

Clinical Efficacy of Microwave Combined with *Sophora flavescens* Gel in Treating HPV Infection Complicated with Chronic Cervicitis and its Influence on Vaginal Microecology of Patients

Yan Cheng*, Jiangzheng Huang

The People's Hospital of Shiyan Maojian, Shiyan 442000, Hubei Province, China

*Corresponding author: Yan Cheng, chengyancn@aliyun.com

Copyright: © 2024 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To analyze the effect of microwave combined with *Sophora flavescens* gel in patients with HPV infection and chronic cervicitis (CC). *Methods:* From May 2022 to May 2023, 65 patients with HPV infection complicated with CC were randomly selected and divided into group A (31 cases, microwave) and group B (34 cases, microwave + *Sophora flavescens* gel) by numerical numbering envelope method, and the effects of the two groups were compared. *Results:* The positive rate of vaginal microenvironment factors, inflammatory factor indexes, immune function indexes, and HPV-DNA viral load in group B were better than those in group A in the following month after treatment ($P < 0.05$). *Conclusion:* Combined use of microwave and *Sophora flavescens* gel in patients with HPV infection and CC can better improve the vaginal microenvironment and inflammatory reaction, boost the body's immune function, and reduce HPV-DNA viral load.

Keywords: Microwave; *Sophora flavescens* gel; HPV infection; Chronic cervicitis; Vaginal microecology

Online publication: June 13, 2024

1. Introduction

Chronic cervicitis (CC) is a common disease characterized by abnormal leucorrhea, cervical congestion, hypertrophy, cervical erosion, etc., which is common among women of childbearing age. Poor sexual hygiene or uterine cavity operation can lead to pathogen invasion of the cervix, causing CC. In addition, if acute cervicitis is not treated properly, it will develop into CC^[1-2]. Human papillomavirus (HPV) infection can be detected in most CC patients, which is also the main factor that increases the difficulty and prolongs the treatment duration^[3]. The female vaginal microecosystem mainly includes normal vaginal anatomy, vaginal flora, periodic endocrine changes, and local immunity of the vaginal cervix. Each component plays a role in maintaining the balance of the vaginal microecosystem. Once this balance is broken, the probability of female reproductive tract infection increases significantly. Clinical studies have confirmed that HPV infection is a high-risk factor for cervical lesions, and vaginal microecological imbalance can increase the risk of HPV

infection^[3]. The main methods of clinical treatment for CC and HPV infection were antiviral and inhibition of cell proliferation. Although these treatments have a quick effect, the cure rate was low and the recurrence rate was high^[4]. CC and HPV infection are classified as leukorrhea diseases in traditional Chinese medicine, and the inducement was the invasion of dampness pathogen, which is affected by disharmony of liver-spleen, injury of conception vessel, and loss of contract of belt vessel. Clinical practice has proved that integrated traditional Chinese and Western medicine therapy can improve the overall effect of treating HPV infection complicated with CC. This study analyzed the effect of microwave and *Sophora flavescens* (hereinafter known as Sophora gel) on patients suffering from HPV infection complicated with CC.

2. Information and methods

2.1. General information

From May 2022 to May 2023, 65 patients diagnosed with HPV infection and cervical cancer (CC) were randomly selected and grouped using a numerical numbering envelope method. Group A consisted of 31 patients, aged 21-52 years, with a mean age of 38.62 ± 3.58 years. The HPV typing in this group revealed 20 cases of high-risk type and 11 cases of low-risk type. The duration of CC ranged from 1 month to 6 years, with a mean duration of 2.35 ± 1.41 years. The severity of cervical erosion was classified as 6 mild cases, 10 moderate cases, and 15 severe cases. Group B comprised 31 cases with ages ranging from 20 to 51 years and a mean age of 38.18 ± 3.49 years. HPV typing showed 21 cases of high-risk type and 10 cases of low-risk type. The duration of CC in this group ranged from 1 month to 6.3 years, with a mean duration of (2.52 ± 1.45) years. Cervical erosion severity was observed as 5 mild cases, 9 moderate cases, and 17 severe cases. General information between the two groups was compared, showing no significant differences ($P > 0.05$).

Inclusion criteria: diagnosed with CC (mainly erosive changes) and HPV, complete medical history, active participation in the study, and signed an informed consent to the study.

Exclusion criteria: patients complicated with malignant neoplasm, psychosis, immune and hematologic system diseases, hepatorenal dysfunction, etc.

2.2. Methods

2.2.1. Group A

Group A underwent microwave treatment, which was conducted 3–7 days after menstruation. The specific procedure involved conventional disinfection of the vulva, cervix, and vagina. Secretions on the cervical surface were wiped off using sterile dry cotton balls. A microwave instrument probe with a frequency of 45-50W was then used to irradiate the erosion surface from the cervical orifice outward, until the erosive tissue turned yellow and white, indicating coagulation and denaturation. The burnt surface extended beyond the erosion surface by 3-5mm, ensuring proper depth of treatment and a smooth wound surface. Patients were advised to abstain from sexual activity and bathing for 1 month post-treatment and to undergo timely reexamination as per the physician's instructions.

2.2.2. Group B

Group B was treated with Sophora gel on top of microwave treatment for 14 days.

2.2.3. Index observation

2.2.4. The rate of vaginal microenvironment factors

Vaginal microenvironmental factors in vaginal secretions were assessed using the Vaginitis Pentagonal Test Kit

3–7 days after menstruation before treatment and again the following month after treatment. The factors tested included leukocyte esterase (LE) (positive indicated by light blue color), hydrogen peroxide (H₂O₂) (positive indicated by red color), N-Acetylgalactosaminidase (NAG) (positive indicated by light blue color), and sialidase (SNA) (positive indicated by light blue color).

Positive rate of vaginal microenvironment factors = Positive cases/total cases × 100%

2.2.5. Inflammatory factor indexes

Enzyme-linked immunosorbent assay (ELISA) was employed to detect high-sensitivity C-reactive protein (hs-CRP), interleukin-1 (IL-1 β), IL-2, IL-10, Tumor necrosis factor- α (TNF- α), and γ -Interferon (IFN- γ) in 5ml of fasting venous blood. The blood samples underwent centrifugation at a speed of 3000r/min for 15 minutes. This procedure was conducted 3–7 days after menstruation before treatment and again the following month after treatment.

2.2.6. Immune function indexes, HPV DNA viral load

Nephelometry was utilized to detect immunoglobulin (Ig) A, G, and M levels in 5 mL of fasting venous blood. Additionally, cervical orifice epithelial cells and transitional zone epithelial cells were collected 3–7 days after menstruation before treatment and again the following month after treatment. The HPV-DNA viral load was then assessed using a PCR fluorescence quantitative analyzer.

2.2.7. Statistical analysis

The data were processed using SPSS 25.0 software. The measurement data were expressed as mean \pm standard deviation. t-tests were conducted to compare the measurement data and chi-square (χ^2) tests for counting data. A significance level of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of positive rates of vaginal microenvironment factors

Before treatment, there was no significant difference in the positive rate of vaginal microenvironment factors ($P > 0.05$). However, after treatment, the positive rate in group B was lower than in group A ($P < 0.05$). Further details are shown in **Table 1**.

3.2. Comparison of Inflammatory factor indexes

Before treatment, the inflammatory factor indexes of the two groups were compared, revealing no significant difference ($P > 0.05$). However, after treatment, Group B exhibited better outcomes compared to Group A ($P < 0.05$). Please refer to Table 2 for detailed data, as shown in **Table 2**.

3.3. Comparison of Immune function indexes and HPV DNA viral load

Before treatment, the immune function indexes and HPV DNA viral load of the two groups were compared, showing no significant difference ($P > 0.05$). However, after treatment, Group B demonstrated superior outcomes compared to Group A ($P < 0.05$), as shown in **Table 3**.

Table 1. Comparison of positive rates of vaginal microenvironment factors [n (%)]

Groups	Cases	Positive rates of LE		Positive rates of H ₂ O ₂		Positive rates of NAG		Positive rates of SNA	
		Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment
Group B	31	15 (48.39)	2 (6.45)*	12 (38.71)	1 (3.23)*	14 (45.16)	2 (6.45)*	11 (35.48)	1 (3.23)*
Group A	31	14 (45.16)	9 (29.03)	13 (41.94)	7 (22.58)	12 (38.71)	8 (25.81)	13 (41.94)	6 (19.35)
χ^2	-	0.064	5.415	0.067	5.166	0.265	4.292	0.271	4.026
<i>P</i>	-	0.799	0.019	0.795	0.023	0.606	0.038	0.602	0.044

Note: Compared with this group before treatment **P* < 0.05.

Table 2. Comparison of Inflammatory factor indexes (mean ± standard deviation)

Groups	Cases	hs-CRP (mg/L)		IL-1 β (ng/L)		IL-2 (pg/mL)		IL-10 (μ g/L)		TNF- α (pg/mL)		IFN- γ (pg/mL)	
		Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment
Group B	31	13.12 ± 1.54	6.23 ± 1.02*	4.25 ± 0.86	0.62 ± 0.13*	27.38 ± 4.35	20.12 ± 4.36*	25.64 ± 4.59	18.06 ± 3.24*	29.34 ± 3.16	20.23 ± 2.05*	9.39 ± 1.27	12.34 ± 1.46*
Group A	31	13.05 ± 1.51	7.68 ± 1.34*	4.37 ± 0.85	1.25 ± 0.39*	27.14 ± 4.28	23.86 ± 3.24*	25.18 ± 4.67	21.95 ± 3.61*	29.81 ± 3.18	23.64 ± 2.53*	9.23 ± 1.24	11.09 ± 1.34*
<i>t</i>	-	0.180	4.793	0.552	8.532	0.218	3.833	0.391	4.465	0.583	5.830	0.501	3.511
<i>P</i>	-	0.857	0.000	0.582	0.000	0.827	0.000	0.697	0.000	0.561	0.000	0.617	0.000

Note: Compared with the same group before treatment **P* < 0.05.

Table 3. Comparison of Immune function indexes, HPV DNA viral load (mean ± standard deviation)

Groups	Cases	IgA (g/L)		IgG (g/L)		IgM (g/L)		HPV-DNA viral load (10 ³ copy/mL)	
		Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment	Before treatment	One month after treatment
Group B	31	2.47±0.26	2.96±0.21*	10.06 ± 1.07	11.68 ± 1.12*	0.92 ± 0.25	1.38 ± 0.26*	83.12 ± 10.37	5.67 ± 1.23*
Group A	31	2.43 ± 0.25	2.52 ± 0.23	10.04 ± 1.08	10.27 ± 1.09	0.94 ± 0.23	1.02 ± 0.22	83.69 ± 10.42	9.26 ± 1.58*
<i>t</i>	-	0.617	7.865	0.073	5.023	0.327	5.885	0.215	9.982
<i>P</i>	-	0.539	0.000	0.941	0.000	0.744	0.000	0.829	0.000

Note: Compared with this group before treatment **P* < 0.05.

4. Discussion

The occurrence and development of CC are directly related to factors such as cervical damage, degree of damage, and viral infection. The local resistance of the cervix is significantly reduced under the influence of cervical damage and physical and chemical factors, increasing the probability of HPV and other types of infection, and thereby inducing inflammatory lesions. CC is induced by long-term inflammatory reactions in the cervix [5]. The incidence of HPV infection combined with cervical cancer (CC) is on the rise each year due to various factors, posing a significant threat to both the physical and mental health of affected individuals. High-risk HPV infection, in particular, is a major contributing factor to the development of cervical cancer. As such, early detection of HPV infection combined with CC and the prompt implementation of effective treatment measures hold paramount clinical importance [6].

Traditional Chinese medicine categorizes patients with HPV infection complicated by CC as having leukorrhea disease. According to this classification, the main causes of this condition are spleen deficiency, liver depression, emotional distress, and invasion of dampness pathogens. These factors lead to an imbalance in the conception vessel, resulting in the accumulation of dampness and turbidity in the lower abdomen and stagnation of the conception vessel [7]. Over time, the dampness evolves into toxins, exacerbated by other factors such as intrauterine procedures and unhygienic sexual practices, leading to the infiltration of pathogenic toxins into the uterus and damage to the Ren and Dai vessels, inducing a series of clinical symptoms. Therefore, traditional Chinese medicine views HPV infection complicated by CC as a syndrome characterized by both deficiency (liver depression and spleen deficiency) and excess (external pathogenic factors and internal dampness retention). The treatment principles involve strengthening the spleen and soothing the liver, eliminating dampness and toxins, and enhancing overall body resistance [8].

The results revealed that in the month following treatment, group B exhibited superior outcomes compared to group A in terms of the positive rate of vaginal microenvironment factors, inflammatory factor indexes, immune function indexes, and HPV-DNA viral load ($P < 0.05$). This confirmed that the combination of microwave therapy and Sophora gel in patients with HPV infection and CC could achieve optimal results.

The female vagina constitutes a vital component of the micro-ecosystem, characterized by its openness. A healthy vaginal micro-ecosystem relies on a dynamic equilibrium between the host and the environment, wherein both are mutually regulated and interdependent. HPV infection can lead to the proliferation of squamous epithelium in the vaginal mucosa, as HPV is a common DNA virus in the vagina. Under normal circumstances, HPV does not cause infection. However, if the balance of the vaginal micro-ecology is disrupted, persistent HPV infection in the vagina can lead to cervical epithelial dysplasia and even cancer. Microwave therapy functions essentially as an electromagnetic wave (with a frequency range of 300MHz-300GHz), coagulating tissue proteins through thermal and biological effects. It can expedite the recovery of cervical erosion and inflammatory tissue infected with HPV, thereby enhancing the local tissue defense barrier. When administered via the vagina, Sophora gel's active ingredient (total alkaloids in Sophora) adheres well to the vaginal wall mucosa. The drug directly contacts the lesion, allowing for rapid absorption and prolonged efficacy. Additionally, it stimulates the production of vaginal lactobacillus, thereby improving the inflammatory reaction and the vaginal micro-ecological environment, ultimately enhancing vaginal immunity with high safety [10]. In traditional Chinese medicine, the concept of "healthy qi" corresponds to immunity in Western medicine, and reduced immunity is one of the high-risk factors for HPV infection. In this study, while group A solely underwent microwave therapy, the immune function index (IgA, IgG, IgM) and inflammatory factor index showed some improvement. However, the degree of improvement was not as significant as observed in group B, which received a combination of Sophora gel. This indicates that the combined use of microwave therapy and Sophora gel effectively enhances the body's immune capacity, alleviates inflammation, and aids in virus resistance, thereby shortening the duration of the inflammatory reaction. Pro-inflammatory cytokines such as TNF- α and IL-1 β sustain and exacerbate inflammation. Elevated levels of these cytokines prolong the duration of HPV infection. Combination therapy

rapidly reduces the levels of pro-inflammatory cytokines, thus swiftly ameliorating the inflammatory response.

5. Conclusion

The combined use of microwave therapy and Sophora gel demonstrates significant benefits for patients with HPV infection and cervical cancer (CC). This combination therapy improves the vaginal microecological environment, alleviates inflammatory reactions, enhances immune function, and reduces HPV-DNA viral load.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Deng L, 2021, Effect of Estrogen Ointment Combined with Radix Sophora Gel on Lactic Acid Bacteria Environment in Elderly Patients with Vaginitis. *Contemporary Medicine*, 27(8): 70–72.
- [2] Zhai M, Li H, 2023, Effect of Cryotherapy Combined with Interferon on Chronic Cervicitis Complicated with Human Papillomavirus Infection and its Influence on Photochemical Value/Critical Value Ratio and Inflammatory Cytokines. *Maternal and Child Health Care of China*, 38(13): 2354–2357.
- [3] Chen H, Xu J, 2022, Effect of Shugan Jianpi Jiedu Decoction Combined with Acupoint Application on Chronic Cervicitis Combined with HPV Infection and Its Influence on Immune Function. *World Journal of Integrated Traditional and Western Medicine*, 17(8): 1574–1579.
- [4] Chen H, Xu J, 2021, Recombinant Human Interferon α : The Effect of 2a Suppository Combined with Laser Therapy on HPV DNA Load, Serum Hypersensitive C-Reactive Protein Levels, and Recurrence Rate in Patients with Chronic Cervicitis Complicated with HPV Infection. *Maternal and Child Health Care of China*, 36(18): 4375–4378.
- [5] He Q, Liu D, 2021, Clinical Effect of Recombinant Human Interferon α 2b Vaginal Effervescent Tablets Combined with Anti-Gongyan Tablets in the Treatment of Chronic Cervicitis Complicated with Human Papillomavirus Infection. *Guangxi Medical Journal*, 43(10): 1201–1204.
- [6] Dou L, Liu F, Miao R, 2021, Effect of Recombinant Human Interferon α -2b on Inflammatory Factors and T Cell Subsets in Patients with Human Papillomavirus Infection Complicated with Refractory Cervicitis. *Shanxi Medical Journal*, 50(19): 2790–2792.
- [7] Ji H, Zhang H, Li L, et al., 2022, Clinical Study on Jiawei Xiaoduyin Combined with Interferon in Treating Persistent High-Risk Human Papillomavirus Infection in Cervical Region. *Journal of Lanzhou University (Medical sciences)*, 48(4): 45–49 + 55.
- [8] Zhang C, Zhao F, Lu Q, et al., 2022, Effect of Qingre Tongli Decoction Combined with Acupuncture on Senile Chronic Cervicitis with HPV Infection. *Chinese Journal of Gerontology*, 42(17): 4229–4232.
- [9] Wang L, Liu N, 2023, Clinical effect of Microwave Combined with Interferon on HPV Infection Complicated with Chronic Cervicitis and its Influence on Vaginal Microecology. *Journal of Clinical Research*, 40(1): 130–133.
- [10] Hong L, Hu L, 2023, Clinical Effect of Sophora Gel Combined with Low-Dose Metronidazole on Trichomonal Vaginitis and its Influence on Inflammatory Factors. *Heilongjiang Medicine Journal*, 36(2): 384–387.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.