through inflammatory cues, resulting in the experience of injurious sensations. This type of pain is chronic and encompasses both somatic and visceral origins, influenced by psychological factors, negative cognition, and other elements, significantly diminishing the patient's quality of life [8,9]. When examining the mechanisms behind chronic pelvic pain following PID, several aspects come to light. Firstly, nerve tissue is stimulated by inflammation, leading to the release of endogenous substances such as vasopressin, neurokinin A, substance P, and others. These substances diffuse to external tissues, and when their concentration reaches a certain level, they stimulate pelvic pain receptors, giving rise to pain. Simultaneously, the occurrence of PID releases a substantial amount of inflammatory factors that stimulate pain receptors in the pelvis, inducing the transmission of pain signals [10]. Furthermore, the progression of PID involves a series of pathological changes, including local adhesions in the pelvis. Fibrotic adhesions between the peritoneum and organs generate tugging sensations, leading to pain. Additionally, this adhesion condition adversely affects local vasculature, causing tissue edema, and triggering compressive pain [11].

There is currently a lack of uniform standards for treating chronic pelvic pain resulting from PID sequelae. The approach often involves a combination of medications and non-pharmacological treatments. Opioid drugs and analgesics are commonly prescribed to help alleviate pain to a certain extent. However, these drugs are not suitable for prolonged use, and patient acceptance is often limited. Therefore, the focus has shifted towards addressing patient needs through non-pharmacological treatments. TCM in China offers a unique perspective on the condition, categorizing abdominal pain as a result of imbalances in cellular veins caused by malevolent factors such as phlegm, dampness, cold, and heat. This imbalance damages the Chongren, leading to stagnation of qi and blood in the lower jiao (lower section of the body), resulting in persistent pain. Prolonged illness weakens the patient's physical condition, depletes positive qi, and further impacts cellular qi and blood, exacerbating the pain. Cold and dampness stagnation is a prevalent symptom in such cases, and its pathogenesis is closely linked to dampness and cold. Therefore, the key focus in treatment involves pain relief, blood activation, and the removal of dampness and dispelling cold [12,13].

Transcutaneous electrical stimulation therapy integrates Western medicine's transcutaneous electrical stimulation method with TCM acupoint theory. Guided by the principles of TCM meridian theory, specific acupoints are chosen for electrode placement, generating pulse currents that simulate acupuncture. This method is particularly unique in its ability to enhance local microcirculation and alleviate pain. For chronic pelvic pain patients, the main mechanisms involve the promotion of thick nerve fiber excitation by specific currents. Tailoring the current to each patient ensures precise stimulation adjustment. The specific current stimulation induces a distinctive pinprick sensation, closing the pain transmission gate and achieving analgesic effects. Additionally, it is suggested that specific current stimulation promotes the release of multiple endogenous opioid peptides, contributing to analgesia [14,15]. Simultaneously, the electric current stimulates muscle tissue, inducing contraction movements that improve local blood circulation. This promotes the adsorption of adhesion and inflammatory hyperplasia tissue, leading to a notable analgesic effect. In this study, the experimental group received transcutaneous acupoint electrical stimulation with alternating sparse and dense waves at 100 Hz and 2 Hz. The high-frequency current at 100 Hz encourages the release of potent morphine peptide, while the low-frequency current at 2 Hz promotes the release of endorphin and enkephalin, achieving a robust analgesic effect. Concurrently, the electrically stimulated pelvic tissues undergo diastolic and contractile movements, enhancing the efficiency of adhesion absorption. The results of the study confirmed a significant improvement in pain levels, symptom scores, and overall clinical effects in the experimental group following treatment.

In conclusion, the application of transcutaneous electrical stimulation on acupoints for chronic pelvic

pain arising from PID sequelae substantially diminishes pain levels, improves overall clinical outcomes, and contributes to enhanced quality of life for patients. Importantly, the researchers have no conflicts of interest related to the trial, making the adoption of this protocol a worthwhile consideration.

Disclosure statement

The authors declare no conflict of interest.

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