

## ACUPUNCTURE RESEARCH

### Observation on Therapeutic Effects of Electroacupuncture on Polycystic Ovary Syndrome of Kidney Deficiency and Phlegm Dampness Type and Oxidative Stress Level

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**Supported by:** The Budget Project of Shanghai University of Traditional Chinese Medicine (2020LK083); General Project of Traditional Chinese Medicine Research of Shanghai Hongkou District Health Association (HKQ-ZYY-2021-15); Shanghai Natural Science Foundation Project (19ZR1451700); Shanghai Young Science and Technology Talents Sailing Program Project (20YF1445800); Chinese Medicine Research Project of Shanghai Health and Wellness Committee (2020JQ004)

**ABSTRACT** **Objective:** To observe the clinical effect of electroacupuncture on improving polycystic ovary syndrome (PCOS) of kidney deficiency and phlegm dampness type and serum oxidative stress level. **Methods:** There were 68 patients with polycystic ovary syndrome were randomly divided into observation group (34 cases) and the control group (34 cases), The observation group was treated by electroacupuncture, while the control group was treated by placebo electroacupuncture. Combined with the evaluation of menstrual cycle, menstrual color, quality, quantity and TCM symptom integral index, the difference of curative effect between the two groups was observed, and the levels of peripheral blood, sex hormones, insulin resistance and oxidative stress were detected before and after treatment for 3 months. **Results:** The total effective rate in the observation group was better than that in the control group ( $P<0.01$ ); After intervention, serum LH, FSH,  $E_2$  and LH/FSH in the observation group were significantly different from those before intervention. The D values of serum LH, FSH, LH/FSH and  $E_2$  before and after intervention were significantly different between the two groups ( $P<0.01$ ); Comparing the level of androgen, the serum A4 and T in the observation group were significantly different from those before intervention ( $P<0.01$ ); After intervention, there was a significant difference in serum A4 and T between the two groups ( $P<0.01$ ), and there was a significant difference in D value between the two groups before and after intervention; There was a difference in insulin resistance in the observation group before and after intervention ( $P<0.05$ ), and there was a significant difference in D value between the two groups before and after intervention ( $P<0.01$ ); After the intervention, the serum SOD, MDA, ROS in the observation group were significantly different from those before the intervention; After intervention, the results of serum SOD and ROS in the observation group were significantly different from those in the control group; There was no significant difference in serum MDA results. There were significant differences in SOD, MDA, ROS between the two groups before and after intervention. **Conclusion:** Electroacupuncture can improve oxidative stress injury, insulin resistance and hyperandrogenism in PCOS patients.

**KEYWORDS** Polycystic Ovary Syndrome; Electroacupuncture; Kidney deficiency and phlegm dampness; Oxidative stress; Insulin resistance; Hyperandrogenism; Clinical curative effect

Polycystic Ovary Syndrome (PCOS) is a common female reproductive endocrine disorder.<sup>[1-2]</sup> According to epidemiological statistics, the incidence

of PCOS in women of childbearing age is 6%-21%;<sup>[3]</sup> Among the patients with ovulation disorder or anovulation, 30%-60% patients are PCOS patients.<sup>[4]</sup>

The pathogenesis of PCOS is complex, and hyperandrogenism and Insulin Resistance (IR) are considered as the important pathological basis of PCOS.<sup>[5]</sup> In recent years, it has been found that oxidative stress (OS) is closely related to the occurrence of PCOS hyperandrogenism and IR, and affects follicular development, resulting in ovulation disorder.<sup>[6]</sup> PCOS leads to infertility due to ovulation disorder, and increases the risk of cardiovascular disease and type 2 diabetes due to endocrine disorder, which seriously affects quality of life of patients.<sup>[7]</sup> At present, Western medicine is mainly symptomatic treatment for this disease, and the drugs such as estrogen and progesterone, insulin sensitizer and ovulation induction are often used. However, these drugs have good short-term curative effect, and long-term medication will bring many adverse reactions, resulting in poor compliance of patients, so clinical treatment is greatly limited.<sup>[8]</sup> Electroacupuncture, as a special and effective kind of traditional Chinese medicine (TCM) therapy, also has a good curative effect on PCOS. This study observed the effect of electroacupuncture on serum sex hormone level, insulin resistance and oxidative stress level in patients with PCOS of kidney deficiency and phlegm dampness type, and provided scientific basis for acupuncture and moxibustion clinical treatment of PCOS. This study has passed the ethical review of the Ethics Committee of Shanghai Hospital of Integrated Traditional Chinese and Western Medicine, and is reported as follows.

## CLINICAL DATA

### General Information

From June 2020 to June 2022, 68 patients with PCOS were randomly divided into control group and observation group, with 34 cases in each group. There was no significant difference in age and course of disease between the 2 groups ( $P>0.05$ ), which was comparable. See Table 1 for details.

## Diagnostic Criteria

### Western diagnostic criteria

Refer to the diagnostic criteria of PCOS recommended by the Rotterdam Expert Meeting of European Society of Human Reproduction and Embryology (ESHRE) and American Society of Reproductive Medicine (ASRM) in 2003<sup>[9]</sup> and the guidelines for diagnosis and treatment of polycystic ovary syndrome in China issued by Endocrinology Group and Guidelines Expert Group of Obstetrics and Gynecology Branch of Chinese Medical Association.<sup>[10]</sup>

Diagnostic criteria of PCOS: ① Rare ovulation or anovulation; ② Clinical manifestations of hyperandrogenism or hyperandrogenism (such as hirsutism, acne, etc.); ③ Ultrasonography showed that there were more than 12 small follicles with a diameter of 2-9 mm in both ovaries, and/or the ovarian volume was more than 10 mL (the ovarian volume was calculated as  $0.5 \times \text{long diameter} \times \text{transverse diameter} \times \text{anterior and posterior diameter}$ ).

At least 2 of the above indicators meet. Ovulation disorder caused by functional hypothalamic amenorrhea, thyroid diseases, hyperprolactinemia and early-onset ovarian insufficiency were eliminated. Hyperandrogenism or hyperandrogenism symptoms caused by Cushing's syndrome, atypical congenital adrenal hyperplasia, androgen-secreting tumors of ovary or adrenal gland and other causes were excluded.

Criteria for insulin resistance: The insulin resistance of patients was judged by steady-state insulin resistance index, and HOMA-IR  $\geq 2.69$  was regarded as insulin resistance.<sup>[11]</sup>

### TCM syndrome differentiation standard

All the cases in the group belong to kidney deficiency and phlegm dampness syndrome (type) according to TCM syndrome differentiation. Referring

Table 1. Comparison of Baseline Data Between two Groups of Patients

| Group             | Number of cases | Age (years) |         |            | Duration of disease (years) |                |           |
|-------------------|-----------------|-------------|---------|------------|-----------------------------|----------------|-----------|
|                   |                 | Maximum     | Minimum | Average    | Shortest                    | Maximum length | Average   |
| Control group     | 34              | 38          | 19      | 31.3 ± 3.1 | 3.1                         | 10.6           | 5.6 ± 0.9 |
| Observation group | 34              | 37          | 20      | 30.2 ± 2.6 | 2.8                         | 11.2           | 5.4 ± 0.8 |

to the diagnostic criteria of "late menstruation", "amenorrhea" and "infertility" and the distribution law of PCOS TCM syndromes (kidney deficiency syndrome, phlegm-dampness syndrome) in the Diagnostic Efficacy Standard of TCM Diseases and Syndromes issued by the Ministry of Health<sup>[12]</sup> and the Guiding Principles for Clinical Research of New Traditional Chinese Medicine.<sup>[13]</sup> The proposed criteria are as follows: (1) Main syndromes: rare menstruation, small amount or even amenorrhea or dripping wet; (2) Secondary syndromes: chills, loose stool, backache and fatigue, hyposexuality, obesity, hirsutism, acne and infertility; (3) Tongue pulse: The tongue is pale and fat, the fur is white and greasy, and the pulse is heavy and thin (smooth). The main syndrome is necessary, and the secondary syndrome has 1-2 items, which can be diagnosed as kidney deficiency and phlegm dampness syndrome (type) by referring to tongue pulse.

### Inclusion Criteria

(1) The diagnostic criteria of PCOS were recommended by the 2003 Rotterdam Expert Meeting of European Society of Human Reproduction and Embryology and American Society of Reproductive Medicine and by the Endocrinology Group and Guideline Expert Group of Obstetrics and Gynecology Branch of Chinese Medical Association; (2) Patients with secondary PCOS are excluded, that is, there are no other systemic diseases; (3) TCM syndrome differentiation belongs to kidney deficiency and phlegm dampness syndrome (type); (4) Women aged between 18 and 42 years old; (5) HOMA-IR  $\geq 2.69$ ; (6) Stop any other treatment during treatment; (7) Volunteer to join this experiment and sign informed consent.

### Exclusion Criteria

(1) It accords with the diagnosis of PCOS, but does not exclude patients with secondary PCOS; (2) Those who suffer from other serious diseases at the same time; (3) Those who use hormones and metabolic drugs at the same time to influence the judgment of results; (4) Those who have fertility requirements within 3 months during the treatment.

### Rejection and Shedding Criteria

(1) Those who can't insist on treatment; (2)

Those who fail to implement the treatment plan; (3) Serious adverse events occur; (4) Serious other complications or deterioration of the disease occurred during the treatment; (5) Unexpected pregnancy during treatment.

## TREATMENT METHODS

### Observation Group

Acupoint selection: Guanyuan (RN4), Zhongji (RN3), Zigong (EX-CA1), Zusanli (ST36), Fenglong (ST40, double sides), Xuehai (SP10, double sides), Sanyinjiao (SP6, double sides) and Taixi (KI3, double sides).

Operation: After routine disinfection of acupoint area, "Huatuo Brand" disposable sterile acupuncture needle (produced by Suzhou Medical Products Factory Co., Ltd.) with a diameter of 0.30 mm  $\times$  40 mm was selected to the above acupuncture acupoints. After the needle is inserted quickly, the needle is used to get qi sensation. The electroacupuncture at Zusanli (ST36), Sanyinjiao (SP6), Guanyuan (RN4) and Zhongji (RN3) points, is connected with HANS-200A acupoint nerve stimulator (Wuxi Yulong Electronic Technology Co., Ltd.), with continuous wave, frequency of 2Hz, current intensity of 2 mA  $\pm$  1 mA, and the needle is retained for 30 mins. The other acupoints are used once every 10 mins. Treating 3 times as a week, 1 menstrual cycle or 1 month as a course of treatment, the curative effect was observed by continuous treatment after 3 courses of treatment.

### Control Group

Acupoint selection was the same with the observation group. Placebo acupuncture method,<sup>[14]</sup> 0.30 mm  $\times$  40 mm "Huatuo Brand" disposable external cannula-type flat-head acupuncture needle (produced by Suzhou Medical Products Factory Co., Ltd.) was used. After routine disinfection in the acupoint area, cannula acupuncture was performed, but only penetrated into the skin, and the needle could not get qi sensation. Zusanli (ST36), Sanyinjiao (SP6), Zhongji (RN3) and Guanyuan (RN4) points were connected with HANS-200A acupoint nerve stimulator (Wuxi Yulong Electronic Technology Co., Ltd.), but no electricity was supplied. Treating 3 times as a week, 1 menstrual cycle or 1 month as a course of treatment,

the curative effect was observed by continuous treatment after 3 courses of treatment.

All acupoints are located according to the national standard GB-12346-90 of the People's Republic of China.

## TREATMENT RESULTS

### Observation Indicators

#### Scoring standard of TCM syndrome

According to the 2002 edition of "Guiding Principles for Clinical Research of New Chinese Medicine (Trial)"<sup>[13]</sup>, the clinical scoring standard was formulated, and scoring was carried out before and after intervention.

#### Determination of serum sex hormone level and oxidative stress index

Venous blood was taken on an empty stomach before intervention and on the morning of the third day of menstruation after intervention for 3 months, and the serum was placed in a refrigerator at -20 °C to be tested; Serum testosterone (T), Androstenedione (A4), FSH, LH, E<sub>2</sub> were detected by chemiluminescence method; Serum levels of MDA, ROS and SOD were detected by ELISA.

#### Insulin resistance indicators

The fasting plasma glucose (FPG), fasting insulin (FINS), HOMA-IR=fasting plasma glucose (FPG) × fasting blood insulin (FINS)/22.5 were measured in the morning after 8-12 h fasting before and 3 months after the intervention.

### Efficacy Criteria

At present, there is no uniform curative effect standard for PCOS in China, so it is formulated with reference to the curative effect judgment standard for treating "irregular menstruation", "amenorrhea" and "infertility" in "Guiding Principles for Clinical Research of New Traditional Chinese Medicine" issued by the Ministry of Health.

**Recovery:** The menstrual cycle is basically normal, the color, quality and quantity of menstruation are normal, BBT is biphasic, the related sex hormone indexes are normal, and the curative effect index of TCM symptoms is ≥90%.

**Effective:** The menstrual cycle, color, quality and quantity of menstruation are improved, BBT is biphasic, related sex hormone indexes are improved, and the curative effect index of TCM symptoms is ≥33.3%.

**Ineffective:** Symptoms, related sex hormone indexes and BBT did not change before and after treatment, and the curative effect index of TCM symptoms was less than 33.3%.

Curative effect index = (pre-treatment integral-post-treatment integral)/pre-treatment integral × 100%.

### Statistical Methods

SPSS23.0 software was used for statistics, and the measurement data conforming to normal distribution were expressed by mean ± standard deviation. Before and after intervention, paired t-test was used for comparison within groups, and independent sample t-test was used for comparison between groups; Non-normal distribution is expressed by median M (P25, P75), and rank sum test in nonparametric test is adopted; Chi-square test was used for counting data. The difference was statistically significant with  $P < 0.05$ .

### Treatment Outcome

#### Comparison of clinical efficacy between the two groups

In the observation group, one patient withdrew from observation due to personal work reasons, and one patient withdrew from observation due to other treatments. One patient in the control group withdrew for personal reasons. As can be seen from Table 2, the total effective rate in the two groups

**Table 2. Comparison of Clinical Efficacy Between the Two Groups**

| Group             | Number of cases | Recovery   | Effective   | Ineffective | Total effective rate | $\chi^2$ value | P value |
|-------------------|-----------------|------------|-------------|-------------|----------------------|----------------|---------|
| Observation group | 32              | 4 (12.50%) | 18 (56.25%) | 10 (31.25%) | 68.75% <sup>a</sup>  | 11.398         | 0.003   |
| Control group     | 33              | 1 (3.03%)  | 8 (24.24%)  | 24 (72.72%) | 27.27%               |                |         |

Note: Compared with the control group, <sup>a</sup> $P < 0.01$ .

was better than that in the control group, with a significant difference ( $P < 0.01$ ).

### Changes of serum LH, FSH, LH/FSH, $E_2$ before and after intervention

As can be seen from Table 3, there is no significant difference in serum LH, FSH and  $E_2$  between the two groups before intervention, which is comparable; After intervention, serum LH, FSH,  $E_2$  and LH/FSH in the observation group were significantly different from those before intervention. After intervention, there were significant differences in serum LH, LH/FSH and  $E_2$  in the observation group, but there was no

significant difference in FSH. The D values of serum LH, FSH, LH/FSH and  $E_2$  before and after intervention were significantly different between the two groups ( $P < 0.01$ ).

### Changes of serum A4 and T before and after intervention

As can be seen from Table 4 and Figure 1, before intervention, there was no significant difference in serum A4 and T between the two groups, which was comparable; The results of serum A4 and T in the observation group were significantly different from those before intervention, but there was no significant difference in the control group.

**Table 3. Comparison of Serum LH, FSH,  $E_2$ , LH/FSH Levels Between the Two Groups Before and After Intervention [ $M (P25, P75)/(\bar{x} \pm s)$ ]**

| Indicators     | Group             | Number of cases | Before intervention | After intervention            | D value before and after intervention |
|----------------|-------------------|-----------------|---------------------|-------------------------------|---------------------------------------|
| LH (mIU/mL)    | Observation group | 32              | 15.09 $\pm$ 3.67    | 8.18 $\pm$ 2.84 <sup>aa</sup> | -5.82 (-7.95, -5.00) <sup>cc</sup>    |
|                | Control group     | 33              | 14.67 $\pm$ 4.25    | 14.02 $\pm$ 3.64              | -0.21 (-0.75, -0.48)                  |
|                | t/Z value         |                 | 0.426               | -7.197                        | -6.11                                 |
|                | P value           |                 | 0.671               | <0.01                         | <0.01                                 |
| FSH (mIU/mL)   | Observation group | 32              | 5.30 $\pm$ 1.35     | 6.40 $\pm$ 0.94 <sup>b</sup>  | 1.82 (1.03, 2.59) <sup>cc</sup>       |
|                | Control group     | 33              | 5.96 $\pm$ 1.41     | 6.03 $\pm$ 1.28               | 0.09 (-0.15, 0.41)                    |
|                | t/Z value         |                 | -1.913              | 1.297                         | -3.874                                |
|                | P value           |                 | 0.060               | 0.199                         | <0.01                                 |
| LH/FSH         | Observation group | 32              | 3.04 $\pm$ 1.11     | 1.31 $\pm$ 0.51 <sup>aa</sup> | -1.95 (-2.34, -1.24) <sup>cc</sup>    |
|                | Control group     | 33              | 2.61 $\pm$ 0.95     | 2.44 $\pm$ 0.78               | -0.05 (-0.24, 0.06)                   |
|                | t/Z value         |                 | 1.694               | -6.975                        | -6.416                                |
|                | P value           |                 | 0.095               | <0.001                        | <0.01                                 |
| $E_2$ (pmol/L) | Observation group | 32              | 67.61 $\pm$ 9.80    | 99.18 $\pm$ 5.37              | 30.26 (22.57, 41.17) <sup>cc</sup>    |
|                | Control group     | 33              | 64.63 $\pm$ 12.82   | 66.03 $\pm$ 11.41             | 0.45 (-1.26, 2.20)                    |
|                | t/Z value         |                 | 1.048               | 15.06                         | -6.915                                |
|                | P value           |                 | 0.298               | <0.01                         | <0.01                                 |

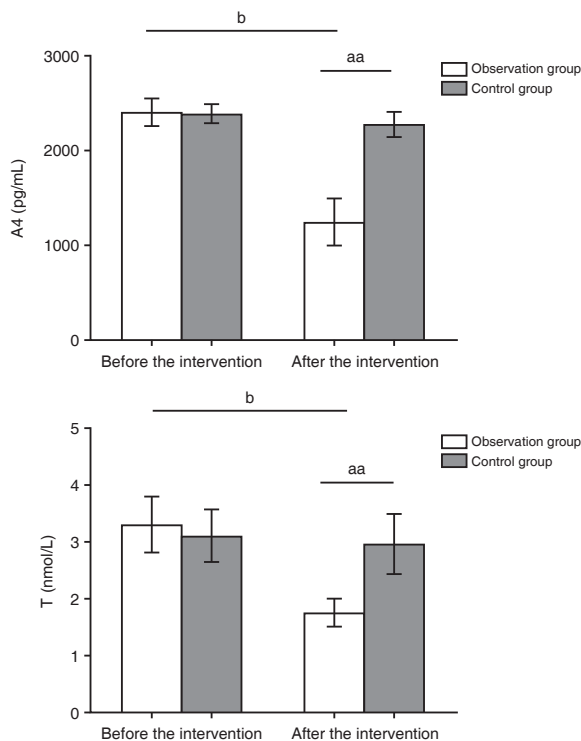
Note: After intervention, compared with the control group, <sup>aa</sup> $P < 0.01$ ; Compared with the same group before intervention, <sup>b</sup> $P < 0.05$ ; The D value before and after intervention was compared with the control group, <sup>cc</sup> $P < 0.01$ .

**Table 4. Changes of Serum A4 and T Before and After Intervention ( $\bar{x} \pm s$ )**

| Indicators | Group             | Number of cases | Before intervention  | After intervention                 | D value before and after intervention |
|------------|-------------------|-----------------|----------------------|------------------------------------|---------------------------------------|
| A4 (pg/mL) | Observation group | 32              | 2410.57 $\pm$ 143.39 | 1252.49 $\pm$ 251.06 <sup>aa</sup> | -1158.08 $\pm$ 210.63 <sup>cc</sup>   |
|            | Control group     | 33              | 2390.59 $\pm$ 101.99 | 2280.69 $\pm$ 135.15               | -109.91 $\pm$ 56.20                   |
|            | t value           |                 | 0.649                | -20.469                            | -25.353                               |
|            | P value           |                 | 0.519                | <0.01                              | <0.01                                 |
| T (nmol/L) | Observation group | 32              | 3.32 $\pm$ 0.49      | 1.77 $\pm$ 0.25 <sup>aa</sup>      | -1.55 $\pm$ 0.51 <sup>cc</sup>        |
|            | Control group     | 33              | 3.12 $\pm$ 0.46      | 2.98 $\pm$ 0.53                    | -1.45 $\pm$ 0.31                      |
|            | t value           |                 | 1.704                | -11.877                            | -13.469                               |
|            | P value           |                 | 0.093                | <0.01                              | <0.01                                 |

Note: After intervention, compared with the control group, <sup>aa</sup> $P < 0.01$ ; Compared with the same group before intervention, <sup>b</sup> $P < 0.05$ ; The D value before and after intervention was compared with the control group, <sup>cc</sup> $P < 0.01$ .

After intervention, there was a significant difference in serum A4 and T between the two groups ( $P<0.01$ ). There was a significant difference in D value between before and after intervention.

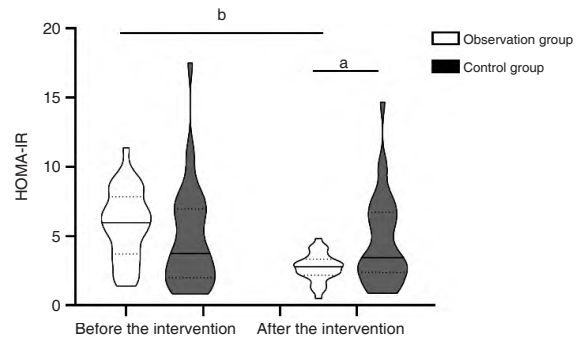


**Figure 1. Changes of Serum A4 and T in the Two Groups Before and After Intervention ( $\bar{x} \pm s$ )**

Note: After the intervention, comparisons were made with the control group <sup>aa</sup> $P<0.01$ ; Compared with the same group before intervention <sup>b</sup> $P<0.05$ .

### Comparison of insulin resistance between the two groups before and after intervention

As can be seen from Table 5 and Figure 2, there is no difference in insulin resistance before intervention ( $P>0.05$ ); After intervention, there was a difference between the two groups ( $P<0.05$ ), and there was a difference before and after intervention in the observation group ( $P<0.05$ ). There was significant difference in D value between the two groups before and after intervention ( $P<0.01$ ).



**Figure 2. Comparisons of Insulin Resistance in Patients with the Two Groups**

Note: After the intervention, compared with the control group <sup>a</sup>( $P<0.05$ ), <sup>b</sup> $P<0.05$ .

### Changes of oxidative stress level before and after intervention in two groups

As can be seen from Table 6, there is no significant difference in serum SOD, MDA and ROS between the two groups before intervention, and they are comparable; After intervention, the results of serum SOD, MDA and ROS in the observation group were significantly different from those before intervention ( $P<0.01$ ), but there was no difference in the control group; After intervention, the results of serum SOD in the observation group were significantly different from those in the control group ( $P<0.05$ ). MDA and ROS in the observation group were significantly different from those in the control group. The D values of serum SOD, MDA and ROS before and after intervention were significantly different between the two groups ( $P<0.01$ ).

## DISCUSSION

PCOS belongs to the categories of "late menstruation" "amenorrhea" and "infertility" in TCM. TCM believes that the pathogenesis of PCOS is kidney deficiency, phlegm dampness and blood stasis. *FU Qing-zhu's Obstetrics and Gynecology* (*Fu Qing Zhu Nv Ke*, <<傅青主女科>>, FQZNK) says: "All kidneys come out through water", while kidney deficiency promotes dereliction of duty in

**Table 5. Comparison of Insulin Resistance Between the Two Groups [M (P25, P75)]**

| Indicators | Group             | Number of cases | Before intervention | After intervention              | D value before and after intervention |
|------------|-------------------|-----------------|---------------------|---------------------------------|---------------------------------------|
| HOMA-IR    | Observation group | 32              | 5.98 (3.72, 7.84)   | 2.79 (2.18, 3.35) <sup>ab</sup> | -3.18 (-4.78, -1.19) <sup>cc</sup>    |
|            | Control group     | 33              | 3.76 (2.77, 6.96)   | 3.45 (2.37, 6.71)               | -0.49 (-0.17, 0.017)                  |
| t/Z value  |                   |                 | -1.929              | -2.178                          | -5.997                                |
| P value    |                   |                 | 0.054               | 0.029                           | <0.01                                 |

Note: After intervention, compared with the control group, <sup>a</sup> $P<0.05$ ; Compared with the same group before intervention, <sup>b</sup> $P<0.05$ ; The D value before and after intervention was compared with the control group, <sup>cc</sup> $P<0.01$ .

**Table 6. Comparison of Serum SOD, MDA and ROS Levels Between the Two Groups Before and After Intervention [M (P25, P75)/( $\bar{x} \pm s$ )]**

| Indicators    | Group             | Number of cases | Before intervention | After intervention             | D value before and after treatment  |
|---------------|-------------------|-----------------|---------------------|--------------------------------|-------------------------------------|
| SOD (U/mL)    | Observation group | 32              | 63.29 $\pm$ 6.41    | 85.68 $\pm$ 5.50 <sup>ab</sup> | 21.95 (17.32, 25.88) <sup>cc</sup>  |
|               | Control group     | 33              | 64.74 $\pm$ 9.02    | 68.17 $\pm$ 9.32               | 1.30 (0.19, 4.76)                   |
|               | t/Z value         |                 | 1.704               | -11.877                        | -6.535                              |
|               | P value           |                 | 0.093               | 0.032                          | <0.01                               |
| MDA (nmol/mL) | Observation group | 32              | 13.59 $\pm$ 1.64    | 8.12 $\pm$ 1.22 <sup>aab</sup> | -5.82 (-6.78, -4.24) <sup>cc</sup>  |
|               | Control group     | 33              | 12.92 $\pm$ 1.45    | 11.8 $\pm$ 1.17                | -0.97 (-1.88, -0.21)                |
|               | t/Z value         |                 | 1.760               | -12.434                        | -6.535                              |
|               | P value           |                 | 0.083               | <0.01                          | <0.01                               |
| ROS (ng/mL)   | Observation group | 32              | 6.32 $\pm$ 0.51     | 3.64 $\pm$ 0.15 <sup>aab</sup> | -2.72 (-0.307, -2.29) <sup>cc</sup> |
|               | Control group     | 33              | 6.38 $\pm$ 0.47     | 5.76 $\pm$ 0.45                | -0.51 (-0.85, -0.37)                |
|               | t/Z value         |                 | -0.526              | -25.510                        | -6.93                               |
|               | P value           |                 | 0.600               | <0.01                          | <0.01                               |

Note: After intervention, compared with the control group, <sup>a</sup>P<0.05, <sup>aa</sup>P<0.01; Compared with the same group before intervention, <sup>b</sup>P<0.05; The D value before and after intervention was compared with the control group, <sup>cc</sup>P<0.01.

warming function, which leads to obstruction of qi, blood and water-liquid transportation, resulting in phlegm-dampness and other pathogenesis, resulting in menstrual disorder, obesity, infertility and other symptoms. Previous studies have confirmed that acupuncture can improve IR, adjust sex hormone levels and promote follicular development in PCOS patients.<sup>[15-16]</sup> Under the guidance of the whole concept and syndrome differentiation theory, this study aims at the pathogenesis of kidney deficiency and phlegm dampness in PCOS patients, and selects Guanyuan (RN4), Taixi (KI3) and Zhongji (RN3) points to nourish kidney and cultivate Yuan, regulate Chong and Ren, Xuehai (SP10) and Zusanli (ST36) to regulate qi and blood, and selects local uterine points to regulate local qi and blood circulation and improve ovarian function, and selects Fenglong (ST40) points and Sanyinjiao (SP6) points to strengthen spleen and eliminate phlegm dampness. All acupoints are used together to tonify kidney and spleen and eliminate dampness. Electroacupuncture at Zusanli (ST36), Sanyinjiao (SP6), Guanyuan (RN4) and Zhongji (RN3) points further strengthens the functions of invigorating spleen, eliminating dampness and regulating Chong and Ren. The results showed that the clinical effective rate of electroacupuncture in PCOS patients was 68.75%, which was obviously better than that in the control group.

The specific pathogenesis of PCOS is still

unclear. It is believed that the pathogenesis of PCOS is related to the dysfunction of hypothalamus-pituitary-ovary axis,<sup>[17]</sup> and the release of hypothalamic gonadotropin causes the pituitary to release a large amount of LH, which leads to abnormal increase of LH *in vivo*, while FSH is low or normal, which leads to hyperandrogenism, insulin resistance and ovulation disorder.<sup>[18-20]</sup> After the intervention, there were significant differences in serum LH, LH/FSH and E<sub>2</sub> in the observation group; The D values of serum LH, FSH, LH/FSH and E<sub>2</sub> before and after intervention were significantly different between the two groups; After intervention, there were significant differences in serum A4 and T results between the two groups, and there were significant differences in D value before and after intervention. After intervention, insulin resistance is different between the two groups, there was a difference in the observation group before and after intervention D value before and after intervention is significantly different between the two groups, suggesting that electroacupuncture can obviously regulate the sex hormone level of PCOS patients, improve hyperandrogenism and insulin resistance, and improve ovulation, which is consistent with previous research results.<sup>[21-24]</sup>

Studies have shown that hormonal hyperandrogenism and insulin resistance in ovary are closely related to oxidative stress level. Oxidative stress (OS) is the imbalance of oxidation/

antioxidation in the body, which leads to abnormal cell function.<sup>[25-26]</sup> Sun Lin and other studies found that the plasma ROS/TAC of PCOS patients was significantly higher than that of normal control group, suggesting that the plasma of PCOS patients was at a high oxidative stress level,<sup>[27]</sup> and PCOS patients had abnormal glucose and lipid metabolism, hyperandrogenism and insulin resistance, which led to abnormal conditions such as hyperglycemia and high free fatty acids, resulting in excess active free radicals and oxidative stress.<sup>[28-29]</sup> The production of free radicals, MDA and other lipid peroxidation products may cause insulin resistance.<sup>[30]</sup> Oxidative stress can stimulate the activity of androgen-producing ovarian steroid synthase, and participate in the abnormal regulation of androgen secretion in ovarian tissue. At the same time, testosterone (T) and androstenedione (A4) can directly participate in the regulation of ROS production. ROS is the product of aerobic metabolism, which can regulate apoptosis, injury repair, cell proliferation and other signal transduction pathways. Excessive expression of ROS in the body can increase the degree of oxidative stress.<sup>[31]</sup> MDA is a decomposition product of lipid peroxidation, and the expression level of serum MDA can reflect the severity of lipid peroxidation and indirectly understand the degree of cell damage.<sup>[32-33]</sup> Superoxide dismutase (SOD) is an important enzyme antioxidant, which can scavenge oxygen free radicals, protect cells from damage and repair damaged cells in time.<sup>[34]</sup> The activity of SOD can indirectly reflect the ability of scavenging oxygen free radicals. Previous clinical and experimental studies have proved that acupuncture can regulate the balance between oxidation and antioxidant factors in the body. It has good antioxidant effect.<sup>[35-37]</sup> The results of this study show that after electroacupuncture intervention, the serum SOD level in the observation group is significantly increased, while the levels of MDA and ROS are significantly decreased, suggesting that electroacupuncture can significantly increase the serum SOD level, reduce the levels of MDA and ROS and alleviate oxidative stress injury in PCOS patients.

To sum up, electroacupuncture can improve oxidative stress injury, insulin resistance and serum hormone level in PCOS patients, which is worthy of

clinical application.

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- (Received November 20, 2022)